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PERSPECTIVE ARTICLE

A narrative review of cultural identity and health risks in forced migration

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Abstract

Forced migrations driven by conflicts, natural disasters, and persecution severely disrupt cultural identity and exacerbate health vulnerabilities in displaced populations. This narrative review focuses on both physical and mental health outcomes in exploring the intricate relationships between forced migrations, cultural dislocation, and health risks. The study identifies four key themes. First, the aspect of forced migrations and cultural identity highlights the fragmentation of cultural practices and reveals the challenges of identity reconstruction. Second, the facet of forced migration and health vulnerabilities underscores the increased risks of infectious diseases, malnutrition, and mental health disorders such as depression and post-traumatic stress disorder. Third, the interplays of cultural identity and health reveal that the preservation of cultural practices can buffer against negative health influences while cultural losses exacerbate the deterioration of health. Finally, culturally sensitive policies and interventions require healthcare systems to adopt culturally competent approaches that can address the unique challenges confronting forced migrants. The review concludes by identifying gaps in the literature, including the need for additional research on long-term health outcomes and the effectiveness of culturally sensitive interventions. This study delivers valuable insights for policymakers and healthcare providers seeking to improve the well-being of displaced populations through culturally responsive care.

Keywords: Conflict; Culture; Displacement; Forced migration; Mortality; Vulnerabilities

1. Introduction

Millions of people worldwide are displaced due to violence, natural calamities, and other emergencies. Such dislocation tears individuals from their roots and impacts their cultural inclusion, a factor crucial for the determination of human communal and psychological wellness (Ford *et al*., 2015). Elevated mortality rates are also common outcomes of the increased health risks facing displaced groups (Cantor *et al*., 2021).

The forced removal of individuals from their homes is labeled compelled migration, and this phenomenon can significantly impact the cultural identities and mortality rates of affected communities (Bhugra, 2004). Disputes, armed conflicts, or collapsing states often force people to flee their home nations. Such individuals are then placed in unfamiliar and challenging environments that require them to adapt to new cultural norms and navigate unpredictable paths to resettlement. Forced transfers immensely impact numerous families, and some of them struggle to preserve their cultural traditions as they adapt to the new location. Furthermore, mortality rates increase dramatically due to difficulties in adjusting to changing living circumstances and the stresses stemming from unforeseen relocations (Saarela & Finnäs, 2009).

Internally, displaced persons suffer greatly because their prolonged proximity to conflict zones and scarcity of resources tend to exacerbate ill health (Khai, 2023). However, the medical conditions of forced migrants vary substantively depending on their circumstances. Such migrants often encounter diverse risks during their transit that jeopardize their well-being: for instance, exposure to illness, limited access to medical care, exploitation, violence, and even death. The psychological impact of forced relocation includes distress caused by their separation from their loved ones, apprehensions about the future, and difficulties in acclimating to a foreign culture. Such issues can result in drug dependence as a coping mechanism (Kuo, 2014a). Their resources also remain limited due to instability, and their safety remains uncertain.

Cultural traditions are focal to the sense of identity of every community; however, forced migrations often disturb cultural practices (Cohen & Sirkeci, 2011). Migrants regularly confront challenges in retaining their cultural contexts when they adjust to new environments. Fadhlia *et al.* (2022) observed that communal gatherings and festive celebrations pivotal to the fostering of cultural unity declined in displaced Syrians. However, some communities demonstrate resilience through innovation. Refugees discover new means of preserving their languages and traditions: For instance, constructing virtual forums to replace lost physical spaces. Younger generations drive the transmission of their legacies through social media and reimagined observances. Displaced individuals strengthen their bonds notwithstanding disruptions by reminding each other of their treasured customs and roots (Alencar & Camargo, 2023).

Often, the displacement of communities results in the erosion of their cultural identities, which can significantly impact their psychological well-being. Studies have evidenced that the dissolution of cultural identities exacerbates feelings of estrangement, gloom, and unease in relocated groups and that such emotions intensify mental health difficulties (Bhugra & Becker, 2005). For example, the abysmal conditions of their refugee camps in Bangladesh have further aggravated the psychological strains that Rohingya refugees must endure because they are forced to forfeit cultural traditions and social structures integral to their selfhood (Tay *et al.*, 2019). In addition, people who are uprooted from their homelands are deprived of familiar cultural fundamentals and support systems that underpin their sense of belonging; thus, their loneliness and hopelessness become amplified (Riley *et al.*, 2020). Relocation can thrust some groups into totally unfamiliar surroundings; nevertheless, most displaced people slowly but surely reconcile with change. Some individuals accept their new community lifestyles with ease and can fuse old and new customs; others cannot relinquish familiar routines and cling to disappearing traditions. Individuals also vary in their adjustment capabilities: some evolve and some stagnate. The literature on the impact of forced migration on health is growing. However, the psychosocial and cultural consequences of displacement on the health outcomes of migrants require further investigation because these facets could exert lasting and deleterious effects. A dearth also exists in the literature focusing on culturally appropriate strategies that can alleviate such threats. Therefore, the cultural identities and health states of forced migrants denote integral objectives of this study. Ultimately, the examination of compelled migration facilitates the comprehension of how policies can be implemented to enhance the overall health of forced immigrants. This study represents an extensive narrative review; it also aims to inform the design and implementation of future research and policy initiatives. Thus, this study investigates the dual impact of forced migrations on cultural identity and health. It emphasizes the need for comprehensive assistance networks addressing cultural issues and highlights their impact on the health-related experiences of displaced people.

2. Data and methods

This study adopted a narrative review methodology to analyze how cultural identities intersect with health vulnerabilities in forcibly displaced persons, emphasizing the complexities of the associations. The narrative review was selected because it searches for an exhaustive combination of theoretical and empirical literature and, thus, helps to demonstrate the enriching and multidisciplinary dimensions of forced migrations, health threats, and cultural integration (Sukhera, 2022). Unlike systematic reviews that focus on specific questions, narrative reviews are ideal for analyses of themes across several studies. Therefore, they facilitate the description of research gaps, new trends, and areas that require further investigation (Gregory & Denniss, 2018).

2.1. Literature selection criteria

The steps that were undertaken to select appropriate and valuable studies for this review and avoid the scrutiny of the literature from irrelevant perspectives or positions are delineated in subsequent sections.

2.2. Databases and sources

Peer-reviewed articles, reports, and studies were searched in the academic databases PubMed, Scopus, Google Scholar, and JSTOR. Moreover, the academic literature was enriched by the inclusion of reports from the United Nations High Commissioner for Refugees (UNHCR) and the World Health Organization.

2.3. Keywords

Some keywords adopted for the literature search included "forced migration," "cultural identity," "vulnerability," "mental health," "physical health," "displaced populations," "acculturation," "interventions," "cultural or ethnically specific attention," and "refugees health." Different combinations of these words were used to search for the studies and reports relevant to this review.

2.4. Inclusion criteria

Studies written in English, discussing the relationships between cultural identity, health, and forced migration, and published between 2000 and 2023 were included in this review. Contained empirical or theoretical exposition on the health effects associated with forced dislocation, including mental and physical health. Discussed aspects such as cultural integration, acculturation, and healthcare barriers among the displaced population.

2.5. Exclusion criteria

Studies that did not explore emotions or probe mental and physical health issues associated with the culture of individuals or cultural isolation were not included in the present investigation. In addition, the present narrative review did not include reviews, commentaries, or studies without empirical or theoretical rationales.

2.6. Study selection

First, keywords were used to locate more than 200 studies. Then, the stated inclusion and exclusion criteria were implemented and 112 primary studies were included for more thorough examination. Subsequently, the selected studies were further divided into three groups based on their focal health dimension concerning refugees: mental well-being, physical welfare, or how culture and acculturation strategies can help migrants remain robust.

2.7. Data synthesis

The narrative synthesis of the selected studies encompassed the description of their key findings, including the role of cultural trauma in deteriorating health, the need for the provision of culturally competent healthcare, and the effects of acculturation on health status. In addition, the review identified gaps in the literature about the ways in which culturally competent healthcare practices including advanced; yet, available culturally tailored interventions could benefit migrants worldwide.

3. Results

This narrative analysis of the literature identified four key themes that are discussed in the subsequent sections. Each ascertained premise reveals critical insights into the intersections of forced migration, cultural identity, and health vulnerabilities. These themes and their subcategories deliver a comprehensive understanding of the challenges that confront migrant populations and the interventions that could address such difficulties.

3.1. Forced migration and cultural identity

3.1.1. Disruption of cultural practices

Cultural practices bind people to their homeland but forced migrations demolish such connections, scattering communities to unfamiliar lands. Such displacements can occur due to wars, climate changes, or oppressive circumstances that compel people to move away from the lands that shaped their ways of life (Martin, 2012; Wodon *et al*., 2014). Besides losing their possessions, relocated individuals lose familiar social values, shared traditions, and rituals that bind them as a kindred unit. Cultural fragmentation impacts the structures of groups bereft of their moorings to their past, adversely affecting their mental well-being, and diminishing their ability to withstand changes forced on them in their new environments (Jolof *et al*., 2022). The ravages of relocations reverberate far beyond perception: they strip displaced people of tethers essential for the preservation of their identities. The sense of identity represents the sum of individual self-perception: It governs how individuals differentiate themselves from others. Cultural identities may be defined as characteristics that unite people into a community (Zacarés & Iborra, 2015) and encompass three essential elements: language, rites of passage, and religion (Reynolds & Erikson, 2017; Ohaja & Anyim, 2021; Aça, 2023). Multicultural individuals identify with varied cultures (Wise-Admin, 2020). Unfortunately, millions of people worldwide are driven away from their homes every year, seeking safety from crises such as conflicts or natural disasters. However, the effects of migration transcend mere physical relocation. People who are forced to flee their homelands are often abruptly disconnected from cultural roots that are intertwined with their sense of self and community. This loss can profoundly undermine their social bonds and harm their mental wellness (Kirkbride *et al*., 2024). Refugees and migrants face immense challenges at every stage of their arduous migration journeys. They must contend with scarcity, oppression, traumatic brutality, or the absence of sustainable living conditions before leaving their homelands (Bempong *et al*., 2019). When they arrive at their relocation destinations, they confront uncertainties about work authorization, stable housing, and healthcare access. Their resettlement and integration introduce even more complex difficulties concerning their gender perceptions, cultures, faiths, and joblessness (Alarcon, 2022). Meanwhile, nostalgia and hope for the future remain their constant companions. However, forced migrants with courage, compassion, and community support can surmount such obstacles (World Health Organization: WHO, 2021a). Furthermore, migrant populations tend to face heightened threats to their well-being without access to their previous healthcare or support systems, and preventable mortality occurs too often. A complex web of risks is created when massive groups of people are compelled to migrate against their will and rebuild their lives elsewhere. Cultural norms provide communities with an intrinsic sense of belonging but forced relocations often challenge long-held traditions. Uprooted groups struggle to safeguard their practices, tongues, and behavioral codes when they arrive in unfamiliar lands. Nevertheless, some traditions endure surprisingly despite such upheavals. Certain communities recover their lost customs in their new environments by sharing familiar stories and recipes with their compatriots, kindling nostalgia in a foreign setting (Smeekes & Jetten, 2019). There is no substitute for stability, but creativity sometimes stems from the tides of change and ensures that some cultural continuity survives such forced migrant journeys. Migrants encounter several stressful experiences that could negatively affect their mental health. For instance, they lose their social support networks, religious rituals, and cultural norms; they must adjust to new societies; and they are forced to experience changes to their identities and self-concepts (Bhugra & Becker, 2005).

3.1.2. Cultural integration and adaptation

Researchers have investigated the persistent imposition of cultural and ethnic identities on immigrants and asylum seekers worldwide (Lau & Rodgers, 2021a). For example, Woźniak-Bobińska's (2020) study reported that strong governments have become the most powerful force for change. They utilize underhanded methods of obtaining their desired results by instituting laws and rules that limit religious and political freedom, rights that should be unalienable. Burkhardt (2017) asserted that people who have fled unstable homelands and regions in which their fundamental human dignity was grievously violated find themselves in exceptionally vulnerable positions. Da Costa's (2006) study endorsed this conclusion: relocating to new domains may deny people fundamental human rights and privileges such as the minimum comfort they deserve. However, generations of communities worldwide have upheld their prized traditions as integral facets of their cultural character. Customs necessitate devotion to endure and remain sustained in the distant future; thus, consistency is a fundamental aspect of their definition. However, are cultural conventions authentically handed down to the next generation? Cultural personae are shaped and influenced by the sincerity with which ancestral practices are communicated. Some regions of the world have successfully preserved their unique practices, passing them down through generations. However, globalization has endangered the continuation of certain practices in other communities, making their youth less connected to their ancestries (Matthews & Thakkar, 2012).

Forced migrants must strategically shape their identities to navigate new settings but their predicaments emanate from inadequate support. Migrants face obstacles solely due to their immigration status, which encourages identity fluidity (Hack-Polay *et al*., 2021). De Haas (2021) further posited the principal question of how refugees reconcile the imposed identity with their inner selves. Variable identities are not formed solely by chance or nature; Virupaksha *et al.* (2014) indicated that complex demands, transitory or permanent, encourage intentional identity creation.

Besides their native attributes, short- or long-term social and mental positioning dynamically informs the sense of self of migrants. At times, certain migrants may highlight identities that promote inclusion; at other times, they could emphasize other traits to conceal their true selves: at all times, their circumstances compel unconscious or careful identity shifts (Timotijevic & Breakwell, 2000). Thus, forced migrants manage their identities, utilizing them as survival and belongingness tools in lands other than their birthplaces. Their experiences underscore the inhumanity of reducing humans to mere legal classifications.

To cite a contemporary example, Trovato *et al*.'s (2023) study demonstrated that millions of Syrians fled their homeland and sought refuge in neighboring Lebanon due to the unrelenting conflict that began in 2011. The mass migration of Syrian refugees to Lebanon profoundly challenged their cultural traditions. Reports have extensively documented the disappearance of cultural practices such as spiritual ceremonies and seasonal celebrations that shaped life in Syrian villages. Ghazyani's (2018) study asserted that adopting to the new linguistic environment and adjusting to unfamiliar Lebanese customs have exacerbated the difficulties Syrian refugees have confronted in preserving their identity. Upheavals caused by displacement have unsettled deeply held beliefs and disrupted generationally shared rituals and festivals, complicating the attempts of Syrian refugees to retain their sense of who they are in a country that is not their own. Similarly, the mass exodus of Rohingya Muslims escaping systemic oppression in Myanmar continues unabated. Thousands of Rohingya Muslims flood into Bangladeshi refugee camps every month, seeking safety from the relentless campaign of violence and deprivation against their people (Sudheer & Banerjee, 2021). Despite crippling poverty, displacement, and limited basic rights, the Rohingya silently attempt to keep their cultural identity alive in the squalid tents and makeshift shelters of Cox's Bazar by passing on their culture by words, practices and community rituals. They struggle to pass their traditions to their younger generations without any resources or mobility as they exist in perpetual limbo. Their inability to freely exercise their faith or use their native tongue further compounds their acute loss of identity and community, exacerbating the psychological trauma of being exiled and intensifying the cultural disintegration of a population whose only crime is being born Rohingya (Bhatia *et al*., 2018). In another example, millions of South Sudanese fled violence and sought refuge in Uganda. Maintaining cultural identity in such turmoil was extremely problematic for such refugees uprooted from their ancestral lands and traditions (Ahimbisibwe, 2019).

3.2. Forced migration and health vulnerabilities

3.2.1. Health vulnerabilities

Insights obtained from mortality statistics can immensely benefit several aspects of migration research. The use of mortality data in migration studies elucidates important aspects of the challenges and health outcomes of migrant populations (Riosmena *et al*., 2012). According to social epidemiology research, higher death rates are consistently associated with lower levels of income, education, and overall social standing (Saydah *et al*., 2012). Immigrants living in most Western destination nations contravene this conclusion: Their overall death rates are lower despite the socioeconomic disadvantage they sometimes face as newcomers (Alegría *et al*., 2017). Haukka *et al.* (2017) demonstrated that effectively managed displacement can nevertheless correlate to increased mortality from ischemic heart disease and reduced suicide rates in the long run and illuminated an often overlooked aspect. Respectful forced relocations executed in instances of conflicts, disasters, or developments do not negate the prolonged effects of such displacements on the health and well-being of migrants. These findings underscore the importance of bearing in mind that adverse health consequences persist for years after compulsory migrations and do not merely prevail in the immediate aftermath.

Reed and Keely (2001) explained that large-scale forced migrations occurring due to armed conflicts and natural calamities frequently result in early mortality and ill health. Levels, types, and patterns of increased death and morbidity differ depending on the situation: the nature of the complicated emergency, the features of the group of forced migrants, the stage of the emergency, and the flow of migration (Reed *et al*., 2017). Hynes *et al.* (2022) illustrated that mortality rates in refugee camps vastly exceed death rates in people who live in secure regions. The UNHCR has also reported findings that refugee child mortality rates could surpass the global mean by 10 times due to undernourishment, contagious sickness, and insufficient healthcare (UNHCR, The UN Refugee Agency, 2023). Some studies have emphasized that prolonged deprivation worsens already terrible conditions; even common illnesses ravage the most vulnerable populations due to the absence of stability (Avogo & Agadjanian, 2010; Saarela & Elo, 2016). Forced migrations often stem from conflicts with deadly consequences. According to (Acharya *et al*., 2020), heightened mortality is noted in the host nations as well as the relocation areas: first, due to the direct violence people must confront during the conflict, and second, due to subsequent indirect factors such as disease and malnutrition exacerbated by displacement.

3.2.2. Migration and infectious diseases

Substandard housing, malnourishment, and limited medical resources plague migrating populations (Reyes *et al*., 2012). Such deprivations significantly impact mortality because displaced communities experience disproportionately high fatality rates. For instance, the South Sudanese evacuees sheltering in Uganda cannot obtain treatment, which severely jeopardizes their well-being (Adaku *et al*., 2016). The death toll resulting from the absence of adequate care climbs precipitously, especially among children and expectant mothers. The plights of refugees highlight the vulnerabilities wrought by displacement and the ensuing hardships endured in exile (Hameed *et al*., 2019). Forced migrations can also notably impact the dissemination of transmittable illnesses in host communities. For example, Ibáñez *et al.*'s (2021) study demonstrated that forcibly displaced persons regularly traverse hazardous distances with little rest, cannot access medical care, and do not have enough provisions to satisfy their necessities. Moreover, the access of forced migrants to pharmaceutical and preventive healthcare, nutritious food and water supplies, and medical services is often constrained in their homeland even before they relocate (Abdul-Ghani *et al.*, 2019). Such compounding privations often mean that forcibly displaced populations exhibit extremely fragile health conditions when they arrive in their host regions. Thus, they are extremely susceptible to infectious pathogens and facilitate more extensive contagion (Stevenson *et al.*, 2024). Studies have shown that those forcibly displaced from their homes encounter myriad health risks. Global health concerns persist about communicable illnesses: for instance, migrants and asylum seekers escaping hostilities could influence the severity of infectious illnesses in receiving nations (Baggaley *et al.*, 2022; Eiset & Wejse, 2017). Other studies have observed that immigrants and refugees are likely to be more susceptible to dying from infectious diseases due to the high incidence of contagious illnesses in their home countries and the obstacles they confront in receiving due treatment in recipient nations (Norredam *et al.*, 2011; Norredam *et al.*, 2014).

Several reports have indicated that overcrowded refugee camps and substandard settlements foster the proliferation of communicable diseases (Altare *et al.*, 2019; Famine-Affected, Refugee, and Displaced Populations: Recommendations for Public Health Issues, 1992). Studies have linked soaring populations crammed into confined areas with elevated transmission of respiratory ailments, including tuberculosis (Gushulak *et al.*, 2008). Abysmal sanitation and scarce supplies of clean water also facilitate cholera and hepatitis E outbreaks by enabling fecal-oral routes of contamination. Unfortunately, the confluence of such pernicious dynamics produces fertile breeding grounds for various infectious scourges (Elias *et al.*, 1990; Saleh *et al.*, 2022). The alleviation of such suffering necessitates concerted efforts to decentralize densities while upgrading infrastructures to curb the spread of sickness in such vulnerable communities. Forced migrations often breed food insecurity and malnutrition and negatively impact health (Orjuela-Grimm *et al.*, 2021). Displaced groups often struggle to access nutritious sustenance and thus exhibit deficiencies that weaken their immunity. Such vulnerable populations become easy prey for diseases. Among refugees, children aged five and under regularly suffer maladies caused by inadequate levels of vitamins and minerals, which amplify their chances of mortality from contagions such as measles or intestinal ailments (Dondi *et al.*, 2020). Conditions of squalor and scarcity spawn severe afflictions, and such regrettable outcomes force further displacements (Zezza *et al.*, 2011). A bleak cycle grips migrants: malnutrition increases their susceptibility to sicknesses which, in turn, triggers migration due to destitution. Solutions demand concerted international efforts to guarantee displaced persons access to life's necessities. Breathing infections are one of the leading causes of sickness and death in relocated communities. Reports have demonstrated that the overcrowding of living spaces, insufficient airflow, and diminished resistance in displaced individuals frequently result in outbreaks of upper respiratory diseases and tuberculosis in refugee camps (Guthmann *et al.*, 2023). Studies uncovered alarmingly high occurrences of TB in squalid and cramped Ethiopia migrant camps. These incidences were primarily blamed on the poor sanitation and living conditions that advanced the spread of the illness before it could be identified and managed (Meaza *et al.*, 2023). Elsewhere, policies enacted to relieve overpopulation have evidenced some success in curtailing the rampant propagation of contagions, though much remains to be done to upgrade conditions and optimize screening. Immunization gaps often emerge among forcibly displaced populations due to service interruptions during migration journeys. Rull *et al.* (2018) demonstrated that refugee children face elevated vulnerability to preventable afflictions such as measles, polio, and diphtheria due to impaired access to routine immunizations. The lethal 2017 measles outbreak in the sprawling Rohingya refugee camps in Bangladesh underscores the critical importance of sustaining high vaccination coverage in displaced populations (Mair *et al.*, 2020). Unfortunately, disruptions to normal life precipitated by flight place refugee communities at heightened risk of outbreaks of illnesses that could otherwise be avoided through widespread inoculation. Forced migration separates families from established healthcare services; nonetheless, public health authorities must strive to bridge such gaps and protect some of the world's most vulnerable people.

3.2.3. Migration and mental health

Traumatic memories and unknowable resettlement prospects burden minds and compromise immune systems (Forman, 2024; Jankovic-Rankovic *et al.*, 2020). The profound psychological impacts of unwilling displacement are undeniable. Duress, mourning, and unpredictability are ubiquitous in forced migrants. These phenomena worsen any existing proclivities toward mental unease and potentially culminate in elevated fatalities. The issue of trauma among immigrant populations has garnered more attention in the past 20 years. Given the well-documented links between such mental illnesses, displacement, and widespread forms of violence, most of the research corpus related to this issue addresses the immediate psychological effects of armed conflicts (Theisen-Womersley, 2021). According to the WHO research, the frequency of common mental illnesses in migrants and refugees is greater than the occurrence of mental disorders in host populations. Examples of such illnesses include depression, anxiety, and posttraumatic stress disorder (PTSD). People who seek asylum are typically more likely to commit suicide (the World Health Organization, 2021b). Emotional anguish can increase when people and families flee their homes, cultures, and communities in search of safety from the danger of violence and persecution (Miller & Rasmussen, 2016). Difficulties encountered in the course of migration cause approximately one-third of displaced populations to suffer from high anxiety, depression, and PTSD, which can exert a serious negative impact on their quality of life (Marković *et al.*, 2023). Refugees are particularly vulnerable to mental health difficulties because they have to suffer terrible experiences throughout the preparation and transit phases of their journeys and confront significant challenges as they resettle in a new nation. If left untreated, such mental strains can result in increased death rates from suicides (Pouraghajan *et al.*, 2023). Extant investigations have also examined whether intergroup interactions with people in host societies mitigated the detrimental effects on the mental health of refugees.

The aforementioned studies have measured exposure to traumatic ordeals such as witnessing brutality, enduring the demise of close companions, and surviving catastrophes that occur frequently during coerced migrations. According to existing studies, intense anxiety, melancholy, unease, and PTSD can emerge in the aftermath of such events. Moreover, hopelessness and PTSD are notably prevalent among displaced people. An investigation of Syrian refugees in Greece revealed that 72% of the men and 45% of the women suffered from PTSD (Theofanidis *et al.*, 2022). Other research initiatives have found that variables such as social support networks can mitigate the lasting psychological effects of dislocation and upheaval (Naal *et al.*, 2021; Abudayya *et al.*, 2023). The path forward remains long but increased awareness of such issues is promising for the development of more compassionate policies and services to help the afflicted heal. Extensive investigations have confirmed that psychological stress often manifests physically. Forced migrants are prone to heightened anxiety and strain and commonly complain of headaches, gastrointestinal trouble, and cardiovascular discomfort, all of which are often precipitated by duress. Such stress-induced sicknesses increase mortality risks and can exacerbate prevailing medical conditions (Kirmayer *et al.*, 2010). Meanwhile, inquiries continue to illuminate how mind and matter interconnect under extraordinary duress. Displaced people coping with the chronic pressures of relocation and recollection are at a higher risk for coronary complications and cerebrovascular diseases than the average population. In fact, recent medical studies of Bosnian refugees living in the United States found that individuals who were still dealing with traumatic memories or bouts of depression had higher rates of high blood pressure and heart problems than fellow Bosnians who had overcome such problems (Comtesse *et al.*, 2019). The physiological pathways that link persistent psychosocial burdens to declining physical wellness must be explored further to improve the identification and treatment of at-risk refugees and immigrants in their new homelands.

Scholars have also explored the interplay between conflict, mental health, and migration in the Palestine–Israel situation. Numerous forced relocations have occurred due to the prolonged Israeli–Palestinian conflict, which has raged for more than seven decades. The establishment of the State of Israel in 1948 caused the forced displacement of more than 700,000 Palestinians in an event they labeled the *Nakba*, which the United Nations Relief and Works Agency (UNRWA) designated as signifying "catastrophe." Palestinians continued to face removals through subsequent battles such as the 1967 6-Day War and other military operations, many of which compelled them to live in overcrowded refugee camps within and outside the territories, (Marshall, 2014). The absence of basic amenities and the cramped quarters of such camps exacerbate the vulnerabilities of displaced populations. The Palestinian people have experienced immense mental suffering due to prolonged violence and displacement (Veronese *et al.*, 2021). Researchers have conducted similar studies on the Russia–Ukraine war. Millions of Ukrainians had no choice but to abandon their homes and seek refuge from the bombardment. The continued violence also wrought untold loss of life and inflicted deep psychic scars on its victims (Pascual & Vincent, 2024). The fighting in Ukraine caused one of Europe's worst displacement catastrophes since World War II. According to statistics reported by the UNHCR (Situation Ukraine Refugee Situation, 2024), more than eight million had Ukrainians emigrated to neighboring territories by mid-2023, and an additional 6 million had been internally displaced within Ukraine. The abrupt dislocations and the forced forfeiture of dwellings, communities, and means of financial support have exacerbated the psychological impact of the brutality suffered by Ukrainian citizens. Thus, innumerable Ukrainians are fraught with feelings of uncertainty and lack of security (Siriwardhana *et al.*, 2014).

Furthermore, sudden separations from extended families and familiar surroundings compound traumatic effects for people struggling to find stability and hope in entirely foreign environments. Neighboring nations absorbing refugees in huge numbers also confront major socioeconomic challenges in accommodating massive influxes of people and providing adequate shelter, resources, and public services to all those seeking safety from violence and war-induced chaos raging in their homelands. The seemingly intractable battles between Israel and Palestine as well as Ukraine and Russia clearly demonstrate the associations between disputes, displacements, psychological well-being, and mortality. Conflict-induced migrations have resulted in significant mental health difficulties, intensifying physical health issues and increasing mortality rates. A multifaceted approach is mandated to tackle such problems. Such methodologies must incorporate enduring remedies to end the bloodshed and ensure stability even as they deliver urgent humanitarian aid and psychiatric care. Diplomatic negotiations must progress simultaneously despite the elusiveness of peace. Such dialogs must also focus on compassion as their common objective because lives remain at risk every day if multidimensional solutions are delayed.

4. Discussion

4.1. Interplays between cultural identity and health

The findings of this review of the relevant literature underscore the complex relationships between cultural identities and mortality rates in unwillingly relocated populations. Health-related susceptibilities, demise rates, and psychological suffering become activated and escalate when cultural traditions fade due to forced uprootings (Yoon *et al*., 2022). Forced migrations often exacerbate the healthcare inequities suffered by marginalized cultural groups. Obstacles such as discrimination, linguistic divides, and paucity of culturally sensitive care can significantly impair the access of displaced communities to medical services (the World Health Organization: WHO, 2022). Research has shown that such impediments result in disproportionate death rates and unequal health outcomes in affected populations (Gamper & Kupfer, 2022). Studies have also observed notable health-related disparities in racial and ethnic minorities in the United States. Such inequalities stem primarily from biases that limit opportunities for high-quality treatments tailored to diverse needs (Patton-López, 2022). Relocations could be caused by crises beyond the control of any group; however, the quality and availability of care received frequently correlate to cultural contexts. Underserved demographics tend to shoulder heavier burdens related to illness and suffer more from longstanding social inequities.

Thus, culturally sensitive therapies that address the medical and customary needs of forcibly displaced peoples are urgently mandated. The loss of social relationships and support mechanisms that previously bolstered displaced groups further compound their elevated risks. Nonetheless, research has noted that new local organizations and faith-based gatherings sustain collective values and shared beliefs in certain displaced communities, which consequently demonstrate remarkable resilience (Ager *et al*., 2015). Some studies have discussed the ways in which relocating to a new country can impact the psychological well-being of migrants, and have attended to the intricate interplays between psychological disorders and acclimating to unfamiliar social and cultural settings (Wagner & Westaby, 2009; Harrison & Brower, 2011). Mental health difficulties could intensify due to the substantial psychological strain-inducing processes of adapting to different locales and integrating into foreign societies. However, acculturation is pivotal to the mental health of migrants, and comprehension of the psychological and cultural facets of forcibly displaced populations is pivotal to their assimilation (Kuo, 2014b; Guler & Berman, 2019; Kodippili *et al*., 2024). Many considerations become necessary: for instance, the trauma experienced by such populations before migrating, the loss of their social roles after migration, their sociodemographic traits, and their cultural orientations (marginalization, assimilation, separation, or biculturalism) (Brance *et al*., 2024). Migrants could safeguard their mental wellness by successfully navigating their new cultures while preserving their original identities (Berry, 2001). Retaining their connections to their ethnic backgrounds and residing near others from their communities can protect migrants from developing problems related to their mental health.

4.2. Culturally sensitive policies and interventions: Addressing challenges

Undeniably, culturally sensitive policies and initiatives must be adopted to address the myriad issues experienced by displaced communities. The recent literature emphasizes the need for holistic approaches that respect and acknowledge the cultural identities of migrants and can, thus, deliver comprehensive healthcare and other supportive services to them. Culturally responsive healthcare is paramount for the alleviation of the health-related vulnerabilities of forced migrants. Nair & Adetayo's (2019) study revealed that health practitioners must understand the cultural backgrounds of their patients to treat them appropriately and effectively. Culture-specific practices and ideologies related to health, illness, and healing must be appreciated. The quality of care provided to displaced populations can be substantially enhanced if cultural competency training is comprehensively integrated into medical education from the outset (Lau & Rodgers, 2021b). Furthermore, Curtis *et al.* (2019) have emphasized the critical importance of involving community members and leaders in the planning and provision of health services. Community-based treatments that leverage local cultural brokers can cultivate trust, enhance health outcomes, and thus help bridge trust divides between medical professionals and immigrant communities (Luig *et al.*, 2023). Cultural practices must endure if displaced groups are to retain their cultural identities. The existing research indicates that the preservation of cultural continuities notably enhances the psychological well-being of immigrant populations (Lee *et al.*, 2023). Policies instituted by host communities that encourage the preservation of the customs, languages, and rituals of immigrants can mitigate cultural disruptions. Such initiatives adopted to preserve their cultural contexts offer immigrants avenues for sustaining their traditions. Freudenberg's thorough investigation (2020) demonstrated that festivals and community hubs allow diverse groups to share their distinctive backgrounds, safeguard discrete identities, and foster togetherness and assimilation into welcoming neighborhoods. Moreover, programs inculcating appreciation for differing heritages can help diverse collectives feel respected in their adopted homelands and strengthen civic bonds by increasing the probabilities of long-established and newly-arrived residents engaging and collaborating on mutually beneficial projects (Jennissen *et al.*, 2022).

Educational initiatives that immerse immigrant populations in their cultural histories greatly benefit the preservation of their cultural identities. Lara and Volante (2019) emphasized the incorporation of multicultural curricula and mother-tongue-based instruction in schools in which immigrant children are educated. Such educational programs help young immigrants acquire new skills and knowledge within the framework of their adopted nations and simultaneously preserve their cultural heritages. Language programs are particularly pivotal to the encouragement of inclusion and interaction. Studies suggest that language-based limitations represent substantial obstacles to obtaining services and engaging completely with society. Language instruction for both adults and children enhances comfort levels in unfamiliar circumstances and mitigates their sense of isolation (Nieuwboer & Rood, 2016; Horgan *et al.*, 2021).

The psychological consequences of forced migrations necessitate holistic approaches to mental healthcare. Research indicates that culturally sensitive strategies should feature in therapies, integrating local support networks and traditional healing practices (Cratsley *et al.*, 2021). Similarly, peer counseling programs have shown promise, improving mental health outcomes for migrants by supplying help and guidance from others who have faced comparable circumstances (Forray *et al.*, 2024). Such initiatives could provide a sense of community and common understanding for individuals grappling with the aftermath of displacement. Programs pairing displaced people with individuals who have navigated similar hardships allow holistic caregiving that recognizes both the medical and social aspects of the recovery of mental health. Culturally grounded applications of conventional treatment models also acknowledge the lived experiences of people displaced from their homes (Warren & Nigbur, 2024).

The complex challenges that confront displaced populations require nuanced and multipronged solutions. Policymakers must acknowledge the associations between cultural identities and vulnerabilities. Environments promoting resilience and well-being can emerge when responsive and culturally aware policies and undertakings are instituted. Some solutions require healthcare to be directly addressed; others necessitate investment in education or culture preservation. Mental health assistance and legal protections complete initiatives that respect and uphold immigrant identities. Decision-makers can integrate these dimensions into comprehensive plans to enhance the welfare of displaced populations and mitigate the negative effects of migration. However, achieving this feat mandates receptive leadership that views cultural diversity as integral and not incidental.

5. Conclusion

The harsh realities of forced migrations pose a dire threat to cultural identities because uprooted peoples struggle to find firm footing in unfamiliar lands and grapple with the necessity of adapting to foreign ways of life. Involuntary relocations shatter community ties and endanger native languages and nuanced traditions that represent the distinguishing hallmarks of all cultures. The far-reaching consequences of dispossession for individuals and their societies can be grasped only by fathoming the profound impact exerted by forced migrations on cultural identification. Indubitably, forced migrations cause cultural turmoil because displaced groups generally find themselves in places that are unreceptive to their traditions. Practices and ceremonies that were once pivotal to the retention of their cultural unity could then become unachievable, triggering feelings of emptiness and isolation from their former ways of life. The void becomes more intense when communication is hindered by unfamiliar tongues because languages symbolize the transmission of ancestral legacies. However, the potential for new connections arises through such suffering because diverse peoples can recognize that shared hopes underlie their outward differences. The consequent intermingling results in innovative blends of expression, revitalizing customs, and passing them on to subsequent generations. Compulsory relocations often shatter communities, fracturing their social bonds and familial ties; however, the impact of forced displacements transcends the mere diminishing of the communal spirit. Besides migrants feeling more exposed and solitary due to the scattering of their community, the loss of such social underpinnings can cause the steady erosion of cultural heritage and the loss of institutions essential for the transmission of cultural knowledge across generations. Moreover, the sense that their vulnerabilities multiply with their dispersion makes the preservation of the cultural identities of migrants an even greater challenge when fewer support networks are available to them.

Those who move between lands must crucially adopt new aspects of foreign peoples during their disruptive journeys. Such undertakings present traumata: newcomers often face prejudices and alienation in their adopted communities, which makes their adjustment and involvement all the more taxing. In addition, some people find cultural transitions simpler than others due to differences in their personal resilience and open-mindedness to change. Forced migrations pose grave health dangers that significantly increase the mortality rates of the displaced. People who are frequently uprooted find themselves residing in unsanitary and crowded quarters that are prone to contagions. Malnutrition and limited access to medical care or psychological support exacerbate their vulnerabilities, increasing the risk of varied infirmities and leading to increased mortality rates. Some refugees live in squalid temporary lodgings where infectious scourges spread rapidly. Others struggle with post-traumatic stress and depression intensified by the loss of their communities and homes, which heightens the risk of their mental unraveling. The consequences endanger both their physical and psychological well-being and underscore the humanitarian imperative of alleviating their suffering. Forced migrations create complex challenges related to the health, identity, and well-being of displaced peoples which require delicate yet decisive policy interventions. Leaders must recognize how displacements uniquely impact discrete groups and act to establish protective measures to ease the heavy tolls wrested by forced displacement on both physical and cultural survival. A diversity of needs emerges in displaced communities that demand a diversity of solutions. Legal protections, healthcare access, identity preservation, and social integration must all be promoted to address the multifaceted difficulties inherent to forced relocations. No two communities can equally bear burdens and remedies: a prudent approach would recognize the unique experiences of each community and customize assistance accordingly. The adverse effects of forced migrations can be justly mitigated only through thoughtful policies that are attentive to the intricacies of displacement. Finally, aspects such as the long-term health effects of forcible displacement and how various acculturation approaches affect physical health require further investigation. More research is also needed to explore the effectiveness of varied culturally sensitive healthcare interventions in a wider range of migrant conditions. Several questions remain unanswered: for instance, how cultural maintenance can be embedded into healthcare models and what role social support structures play in mitigating the health risks of displaced populations. These gaps must be tackled by future studies to advance policy research and development in this domain.

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RESEARCH ARTICLE

Typologies of living alone and loneliness and their correlates among community-dwelling older adults: Results from the Chinese Longitudinal Healthy Longevity Survey

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Abstract

This study examined typology among Chinese older adults based on living alone and loneliness and their correlates and the urban–rural difference between them. Data were derived from the 2018 wave of the Chinese Longitudinal Healthy Longevity Survey. Four subgroups were generated – living alone and feeling lonely, living alone but not lonely, not living alone but feeling lonely, and neither living alone nor feeling lonely. Multinomial logistic models were used. Among the 14,469 respondents, 7.84% lived alone and felt lonely, 8.69% lived alone but did not feel lonely, 20.13% did not live alone but felt lonely, and 63.34% neither lived alone nor felt lonely. Compared with those who neither lived alone nor were lonely, older adults who lived alone and were lonely were characterized by low socioeconomic status and poor health, as well as a lack of family support and participation in individual activities. Older adults who lived alone but were not lonely generally reported good health. In contrast, older adults who were not living alone but were lonely generally reported poor health and lacked community old-age care services and participation in individual activities. The results indicate that investigating living alone and loneliness in tandem could provide a better understanding of the social circumstances of older adults within each subgroup and help provide tailored services for each subgroup.

Keywords: Living alone; Loneliness; Typology; China Longitudinal Healthy Longevity Survey

1. Introduction

In recent years, loneliness in older adults has become an increasingly notable global public health concern with a variety of negative consequences, such as mortality (Takagi & Saito, 2020), depression (Schiller *et al.*, 2023), poor self-rated health (Phillips *et al.*, 2023), and cognitive impairment (Foong *et al.*, 2018). Moreover, social distancing and the lockdowns due to the COVID-19 pandemic have worsened the situation, with an increase in the prevalence of loneliness among older adults (Hajek & König, 2021; Wu, 2020). Due to the dramatic societal transitions in China characterized by urbanization, the erosion of filial piety, smaller households, and changes in living arrangements, loneliness has emerged as a public epidemic in older adults. Yang & Victor (2008) found that the number of people reporting loneliness increased from 15.6% in 1992 to 29.6% in 2002 (Yang & Victor, 2008). Similarly, Luo & Waite (2014) found a significant increase in loneliness from 2002 to 2008 (Luo & Waite, 2014). Globally, the percentage of older adults who live alone is increasing, and fewer people are living with their extended family. For instance, 20 – 30% of adults aged 60 and older live alone across most of Europe (United Nations, 2019); this percentage is close to 28% in the United States (Ausubel, 2020). Similarly, the percentage of older adults in China living alone reached 21.38%, rising from 9.6% in 1990 to 12.5% in 2010 (Hu & Peng, 2015).

Although living alone and experiencing loneliness display an increasing trend, the two concepts are distinct. Most research shows that living alone is a significant risk factor for loneliness (Hutten *et al.*, 2022; Routasalo *et al.*, 2006); however, these studies may have overlooked the diversity and complexity of older adults' circumstances. Living alone may not necessarily cause loneliness for the following reasons. First, older adults who live alone have different profiles. On the one hand, living alone may be a preferred alternative living arrangement for older adults who are healthy, relatively young, or economically advantaged, or those who pursue a sense of autonomy and independence (Birditt *et al.*, 2019; De Jong Gierveld *et al.*, 2012). On the other hand, living alone can be an inevitable arrangement for older adults when they become single, divorced, or widowed, or when they have no informal caregivers who look after them (Gu *et al.*, 2019). Moreover, there may be degrees to living alone – older adults may not live with their adult children in the same household but live geographically nearby, which is referred to (Sun *et al.*, 2018).

Second, the relationship between living alone and loneliness is based on older adults' cultural context and resources. For example, individuals from countries in northern and western Europe, which highly emphasize independence, have lower rates of loneliness because they expect less mutual dependence compared with those from the more familistic regions of southern and eastern Europe (De Jong Gierveld *et al.*, 2012). In Germany, approximately 70% of older adults living alone were not lonely, and social integration and the absence of depression could compensate for the risk of living alone or loneliness (Zebhauser *et al.*, 2015). Similarly, a diverse social network and active social participation could help Chinese older adults who are living alone to obtain resources and thus reduce their sense of loneliness (Yang *et al.*, 2023). In short, living alone is not equated with feeling lonely; it is only a structural risk factor for loneliness to the extent that it is associated with the functional factors related to loneliness.

Notably, living alone and loneliness are distinct constructs, but with an overlap. Older adults in specific subgroups of living alone/loneliness might have different social and health consequences (Hao *et al.*, 2016; O'Súilleabháin *et al.*, 2019). For instance, older adults who lived with their spouses and children and are never or seldom lonely reported a higher level of self-rated health compared with those who lived alone and reported occasionally feeling lonely (Hao *et al.*, 2016). Notably, Chinese co-resident older adults who reported feeling lonely had worse cognitive and physical functions and higher mortality than those who were co-resident but not lonely (Wei *et al.*, 2022).

Furthermore, the urban–rural distinction is a prominent characteristic in China's societal transition, and studies have demonstrated its varying impact on living alone and loneliness. Rural older adults are more likely to live alone than urban older adults, based on a study using the Chinese Longitudinal Healthy Longevity Survey (CLHLS; Yin & Liu, 2017). Moreover, rural Chinese older adults were more likely to report loneliness than their urban counterparts (Dong, 2017). However, the urban–rural differences in the correlates of loneliness have not received enough academic attention. Thus, examining how the profiles for the typologies of living alone and loneliness might differ between older adults living in urban and rural areas presents an important academic contribution.

1.1. Theoretical framework

One's choice of a specific living arrangement (e.g., living alone) is affected by a myriad of factors such as personal preferences, demographic and socioeconomic characteristics, their own and their family's resources, and health status (Gu *et al.*, 2019; Sereny, 2011). The case is similar for loneliness (Hutten *et al.*, 2022; Pinquart & Sorensen, 2001). These factors are aligned with the basic principles of Andersen's (1995) behavioral model. According to this model, health behaviors are determined by factors in three dimensions: predisposing factors, enabling factors, and need factors. This model has been used widely in examining health service and care use, and it has recently been extended to examine old-age service use and other related behaviors such as living arrangements (Zeng *et al.*, 2021). For instance, Zeng *et al.* (2021) used Andersen's model as a theoretical framework for analyzing the factors affecting the expected living arrangements of the oldest old in China. Meanwhile, older adults' loneliness is the interplay of their needs and resources, such that if their resources cannot fulfill their needs, especially in terms of emotional and social needs, they will feel lonely (Bedard-Thomas *et al.*, 2019; Teater *et al.*, 2021). Certain demographic and personality variables, such as older age, being female, and lower socioeconomic status, predispose people to loneliness (Cohen-Mansfield *et al.*, 2016; Pinquart & Sorensen, 2001). As such, informed by Andersen's behavior model (Andersen, 1995), this study attempts to examine the typology and correlates of living alone and loneliness. Specifically, the correlates were categorized as predisposing, enabling, and need factors.

1.2. The current study

The correlates of living arrangements and loneliness have been well documented in the literature; however, such research might overlook the complexity of older adults' circumstances. Thus, as per Andersen's behavioral Model, this study attempted to examine the typology of living alone and loneliness—living alone and feeling lonely, living alone and not lonely, not living alone but lonely, and neither living alone nor feeling lonely—and the correlates as well as urban–rural differences in a nationally representative sample of Chinese older adults.

2. Methods

2.1. Data

This study used data from the 2018 CLHLS. More details about the sampling can be found in previous studies (Gu, 2008; Gu *et al.*, 2021). Because we focused on adults aged 65 and older and given that some variables had missing data, including loneliness (1,766 missing cases), living alone (259 missing cases), self-rated health (1,238 missing cases), and chronic disease (2,260 missing cases), we conducted 10 imputations using the multiple imputation method for variables with missing values. The final sample for the study was 14,469. Ethical approval for this study was obtained from the Institutional Review Board of Peking University (Approval number: 2022-147).

2.2. Measurements

The dependent variable was typology based on living alone and loneliness. Living arrangements were measured by the question, "Whom do you live with now?" The answers included "with household member(s)," "alone," and "in a nursing home." As community home-based care is the main way of providing old-age care and older adults in China primarily prefer to live in their communities or at home, this study focused on community-dwelling older adults and excluded institutionalized older adults. "Living with household members" was coded as "not living alone."

Loneliness was measured by the question, "Do you often feel lonely and isolated?" This item, measured on a five-point Likert scale, has been used widely in previous studies and has good predictive validity in health outcomes (Wei *et al.*, 2022; Yang & Gu, 2021). Following previous studies (Wei *et al.*, 2022; Yang, 2021) and considering the highly skewed nature of this loneliness measure in the CLHLS, the item was dichotomized to combine ratings of "sometimes," "often," and "always" into the "lonely" category (coded as 1) and ratings "seldom" and "never" into the "not lonely" category (coded as 0).

Combining living arrangements, four categories were generated, namely, living alone and feeling lonely, living alone but not lonely, not living alone but lonely, and neither living alone nor feeling lonely.

We categorized the variables into predisposing, enabling, and need factors. Predisposing factors included the following: age (65 – 79, 80 – 89, 90 – 99, and 100+); sex (men vs. women); residence (rural vs. urban); marital status (currently married vs. not married); educational attainment in terms of the number of years of education received (0, 1 – 6, 7+); and occupation before retirement (white-collar occupation vs. others).

Enabling factors included financial independence (yes vs. no), family economic status (rich vs. not rich), family emotional support, participation in individual and group activities, and community old-age care services. Family emotional support included the following questions: "Whom do you ask first for help when you have problems/difficulties?," "To whom do you usually talk most frequently in daily life?," and "Whom do you talk to first when you need to tell something about your thoughts?" When family members were selected, the response was coded as 1; otherwise, it was coded as 0. The Cronbach's alpha for this item was 0.87. Participation in individual activities was measured by four items, namely, gardening, reading newspapers and/or books, raising domestic animals, and watching television and/or listening to the radio. When older adults participated in at least one of the above activities, it was considered participation in individual activities; otherwise, it was considered non-participation. Meanwhile, group activity participation was dichotomized and coded based on playing cards and/or mahjong and organized social activities. It was coded as participation for those who participated in at least one activity, and otherwise as non-participation. Community services were measured by eight old-age care services, including recreational activities and psychological support. If at least one service was available, community services were considered to be available; otherwise, they were considered to be unavailable.

Finally, need factors comprised health-related variables, including the activities of daily living (ADL), the instrumental activity of daily living (IADL), Mini-Mental State Examination (MMSE) scores, self-rated health, and chronic disease. Participants were classified as disabled in terms of ADL or IADL if they reported difficulty in one of the six basic ADL activities (e.g., bathing and dressing; $\alpha = 0.90$) or one of the eight IADL activities (e.g., cooking and shopping; $\alpha = 0.94$). Cognitive functioning was measured using the Chinese version of the MMSE, which has a maximum score of 30 ($\alpha = 0.89$; Lagona & Zhang, 2010). It was coded as a binary variable: cognitive impairment (0 – 23) and cognitively normal (24 and above; Yang, 2021). Self-rated health (SRH) was measured by the question, "How do you rate your health at present?" It was dichotomized and recorded as "good" and "bad" based on a five-point Likert scale. Finally, chronic disease was measured by whether the participants had chronic diseases diagnosed by physicians.

2.3. Statistical analysis

First, a descriptive analysis of the variables was performed using percentages and frequencies. The urban–rural difference in the variables was analyzed using the chi-square test. Second, considering that the dependent variable was a four-category variable, we used multinomial logistic models. Not living alone and not feeling lonely was regarded as a reference category. In addition, the multinomial logistic models were also separately run among urban and rural older adults to examine urban–rural differences. All analyses were performed using Stata v17.0.

3. Results

3.1. Descriptive results

As Table 1 shows, approximately 7.84% of people surveyed lived alone and felt lonely, 8.69% lived alone but did not feel lonely, 20.13% did not live alone but felt lonely, and 63.34% neither lived alone nor felt lonely. Except for chronic diseases, differences were observed in the four types of living alone and loneliness in terms of predisposing, enabling, and need factors.

3.2. Multinomial logistic regression results

As Table 2 shows, compared with the reference category, the profile for older adults who lived alone and were lonely was younger age, older men, currently not married, poor family economic status, no emotional support from the family, no individual activity participation, not ADL disabled, and poor self-rated health. Men had a higher likelihood (b = 0.257, $p < 0.001$) of living alone and feeling lonely, whereas currently married (b = −3.926, $p < 0.001$) and rich older adults (b = −0.736, $p < 0.001$) had a lower likelihood of living alone and feeling lonely. Regarding enabling factors, family emotional support (b = −0.536, $p < 0.001$) and individual activity participation (b = −0.452, $p < 0.001$) were related negatively to the typology of living alone and feeling lonely. Regarding need factors, older adults who were in poorer health were less likely to live alone and be lonely (ADL disabled: b = −0.950, $p < 0.001$; SRH: b = −0.938, $p < 0.001$, respectively).

In addition, compared with the reference category, the profile for older adults living alone but not lonely was younger age, currently not married, poor family economic status, non-ADL disabled, and good self-rated health. Currently married (b = −2.894, $p < 0.001$) and rich older adults (b = −0.357, $p < 0.001$) were less likely to live alone but not be lonely. Regarding need factors, older adults in poorer health were less likely to live alone but not be lonely compared with those with good SRH (b = 0.149, $p = 0.025$), who were more likely to live alone but not be lonely (ADL-disabled: b = −0.976, $p < 0.001$).

Compared to the reference category, the characteristics of older adults who were not living alone but were lonely were younger age, urban residence, currently not married, being illiterate, not having a white-collar occupation before retirement, poor family economic status, no individual activity participation, unavailability of community services, ADL disabled, IADL disabled, cognitive impairment, and poor self-rated health. Urban older adults had a higher likelihood (b = 0.094, $p = 0.045$), whereas currently married (b = −0.848, $p < 0.001$), educated for 1 – 6 years (b = −0.137, $p = 0.020$), white-collar occupation before retirement (b = −0.278, $p = 0.003$), and rich older adults (b = −0.426, $p < 0.001$) were less likely to not live alone but be lonely. Regarding enabling factors, individual activity participation (b = −0.192, $p = 0.001$) and the availability of community services (b = −0.105, $p = 0.022$) were related negatively to the typology of not living alone but feeling lonely. In terms of need factors, older adults in poorer health were more likely to not live alone but be lonely, whereas those with good SRH (b = −0.825, $p < 0.001$) were less likely (ADL disabled: b = 0.143, $p = 0.013$; IADL disabled: b = 0.302, $p < 0.001$; cognitively impaired: b = 0.130, $p = 0.025$, respectively).

The results for those living alone and feeling lonely and living alone but not feeling lonely were largely similar among urban and rural older adults. However, for urban older adults, those with a non-white-collar occupation before retirement and those with cognitive impairment

Table 1. Distribution of the sample of the study, CLHLS 2018

Type	Variables	Classification	Living alone and lonely	Living alone but not lonely	Not living alone but lonely	Neither living alone nor lonely	χ²
Predisposing factors	Age	1=65 – 79	309	356	762	3,527	403.927***
		2=80 – 89	401	451	710	2,067	
		3=90 – 99	282	310	730	1,902	
		4=100⁺	142	140	711	1,669	
	Residence	1=Urban	588	671	1,623	5,182	12.169**
		0=Rural	546	586	1,290	3,983	
	Sex	1=Men	414	456	1,098	4,307	134.724***
		0=Women	720	801	1,815	4,858	
	Marriage	1=Currently married	65	144	921	4,871	1.7e+03***
		0=Currently not married	1,069	1,113	1,992	4,294	
	Years of educational attainment	0=0	679	689	1,768	4,262	255.936***
		1=1 – 6	331	393	773	3,064	
		2=7⁺	124	175	372	1,839	
	Occupation before retirement	1=White collar	75	100	209	1,172	108.894***
		0=Non-white collar	1,059	1,157	2,704	7,993	
Enabling factors	Financial independence	1=Yes	285	397	832	3,684	208.934***
		0=No	849	860	2,081	5,481	
	Family economic status	1=Rich	115	223	373	2,033	192.339***
		0=Not rich	1,019	1,034	2,540	7,132	
	Family emotional support	1=Yes	991	1,097	2,259	5,917	554.084***
		0=No	143	160	654	3,248	
	Individual activity participation	1=Yes	754	952	1,866	7,082	232.751***
		0=No	380	305	1,047	2,083	
	Group activity participation	1=Yes	249	318	524	2,478	102.391***
		0=No	885	939	2,389	6,687	
	Community service	1=Yes	672	781	1,758	5,826	15.340**
		0=No	462	476	1,155	3,339	
Need factors	ADL disabled	1=Yes	187	167	1,109	2,301	383.180***
		0=No	947	1,090	1,804	6,864	
	IADL disabled	1=Yes	819	821	2,306	5,750	285.817***
		0=No	315	436	607	3,415	
	Cognitively impaired	1=Yes	413	390	1,409	3,017	244.260***
		0=No	721	867	1,504	6,148	
	Self-rated good health	1=Yes	344	726	874	4,743	603.412***
		0=No	790	531	2,039	4,422	
	Chronic disease	1=Yes	887	974	2,291	7,131	1.132
		0=No	247	283	622	2,034	

Notes: *p<0.05, **p<0.01, ***p<0.001. 100⁺ means older adults aged 100+. Specifically, 100+ means 100-105.
Abbreviations: ADL: Activities of daily living; IADL: Instrumental activities of daily living.

were more likely to not live alone but be lonely compared with the reference category. For rural older adults, those without individual activity participation and without community services and those with ADL disabilities were more likely to not live alone but be lonely compared with the reference category (Tables 3 and 4).

Table 2. Multinomial logistic regression analysis of the correlates of the typology based on living alone and loneliness for older adults in China

	Living alone and lonely	Living alone but not lonely	Not living alone but lonely
Age (80 – 89) (vs. 65 – 79)	−0.008 (0.099)	0.159+ (0.092)	−0.010 (0.069)
Age (90 – 99) (vs. 65 – 79)	−0.735*** (0.117)	−0.443*** (0.110)	−0.306*** (0.082)
Age (100+) (vs. 65 – 79)	−1.382*** (0.140)	−1.157*** (0.136)	−0.453*** (0.091)
Men (vs. women)	0.257** (0.079)	0.040 (0.074)	0.070 (0.052)
Urban (vs. rural)	0.007 (0.072)	−0.030 (0.068)	0.094* (0.047)
Currently married (vs. no)	−3.926*** (0.159)	−2.894*** (0.123)	−0.848*** (0.069)
1 – 6 years of education (vs. 0)	−0.157+ (0.088)	−0.068 (0.082)	−0.137* (0.059)
7+years of education (vs. 0)	−0.145 (0.141)	0.041 (0.123)	−0.057 (0.086)
White-collar occupation before retirement (vs. no)	0.033 (0.157)	−0.123 (0.136)	−0.278** (0.095)
Financially independent (vs. no)	0.010 (0.091)	0.127 (0.081)	−0.008 (0.058)
Rich family economic status (vs. no)	−0.736*** (0.110)	−0.357*** (0.086)	−0.426*** (0.065)
Family emotional support (vs. no)	−0.536*** (0.123)	−0.156 (0.118)	−0.016 (0.067)
Individual activity participation (vs. no)	−0.452*** (0.084)	−0.130 (0.084)	−0.192** (0.057)
Group activity participation (vs. no)	0.093 (0.090)	0.019 (0.080)	−0.070 (0.061)
Community service (vs. no)	−0.066 (0.070)	0.025 (0.066)	−0.105* (0.046)
ADL disabled (vs. no)	−0.950*** (0.099)	−0.976*** (0.100)	0.143* (0.058)
IADL disabled (vs. no)	0.014 (0.093)	−0.121 (0.084)	0.302*** (0.065)
Cognitively impaired (vs. no)	−0.056 (0.087)	−0.047 (0.083)	0.130* (0.058)
Self-rated good health (vs. no)	−0.938*** (0.074)	0.149* (0.066)	−0.825*** (0.048)
Chronic disease (vs. no)	−0.003 (0.084)	0.053 (0.078)	0.034 (0.055)
intercept	0.733*** (0.181)	−0.458* (0.177)	−0.327** (0.121)
Log-likelihood		−12,909.691	
N		14,469	
Pseudo R^2		0.129	

Notes: +$p < 0.1$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. Standard error in brackets.
Abbreviations: ADL: Activities of daily living; IADL: Instrumental activities of daily living.

Table 3. Multinomial logistic regression analysis of the correlates of the typology based on living alone and loneliness for urban older adults in China

	Living alone and lonely	Living alone but not lonely	Not living alone but lonely
Age (80 – 89) (vs. 65 – 79)	0.038 (0.137)	0.040 (0.125)	0.029 (0.092)
Age (90 – 99) (vs. 65 – 79)	−0.737*** (0.163)	−0.541*** (0.151)	−0.300** (0.110)
Age (100+) (vs. 65 – 79)	−1.516*** (0.200)	−1.303*** (0.188)	−0.446*** (0.124)
Men (vs. women)	0.307** (0.108)	0.134 (0.100)	0.035 (0.069)
Currently married (vs. no)	−4.063*** (0.224)	−2.939*** (0.166)	−0.773*** (0.092)
1 – 6 years of education (vs. 0)	−0.099 (0.121)	−0.114 (0.112)	−0.162* (0.079)
7+ years of education (vs. 0)	−0.116 (0.177)	−0.049 (0.156)	−0.025 (0.107)
White-collar occupation before retirement (vs. no)	0.032 (0.180)	−0.022 (0.154)	−0.324** (0.107)
Financially independent (vs. no)	−0.003 (0.115)	0.117 (0.104)	−0.013 (0.072)
Rich family economic status (vs. no)	−0.718*** (0.142)	−0.384** (0.112)	−0.363*** (0.082)
Family emotional support (vs. no)	−0.406* (0.170)	−0.143 (0.158)	−0.011 (0.088)
Individual activity participation (vs. no)	−0.453*** (0.123)	−0.225 (0.122)	−0.049 (0.080)
Group activity participation (vs. no)	0.112 (0.118)	0.089 (0.105)	−0.037 (0.078)
Community service (vs. no)	0.148 (0.100)	0.091 (0.092)	−0.015 (0.062)
ADL disabled (vs. no)	−0.975*** (0.136)	−1.106*** (0.137)	0.101 (0.078)
IADL disabled (vs. no)	−0.006 (0.127)	−0.101 (0.113)	0.352*** (0.086)
Cognitively impaired (vs. no)	0.000 (0.124)	−0.059 (0.119)	0.220** (0.079)
Self-rated good health (vs. no)	−0.966*** (0.103)	0.154 (0.091)	−0.936*** (0.065)
Chronic disease (vs. no)	−0.153 (0.120)	−0.030 (0.109)	−0.030 (0.077)
intercept	0.590* (0.255)	−0.331 (0.244)	−0.405* (0.164)
Log-likelihood		−7,008.503	
N		8,064	
Pseudo R^2		0.135	

Notes: +p<0.1, *p<0.05, **p<0.01, ***p<0.001. Standard error in brackets.
Abbreviations: ADL: Activities of daily living; IADL: Instrumental activities of daily living.

4. Discussion

To the best of our knowledge, this is the first study to examine the typology of living alone and loneliness using a nationally representative sample in China and examine the correlates of the typology according to Andersen's behavioral model, which facilitates the

Table 4. Multinomial logistic regression analysis of the correlates of the typology based on living alone and loneliness for rural older adults in China

	Living alone and lonely	Living alone but not lonely	Not living alone but lonely
Age (80 – 89) (vs. 65 – 79)	−0.063 (0.146)	0.314* (0.138)	−0.059 (0.106)
Age (90 – 99) (vs. 65 – 79)	−0.746*** (0.168)	−0.316+ (0.162)	−0.327** (0.123)
Age (100+) (vs. 65 – 79)	−1.271*** (0.198)	−0.975*** (0.198)	−0.469** (0.137)
Men (vs. women)	0.212+ (0.117)	−0.072 (0.112)	0.120 (0.079)
Currently married (vs. no)	−3.815*** (0.227)	−2.879*** (0.186)	−0.951*** (0.106)
1 – 6 years of education (vs. 0)	−0.223+ (0.130)	0.010 (0.121)	−0.107 (0.088)
7+ years of education (vs. 0)	−0.152 (0.244)	0.164 (0.213)	−0.191 (0.156)
White-collar occupation before retirement (vs. no)	0.064 (0.344)	−0.479 (0.335)	−0.151 (0.216)
Financially independent (vs. no)	0.060 (0.153)	0.214 (0.135)	−0.008 (0.100)
Rich family economic status (vs. no)	−0.767*** (0.175)	−0.317* (0.134)	−0.530*** (0.108)
Family emotional support (vs. no)	−0.692*** (0.180)	−0.175 (0.179)	−0.017 (0.106)
Individual activity participation (vs. no)	−0.452*** (0.116)	−0.030 (0.117)	−0.330*** (0.082)
Group activity participation (vs. no)	0.028 (0.139)	−0.098 (0.126)	−0.151 (0.098)
Community service (vs. no)	−0.297** (0.100)	−0.065 (0.096)	−0.229** (0.068)
ADL disabled (vs. no)	−0.892*** (0.147)	−0.793*** (0.147)	0.218* (0.087)
IADL disabled (vs. no)	0.046 (0.140)	−0.128 (0.127)	0.242* (0.100)
Cognitively impaired (vs. no)	−0.123 (0.123)	−0.052 (0.118)	0.034 (0.087)
Self-rated good health (vs. no)	−0.900*** 0.107	0.155 (0.097)	−0.681*** (0.072)
Chronic disease (vs. no)	0.160 (0.118)	0.155 (0.112)	0.106 (0.080)
intercept	0.897** (0.260)	−0.649* (0.261)	−0.147 (0.181)
Log-likelihood		−5,868.763	
N		6405	
Pseudo R^2		0.125	

Notes: +p<0.1, *p<0.05, **p<0.01, ***p<0.001. Standard error in brackets.
Abbreviations: ADL: Activities of daily living; IADL: Instrumental activities of daily living.

understanding of the social circumstances for older adults in each category.

Compared with the reference category of neither living alone nor feeling lonely, older adults who live alone and feel lonely display multiple vulnerabilities. Lack of economic and social resources, especially low family economic status, inadequate family support, and inadequate social participation increase the likelihood of loneliness for those living alone. This finding aligns with those of previous research showing that lack of emotional support (Pinquart & Sörensen, 2000) and social participation are significant predictors of loneliness. In terms of interventions, such individuals may come to the attention of service providers and benefit from the provision of long-term care, social support, and social activities. It might also be helpful to invite them to participate in community activities to establish a sense of value or provide life-review services for them to help them deal with loneliness (Teh & Tey, 2019).

Compared with the reference category, those living alone but not lonely demonstrate good ADL ability and SRH, which enable them to interact with others (Li *et al.*, 2022; Zhang *et al.*, 2023). Several potential reasons exist for this finding. First, older adults in good health are capable of taking care of themselves and choose to live alone; they might be motivated to interact with others and fulfill their social needs (Reher & Requena, 2018). Second, it is possible that individuals in this subgroup have a lower level of expectations for social relationships, and high quality of social contacts could align with their needs due to socioemotional selection (Carstensen, 1992; English & Carstensen, 2014). In terms of future interventions, individuals of this subgroup might not need specific social-contact opportunities or activities. Instead, services in case of emergencies, such as fall monitoring at night, should be made available to them. More importantly, older adults in this subgroup can be encouraged to participate in voluntary activities from the perspective of promoting positive aging.

Furthermore, compared with the reference category, those older adults who do not live alone but feel lonely are generally in poor health. They might live with family members and receive basic care from them but not necessarily emotional support, meaning that this subgroup's social needs are not met (Logan & Bian, 2003; Morelli *et al.*, 2015). People in this subgroup do not have enough resources to fulfill their needs, thus leading to loneliness. It is also possible that individuals in this group have conflictual intergenerational relationships (Long, 2021; Wu, 2022), or are experiencing a caregiving burden as caregivers to other family members (Cloutier-Fisher *et al.*, 2011). Without individual activity participation or community services, such people's loneliness is exacerbated (Zhu, 2021). In terms of interventions, there is a great need to reach this group of people, given that current caregiving services focus more on older adults who live alone. This group of older adults thus carries significant potential as clients for social workers. It would be especially helpful to investigate the circumstances of these subgroups and provide necessary resources to ensure quality health and rehabilitation services, improve family communication, or empower older adults as family caregivers.

Urban–rural differences exist in the correlates of the typology. Occupational background and cognitive impairment might influence the social connections of older adults living in urban areas, which increases their risk of loneliness, even for those not living alone. In contrast, among rural older adults, ADL disability and inadequate individual activity participation and community services can exacerbate loneliness, even though they may not live alone. Rural older adults typically have a lower level of individual activity participation compared with their urban counterparts; community old-age care services tend to be less developed in rural areas than in urban areas (Mi & Li, 2021). Thus, lack of individual activity participation and community services and ADL disability are important risk factors for loneliness for rural older adults who do not live alone, especially for those in poor health (Yang & Gu, 2020). Improving old-age care services in rural areas and providing more opportunities for social participation for rural older adults will be key to alleviating loneliness among this group.

This study has several implications for practice and research. First, the study establishes profiles of older adults, which can help ensure tailored social work services for those in each subgroup. For instance, older adults who do not live alone yet feel lonely are "invisible with a high risk of loneliness," and this group requires urgent attention. Second, enlightened by Andersen's behavioral model, this study extends the applications of the model and provides new evidence for the role of enabling and need factors in predicting loneliness and living alone. Third, future research should disentangle the trajectories of the four subgroups with time as well as clarify their linkage with health outcomes and old-age care needs using data from more waves of the CLHLS. Last, future research is needed to investigate the younger population with a high risk of loneliness because this population is characterized by increasing online socialization and decreasing face-to-face interactions.

Despite the contributions of this study, there are some limitations that should be noted. First, despite the fact that we use a single-item measure, studies have demonstrated the robustness and predictive validity of this measure (Luo & Waite, 2014; Yang & Gu, 2020). Nevertheless, future research is needed to verify the findings of this study using a loneliness scale. Second, due to the limitations of the dataset, this study did not examine the role of more sophisticated family-level factors in the typology profiles, such as relationship quality and family interactions. Third, this study did not examine whether and how the four subgroups will change with time and the reasons for transitions into and out of different groups. It would be beneficial if future research touches on this topic using more data.

5. Conclusion

Given the large sample size of the dataset and the analytical strategies employed, this study contributes to the literature by facilitating the understanding of the typology of living alone and loneliness as well as its relationship with correlates according to the Andersen behavioral model. We hope that this study catalyzes more novel analyses to disentangle the dynamics and correlates of the typology of living alone and loneliness with time. In addition, the differences between older adults living in urban and rural areas highlight the importance of recognizing the urban–rural divide in China; in particular, the differences in the correlates of the typology. These differences need to be considered to provide efficient and tailored policies and services and remain to be addressed in future research.

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Conflict of interest

Fang Yang is an Editorial Board Member of this journal but was not in any way involved in the editorial and peer-review process conducted for this paper, directly or indirectly. Separately, other authors declared that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

Author contributions

Conceptualization: Fang Yang
Formal analysis: Xiang Zhou, Huiguang Wang
Methodology: Fang Yang, Xiang Zhou
Writing – original draft: Fang Yang, Xiang Zhou
Writing – review & editing: Fang Yang

Ethics approval and consent to participate

Ethical approval of this study was obtained from the Institutional Review Board of Shanghai University (ECSHU: 2022-147). The data used in the current study is sourced from a publicly available database (Chinese Longitudinal Healthy Longevity Survey). This data was collected with the informed consent of the respondents.

Consent for publication

The respondents gave consent to use their data in scientific publications.

Availability of data

The datasets used in this study are openly available from the Open Research Data of Peking University at https://opendata.pku.edu.cn/dataverse/CHADS

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RESEARCH ARTICLE

Insights from a population grid of South Africa: An applied spatial satellite data analysis

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Abstract

The present study explores the reliability and accuracy of various spatial mapping methodologies in estimating and presenting the spatial characteristic and dynamics (location, distribution, density, and size) of the population in South Africa. As a basic underlying concept, the study first explores spatial heterogeneity, *that is*, that every location is related to every other location, and those nearby are related stronger. This study, therefore, illustrates the spatial relationships between locations and the spatial pattern of the population in South Africa. Analyzing the spatial images determines the extent of such influence and the nature of the spatial patterns. To this end, a granular gridded population dataset was derived using satellite image data, and the NASA's Socioeconomic Data and Applications Center gridded population of the world version 4 population images and datasets were used. Several spatial data models and geostatistical applications were applied to study the spatial characteristics and dynamics of the population of South Africa from 2000 to 2020. Spatial analysis was performed using R-Studio, QGIS, and GeoDa. Among others, the results point to the fact that the South African population is very densely located that population density decreases marginally outward and suggests that the underlying process for the population distribution is stationary. This study proposes that it is indeed possible to reliably and accurately estimate and present gridded population images and datasets using spatial and geostatistical methodologies.

Keywords: Population count; Socioeconomic data and applications center; Spatial data analysis; Spatial randomness; Geostatistical applications; Geographic information system

1. Introduction

Understanding a country's population's spatial characteristics and dynamics requires detailed knowledge and understanding of its spatial location, distribution, density, and size. Over the past 25 years, there has been a notable rise in the utilization of gridded population images and datasets in research, with the most significant increase occurring in the last decade (Bustos *et al*., 2020). Gridded population images and datasets can be helpful, for example, to identify and map populated and unpopulated places, *that is*, population distribution. It can further be used in estimation of population size and density in specific locations, as well as in modeling and projections.

Hachadoorian *et al.* (2011) argue that population data are inherently spatial due to human habitation of geographic areas. Population distribution refers to the spatial arrangement of population dispersal, clustering, and linear spread. Across most countries, significant regional variations exist in population distribution, leading to differing population densities worldwide.

Getis & Ord (1996) and Getis & Paelinck (2004) assert that conventional statistical theory relies on general models assuming independent observations. Hence, spatial independence remains a relevant reference point for detecting statistically significant non-independent phenomena. Spatial statistics, as a field, is founded on the premise of observation non-independence, assuming that neighboring units are somehow linked (Coetzee & Kleynhans, 2018).

Calka & Bielecka (2019) suggest that a comprehensive understanding of many earth surface phenomena and processes hinges on specific details regarding human activity locations and characteristics. Consequently, there is a growing emphasis on the challenge of obtaining reliable population distribution data. Dong *et al.* (2017) highlight the increasing use of gridded population distribution datasets, primarily due to their compatibility and ease of integration with other spatial datasets. Leyk *et al.* (2019) further observed that recent endeavors have resulted in the development of global and continental gridded population datasets, which are gaining popularity across various research communities.

This paper seeks to add to the discourse regarding the reliability and precision of utilizing gridded population images and datasets to estimate and illustrate the spatial attributes and changes in the population, focusing on South Africa. Regarding the structure of the study, the next section introduces the theoretical departure of population distribution and spatial analysis. This is followed by a brief introduction to gridded population statistics images and dataset, followed by the testing for spatial concentration, autocorrelation, and randomness, *that is*, spatial heterogeneity. Section 4.2 focuses on the trend surface analysis that uses the gridded population images and datasets. That indicates that higher-order trend surfaces are indeed better than lower-order trend surfaces, *that is*, the population distribution in South Africa is not linear. Based on the results obtained in the previous two sections, spatial interpolation was performed and the results are presented in section 4.3. The article culminates with a summary and conclusions.

1.1. Literature review

Population characteristics and dynamics encompass the patterns and trends of human distribution across the earth. Areas with sparse populations, marked by few inhabitants, are typically challenging to inhabit and are usually places with hostile environments, whereas densely populated areas are more habitable. The particular scattering of the population, agglomeration organization, and linear spread determine the spatial structure and pattern (Chandna, 2009).

Doignon *et al.* (2023) suggest that analyzing the spatial distribution of a population is an interdisciplinary exercise involving geography and demography. This analysis occurs on various scales, encompassing both global and local perspectives, given the pronouncedly uneven distribution of populations nationally and worldwide. These spatial disparities in population distribution constitute a crucial element in the functioning of societies, influencing their organization and future trajectory. While the spatial distribution of a population offers a snapshot of societies at a particular moment, it also reflects phenomena that characterize human temporal dynamics: the short-term lifespan of individuals and generations, population dynamics, and the long-term endurance of societies. Furthermore, population distribution is a consequence of populations adapting, to varying degrees, to environmental constraints such as accessibility of locations, available resources, and environmental quality, thereby demonstrating their ability to exploit these factors for settlement and habitation.

Physical factors, attraction, constraints, and cultural factors, in the main, account for the Earth's population characteristics and dynamics (Hornby & Jones, 1980). During economic development, social and political factors also play a role. Physical, social, demographic, economic, political, and historical factors do not operate in isolation; instead, they affect each other. Thus, pinpointing the influence of a single factor and deciphering the interplay between these factors is a complicated task (Clarke, 1972).

Several factors influence population characteristics and dynamics. These include the topography of the region—its soil, rivers, natural recourses, climate—whether it is landlocked or close to the sea, airports and harbors, and borders, as well as economic activity, culture, and religion. Related demographic factors include changes in natural population growth and migration (Brush, 1968, Hugo, 2002, Small, 2003; and Liu *et al.*, 2018). Adverse physical conditions and a lack of enough opportunities to earn a living also discourage people to live at particular locations. Nevertheless, climatic conditions are probably the most significant factor.

Duncan (1957) suggests several methods for analyzing and presenting the spatial characteristics and dynamics of the population. A very simplified method is the percentage distribution of the population over geographical areas. Evaluation of the censuses of these regions is relatively straightforward once they are listed in rank order. This proposes temporal population trend changes. Population characteristics and dynamics can also analyzed by focusing on the calculation of the median point, the mean point or the center of population, the point of minimum aggregate travel, and the point of maximum population potential.

Sang *et al.* (2024) emphasizes the importance of conducting frequent nationwide studies on population distribution, focusing on spatial and temporal changes at the county (sub-national) level. They highlight population density, spatial autocorrelation, the population-land Gini coefficient, and ARIMA modeling as standard methodologies for such studies. The derived results should include the distribution pattern of population size in the county, the divergence of population increase and decrease in counties, spatial autocorrelation analysis of county population change, types of population change in the county, and population count and spatial projections. These results are crucial for enabling policymakers to make predictions about national population trends and to understand the patterns of spatial and temporal distribution of county populations, providing valuable insights for future population change trends.

An alternative approach to delineate spatial characteristics and dynamics is to examine the positioning of individual entities in space (Borregaard *et al*., 2009). When observed from above, the population's distribution can be visualized as a pattern of small dots scattered across a blank surface. This pattern of distribution can theoretically be entirely random. However, individuals can also be clustered together or, conversely, evenly dispersed. This study primarily concentrates on measuring the spacing between population units.

In broad terms, a spatial pattern can be viewed as the perceptual structure, positioning, or organization of objects on Earth, encompassing the spaces between them. Patterns are discernible based on how objects are arranged, such as in a line or clustered together. The distribution of individuals within a population can be classified into three basic patterns: uniform dispersion, where individuals are evenly spaced; random dispersion, lacking a discernible pattern; and clumped or clustered dispersion (Getis & Paelinck, 2004). These patterns are visually represented in Figure 1.

Within the context of spatial science, statistical analysis of patterns and underlying processes attempts to explain how population patterns and other human activity came about (Anselin & O'Loughlin, 1992). It is an exploratory process that attempts to quantify the observed patterns and their origins. Modern spatial analysis is generally performed using a geographic information system (GIS). It becomes even more powerful when a GIS system combines standard quantitative and statistical techniques using computer software such as R-studio and GeoDa.

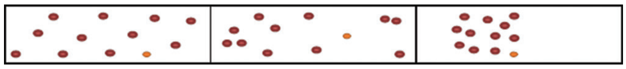

Figure 1. Types of spatial distributions: uniform (left), random (middle), and clustered (right). Source: Authors' construction based on Getis & Paelinck (2004).

Taking the above into account, the present study is fundamentally rooted in the spatial pattern analysis methodologies outlined by Scott (2015), Griffith & Chun (2017), Bailey & Gatrell (2019), and Anselin (2019). Spatial pattern analysis is a methodology utilized to investigate the distribution of objects or phenomena across space. Within the realm of population studies, spatial pattern analysis is used to examine the distribution of population across a geographical area and to discern spatial trends and patterns. To this end, Zhao *et al.* (2022), for example, found that the spatial distribution of the population urbanization level was uneven in upper reaches of the Yellow River Basin, China, from 2000 to 2018, that is, high in the north and low in the south, with substantial spatial agglomeration and spatial autocorrelation.

2. Data and methods

2.1. Gridded population statistics

Statistical gridded images and datasets are statistical data that are geographically referenced to a system of grid cells, typically square in shape, within a grid network using Cartesian coordinates (Eurostat, 2024). In contrast to traditional reporting methods that rely on a hierarchical system of administrative units from local to national levels, which are often used for official or governmental statistics, grid-based systems offer advantages for studying many socioeconomic and environmental phenomena. While the hierarchical system is suitable for accounting and reporting to the governing authority, it may not be optimal for analyzing the causes and effects of such phenomena. The advantages on offer include the following:

- Grid cells all have the same size allowing for easy comparison;
- Grids are stable over time;
- Grids integrate easily with other scientific data;
- Grid systems can be constructed hierarchically in terms of cell size, therefore matching the study area; and
- Grid cells can be assembled to form areas, for example, mountain regions and water catchments, reflecting a specific purpose and study area.

Eurostat (2024) also contends that generating grid statistics typically necessitates georeferenced point images and datasets with a prominent level of spatial precision. This involves, for instance, geocoding building, business, and address registers with geographic coordinates, enabling statistical information to be associated with specific locations. These point-based datasets can subsequently be aggregated to various areas as needed, including square grid cells.

One such gridded population dataset is the gridded population of the world (GPW), which is produced by the Socioeconomic Data and Applications Centre (SEDAC) (about SEDAC, see https://sedac.ciesin.columbia.edu/about). SEDAC operates as a data center within the NASA's Earth Observing System Data and Information System. SEDAC gathers data based on light and infrared emissions from Earth, captured by satellites initially launched by the United States Department of Defence. The GPW is a minimally modeled collection of gridded population data. In order to facilitate data integration, the GPW aims to provide estimates of population counts in raster format that are consistent with national censuses and population registers.

The GPW (version 4) provides population distribution surfaces in both population counts (individuals per pixel) and population density (individuals per square kilometer) for the years 2000, 2005, 2010, 2015, and 2020 (Bustos *et al*., 2020). These surfaces have a spatial resolution of 30 arc s (approximately 1 km at the equator); however, aggregated datasets are also accessible at resolutions of 2.5 arc min, 15 arc min, 30 arc min, and one degree for expedited processing. The GPW population surfaces are created using areal weighting.

The SEDAC GPW for South Africa can be displayed through various GIS. The grid covers 86,948 spatial and/or point locations for 2000, 2005, 2010, 2015, and 2020. The population estimates (estimated number of people) for each location (30 arc seconds) for 2000 and 2020 are displayed in Figure 2. The distribution of the South African population appears to be uneven, with a concentration of people living in a limited number of locations, resulting in high spatial density in these areas and low spatial density in many others. This represents the geographic concentration of South Africa's population.

3. Key findings

3.1. Spatial concentration, autocorrelation, and randomness

The hoover index (HI), introduced by Edgar Hoover in 1941, assesses the evenness or unevenness of population distribution among U.S. states (Long & Nucci, 1997). Hoover's concept posited that population distribution was even if a state comprising 10% of the nation's land area also contained 10% of the nation's population (Hoover, 1941). The index would reach zero if each area had an equal share of the nation's population and land, and it would approach a hundred if everyone resided in a single locality. Based on the GPW population grids for South Africa, as displayed in Figure 2, the HI was estimated at 90.4 in 2000 and 90.6 in 2020. This gives a statistical number to the GPW population grids, confirming the view of a significant and increasing population concentration in South Africa. The HI for South Africa for 2000 and 2020 is visually presented in Figure 3, which showcases the evident concentration of the population.

To identify the clusters of population concentration, as proposed in Figures 2 and 3, the global spatial autocorrelation (Moran I) can be used. The Moran I statistic is a correlation coefficient that calculates the universal spatial autocorrelation of a data set, *that is*, the statistic measures the similarity of one object to others surrounding it (Coetzee & Kleynhans 2018). The Moran I statistics indicate values of 0.67 in 2000 and 0.68 in 2020, displayed in the first column of Figure 4. The absence of specified z-values for the two periods implies a strong acceptance of the alternative hypothesis of spatial clustering. The second column in the same figure, representing the cluster map, illustrates that high-concentration population clusters (depicted in red as high-high clusters) are sparse and widely dispersed. In contrast, low-concentration population clusters (depicted in blue as low-low clusters) encompass the majority of the South African landscape, accounting for 78% in 2000 and 79% in 2020. The results, depicted in the third column as a significance map, indicate that the locations with significant clusters (shown in green) have remained largely unchanged over the two periods, suggesting minor change in high/low population concentration clusters.

To further support the aforementioned findings, it is essential to evaluate the complete spatial randomness (CSR) of the South African population's spatial distribution. Complete randomness suggests that the observations are scattered indiscriminately over the region. In no area would it then be possible to predict whether there would be more observations than in others. The chance to find some observation should also be independent and not be caused or altered by the presence of others (Dixon, 2018). A scatter plot can be assessed to determine whether any pattern exists among the observation data to determine the CSR. When there is normal restraint or rivalry between the points, resulting patterns are regular, but if gravitation or transmission occurs between them, clustering of observations is possible (Kyriakidis, 2009). Clustering

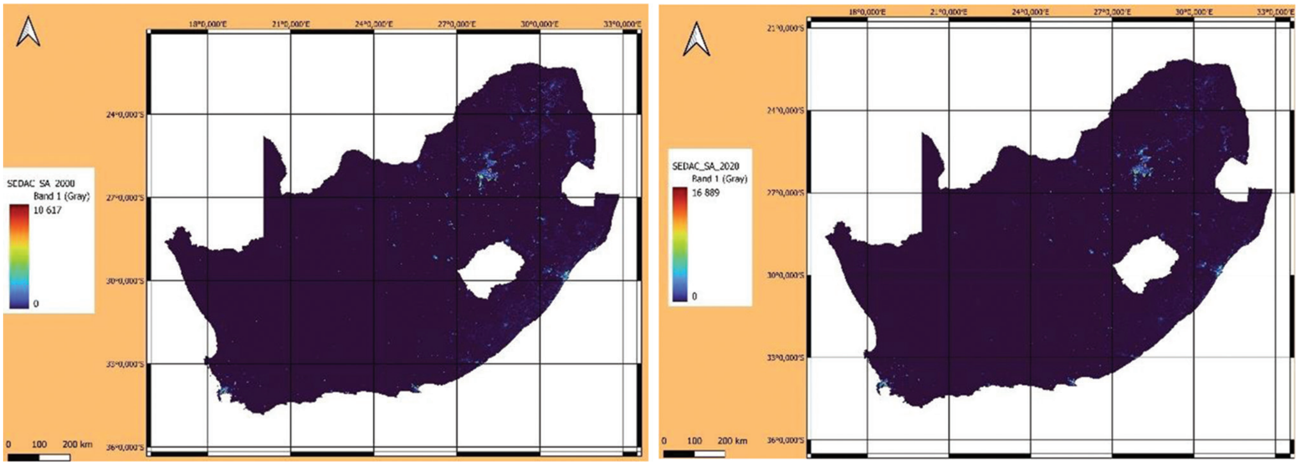

Figure 2. GPW population grid in 2000 (left) and 2020 (right). Source: Authors' QGIS analysis based on data from SEDAC (2024). Abbreviations: GPW: Gridded population of the world; SEDAC: Socioeconomic Data and Applications Center.

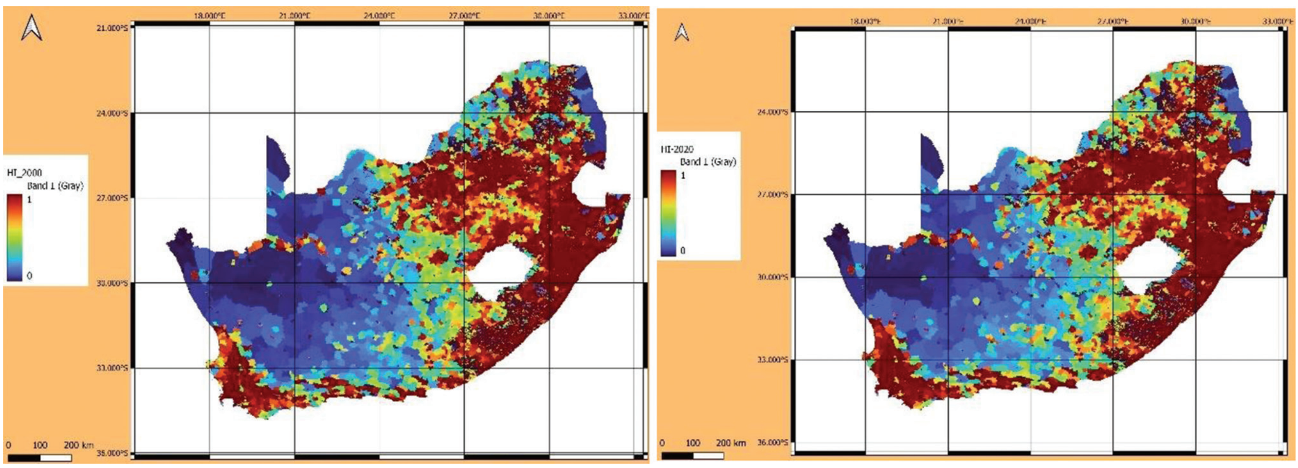

Figure 3. GPW Hoover Index in 2000 (left) and 2020 (right). Source: Authors' QGIS analysis based on data from SEDAC (2024). Abbreviations: GPW: Gridded population of the world; SEDAC: Socioeconomic Data and Applications Center.

occurs when points are grouped. This happens when points "attract" each other. In the case where points are dispersed, *that is*, points are farther apart than expected, points repel each other.

The K-function was used to test for CSR. The test analyses and presents the occurrence or layout of point patterns over a given area of interest or surface. The function enables the ability to explore whether the variable of interest (*e.g.*, population) follows a dispersed, clustered, or randomly distributed pattern throughout the study area or surface. In general, this function is computed at different distances, illustrating how point pattern distributions can vary with scale. For instance, points may cluster closely together at shorter distances, while they may be more dispersed at greater distances (Kyriakidis, 2009).

As illustrated in Figure 5, the plots (left = 2000 and right = 2020) show that the K-obs (black line) are considerably higher than the envelope of simulated K values (K-theo) in all but the shortest distances, suggesting significant clustering and deviations from CSR, *that is*, significant spatial clustering of the population of South Africa in 2000 and 2020.

3.2. Trend surface analysis

Spatial-temporal change analysis is necessary, given the findings related to the autocorrelation of the GPW. This investigation is known as trend surface analysis or mapping and it intends to represent, map, and summarize the surface in question. The fundamental model breaks down the data into components associated with regional trends within the data and components associated with purely local influences. Using normal regression analysis to find the optimal estimation that adheres to predetermined specifications, the observations can be separated into the two derived components. The trend surface analysis then

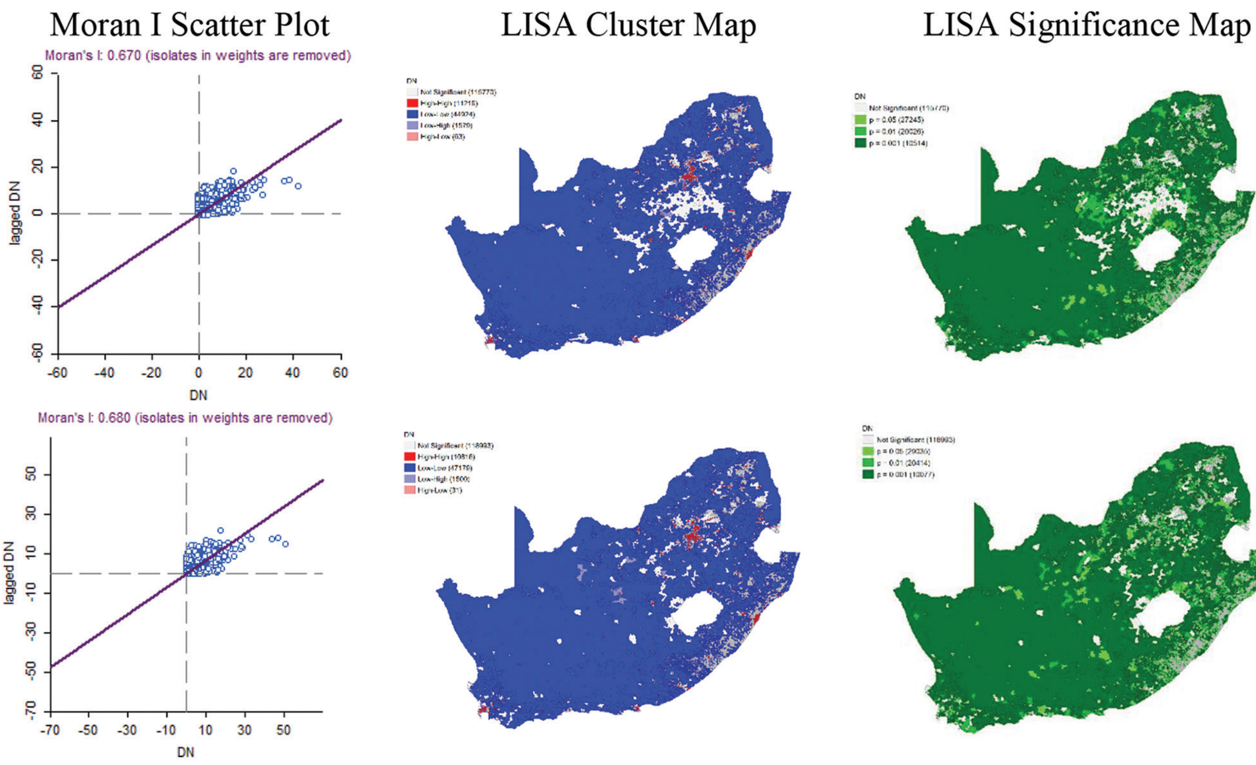

Figure 4. GPW Moran I, cluster and significance maps in 2000 and 2022. Source: Authors' GeoDA analysis based on data from SEDAC (2024). Abbreviations: GPW: Gridded population of the world; SEDAC: Socioeconomic Data and Applications Center.

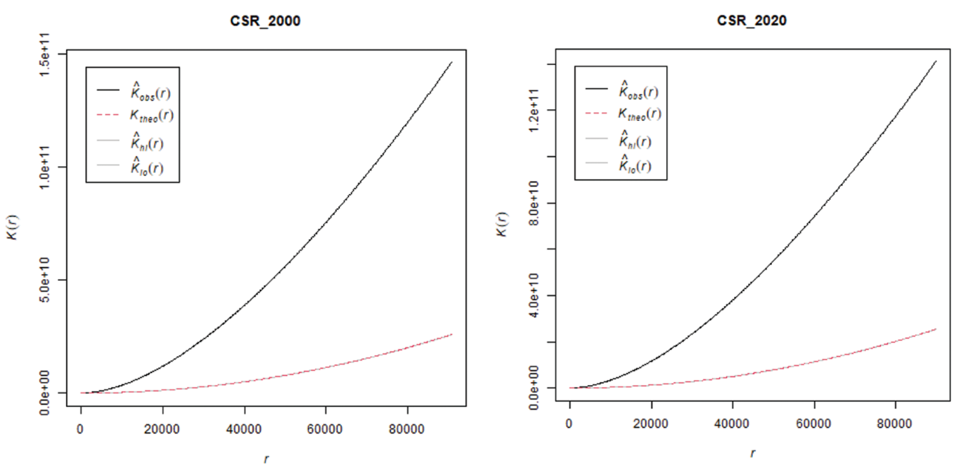

Figure 5. GPW K-function in 2000 (left) and 2020 (right). Source: Authors' R-Studio analysis based on data from SEDAC (2024). Abbreviations: GPW: Gridded population of the world; SEDAC: Socioeconomic Data and Applications Center.

predicts estimates related to regional effects. Any other deviations are then attributed to local influences (Unwin, 1978). According to Grohmann (2005), the residuals map is crucial in trend-surface analysis because it can highlight and emphasize features of interest.

Mapping these values requires their coordinates; firstly, the length and depth (x and y) as well as the height higher than a specific level (z). This z level can be taken according to a chosen spatial distribution (Hembd & Infanger, 1981). The longitude for South Africa (x) is higher above than zero but the latitude (y) is negative (Coetzee & Kleynhans, 2021). The z is assigned to the total population per point.

When a trend component changes gradually over the map, the relative z heights of all distinct locations are denoted according to their coordinates as:

$$\text{Z-obs}_i = f(x_i, y_i) + \mu_i \tag{I}$$

Given the particular value of the i-th mark (x_i) of observation Z-obs$_i$ with coordinates x_i and y_i, that is, term components (x_i, y_i), with residual μ_i. Each point (x_i, y_i) is unique in the sense that only one z value corresponds to it, and the samples to be analyzed consist of (x, y, z) triplets—one triplet for each observation, one for each year of the study period. Using Equation I, the trend component of any location on the map can be determined.

The slanted flat plane surface (first order) equals $z = a + bx + cy$ (Equation II) while the parabolic or geodesic dome (second order) is given as $z = a + bx + cy + dx^2 + ey^2 + fxy$ (Equation III), depending on the highest degrees of x and y (Hota, 2014). In general, first-order effects suggest that the structure of the underlying area influences the location of the point. When some points do, however, guide the location of others, second- and higher-order effects are possible.

To select the correct equation for the trend, the smallest variance should be determined by minimizing the squared deviation. When the equations optimize the minimum square value simultaneously, trend surface expression can be derived.

Appendix A1 gives the results of the total population per point's first-order trend surface, *that is*, Equation II, in logarithmic format, which was obtained using the 2000 and 2020 GPW grid for South Africa.

The first-order trend surface model generates population predictions for each point based on a smooth surface that can be compared to the actual population for each location. The residuals (actual minus predicted population) for 2000 and 2020 are displayed below (Figure 6A and 6B). Locations, with positive residuals (under-predictions of the population) are shown in green and locations with negative residuals (over-predictions of the population) in red. The location and clustering of an under-representative population point are evident for both periods. The presence of large residuals that tend to be near to each other, and *vice versa*, suggests a higher-order trend.

To test the hypothesis that improved results could be achieved, we applied the second-order equation (Equation III) to the dome surface population per point in logarithmic format. The results are presented in Appendix A2. Similar as per the first-order trend surface model, locations with positive residuals (under-predictions of the population) are shown in green and locations with negative residuals (over-predictions of the population) in red (Figure 6C and D).

The location and clustering of over and under-representative population point are evident for both periods.

The computed Akaike information criterion (AIC) scores for the first and second order models are displayed in Appendix A3. The results for the selected years suggest that the results of the second-order trend surface are superior to the first-order results.

Third- and higher-degree polynomial plots can represent surfaces with a maximum number of extrema possible in each case being $(n\text{-}f)^2$, where n is the polynomial degree. The regression results of the third order trend surface model over the period, in logarithmic format, can be obtained using the Equation IV:

$$z = a + bx + cy + d(x^2) + e(y^2) + f(yx) + g(x^2y) + h(xy^2) + i(x^3) + j(y^3) \tag{IV}$$

The AIC and residual results for the third-order trend surface compared to the second-order one are illustrated in Appendix A4. The results for the selected years suggest the third-order trend surface is superior to the second-order one.

One can test the significance of the trend surface by examining whether the distribution of "z" values is random and independent of "x" and "y." Stated differently, the "z" values should not be a function of "x and y." The F-test is employed to evaluate the null hypothesis (H0) that the coefficients in the trend surface expression are all zero, indicating no trend. Conversely, the alternative hypothesis (H1) suggests that at least some of the coefficients in the trend surface equation are not zero and should be accepted. Given the significance of the parameters, it can be concluded that the trend surface analysis proposes that a non-random spatial pattern of the population exists. The population distribution is non-linear, that is, a higher-order distribution.

3.3. Spatial interpolation

The Kriging method was applied in this section to examine the spatial interpolation of the GPW for South Africa. Kriging method involves using known population values at certain points to estimate values at unknown points, building on the results of the trend surface analysis that utilizes higher-order surfaces. The method calculates weights for linear and non-linear observed samples based on correlations, which are then used to estimate values for unobserved regions. By considering the distances between neighboring observations, Kriging calculates a locally weighted average to estimate values at new points. Two spatial domains are needed, one having values associated with the points and one for which estimates are needed. As the average weights of unknown regions are estimated

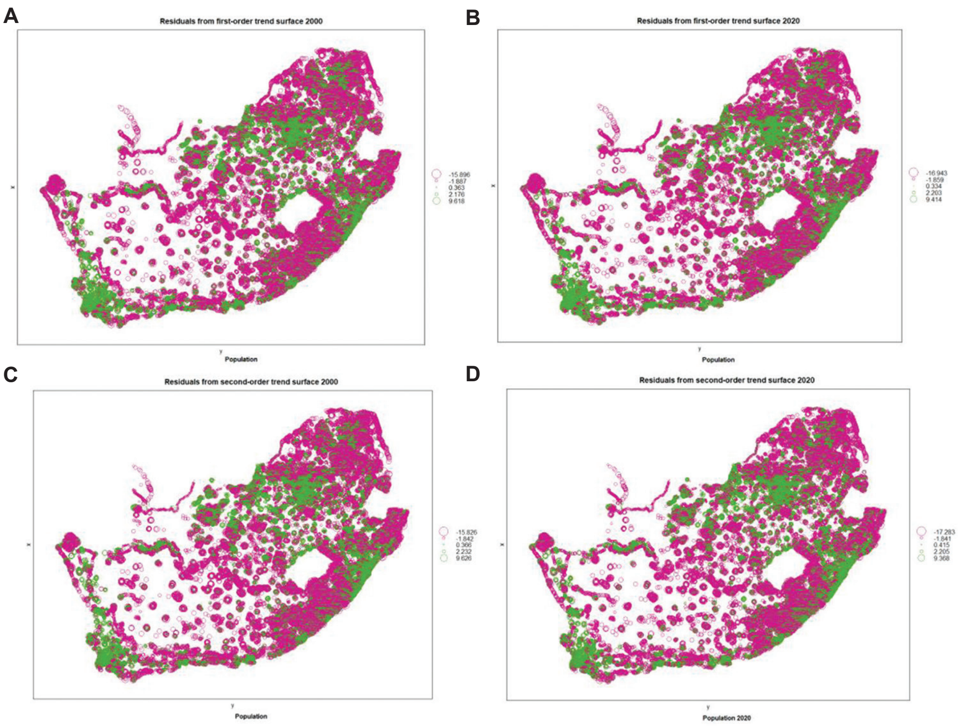

Figure 6. GPW first- (A and B) and second- (C and D) order trend surface function in 2000 and 2020. Source: Authors' estimates using R-studio (left) and QGIS (right).

using the structure through space, dictated by variograms, Kriging method is assumed superior.

The ordinary Kriging method, in general, incorporates these steps:

- Removing any spatial trend in the underlying data, if present.
- Estimating the experimental variogram, γ, *that is*, calculating the degree of spatial autocorrelation.
- Stating the experimental variogram model that optimally characterizes the spatial autocorrelation in the underlying data.
- Interpolating the surface by using the experimental variogram.
- Producing the final output by adding the kriged interpolated surface to the trend interpolated surface.

When plotting the above steps and constructing the interpolated surface can be done using the statistical conditions of "free of bias" and "minimum spread or variance" (Hutchinson & Gessler, 1994), the twin version can express the universal kriging interpolation function as:

$$F(r) = T(r) + \sum_{j=1}^{N} \lambda j C(r - rj) \qquad \text{(V)}$$

Where T(r) is the non-random drift component representing a combination of low-order monomials in linear form. By solving a combination of simulations linear equations, the monomials and (λj) coefficients can be estimated (Hutchinson & Gessler, 1994).

The results of the Kriging interpolation (in logarithmic format) for 2000 employing the Natural Neighbor Interpolation (Appendix A5 panel A) and average Gaussian, Exponential and Spherical Interpolation (Appendix A5, panel B) suggest a further concentration and geographical expansion of the population in and around the existing major population centers, among others.

The population interpolation (based on the 2000 GPW and logarithmic format) can be assessed for accuracy and reliability in terms of the 2020 GPW (in logarithmic format) for South Africa. A visual comparison of the 2000 GPW-based interpolation and 2020 GPW for South Africa revealed significant similarity between the predicted (Appendix A5, panel C) and actual population grids (Appendix A5, panel D), in terms of population location, distribution, density and size.

The heatmaps (Appendix A5, panels E and F), based on the raster images displayed in panels C and D of Appendix A5, further support the similarity inference between the predicted (Appendix A5, panel C) and actual (Appendix A5, panel D) population grids. It, however, appears that the predicted grid (as derived from the 2000 GPW interpolation, Appendix A5, panel E) has a greater degree of spatial distribution than the actual, as derived from the 2020 GPW (Appendix A5, panel F) for South Africa.

Statistically, the degree of similarity between the predicted and actual population grids can be estimated using the spatial correlation function. This is displayed in panels G and H of Appendix A5. The spatial correlation function is estimated at 0.83, suggesting a strong degree of similarity between the predicted and actual population grids. Equivalent results were obtained using Gaussian, Exponential, and Spherical interpolations.

Based on the presented results (Appendix A5, panels A-H), it can be concluded that the prediction of population location, distribution, density, and size using GPW images is highly accurate and dependable when employing various interpolation techniques. As such, it is possible to predict or develop a GPW for South Africa post-2020 (Appendix A5, panel J) based on the actual 2020 GPW for South Africa (Appendix A5, panel I). The derived results yield confidence in the post-2020 GPW for South Africa, proposing a further concentration and density of the South African population in the future in and around the existing population centers. The presence and expansion of population corridors linking the main population centers in South Africa also seem evident.

4. Concluding remarks

The present study explores the reliability and accuracy of various spatial mapping methodologies in estimating and presenting the spatial characteristic and dynamics (location, distribution, density, and size) of the population in South Africa. This is of relevance, given the importance of accurate population mapping and modeling. The study utilizes geographical information systems and global positioning systems, revolutionizing the landscape of methodologies typically adopted in this type of study and reshaping the modeling of human population distribution in both space and time. This study applied several spatial data models and geostatistical applications to study the spatial characteristics or dynamics of the population distribution of the country between 2000 and 2020.

This article illustrates how spatial relationships can be used to investigate demographic relations and estimate population characteristics and dynamics, by applying explanatory spatial data analysis and deriving a granular gridded population dataset. The present work also studied how regions close to each other can influence each other's population characteristics, by using the SEDAC's GPW version 4 images and the SEDAC's GPW version 4 dataset.

A series of spatial concentration, autocorrelation, and randomness analyses indicated that the South African population is undergoing a significant and increasing population concentration. The derived HI was estimated at 90.4 in 2000 and 90.6 in 2020, while the Moran I statistics show a value of 0.67 and 0.68 in 2000 and 2020, respectively. The results further suggest a significant clustering and deviation from CSR, *that is*, significant spatial clustering of the population of South Africa in 2000 and 2020.

The trend surface analysis revealed that the higher-order trend surfaces are more optimal than the lower-order trend surfaces, for the time periods under analysis. The higher-order trend surfaces suggest that the population distribution is influenced by local fluctuations and not regional dynamics and point to an apparent spatial pattern. This reflects that South African has a very dense population, with the population density decreasing marginally outwards, suggesting that the underlying process for the population distribution is stationary.

The interpolation analysis suggests a prominent level of accuracy and reliability in predicting population location, distribution, density, and size using GPW images with a range of interpolation techniques. As such, it is possible to predict or develop a GPW for South Africa post-2020 based on the actual 2020 GPW for South Africa. The derived results yield confidence in the post-2020 GPW for South Africa, proposing a further concentration and density of the South African population in the future in and around the existing population centers. The presence and expansion of population corridors linking the main population centers in South Africa also seem evident.

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Conflict of interest

The authors declare that they have no competing interests.

Author contributions

Conceptualization: Clive Egbert Coetzee
Formal analysis: All authors
Methodology: Clive Egbert Coetzee
Investigation: All authors

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Ethics approval and consent to participate

No human subjects were involved in this research. The authors declare that all ethical practices have been followed concerning the development, writing, and publication of this article. The ethical research approval for this work was granted by the Economic and Management Sciences Research Ethics Committee (EMS-REC), North-West University, South Africa (approval no.: NWU-00911-20-A4).

Consent for publication

Not applicable.

Availability of data

The data utilized in this article are freely available from the Internet and the references listed in this article.

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Appendices

Appendix A1. First-order trend surface of the population (in logarithmic format)

Logarithmic	2000	2020
a	−7.036***	−5.246***
x	0.253***	0.219***
y	−0.079***	−0.053***
Adj R^2	0.059	0.045
F-stat	2833***	2104***

Notes: *p<0.05; **p<0.01; ***p<0.005. Source: Authors' estimates using R-studio.

Appendix A2. Second-order trend surface of the population (in logarithmic format)

Logarithmic	2000	2020
A	−49.95***	−64.341***
X	2.072***	2.493***
Y	−1.334***	−1.997***
(x^2)	−0.014***	−0.016***
(y^2)	−0.004*	−0.011***
(y * x)	0.036***	0.048***
Adj R^2	0.067	0.056
F-stat	1291***	1056***

Notes: *p<0.05; **p<0.01; ***p<0.005. Source: Authors' analysis using EViews.

Appendix A3. Akaike information criterion test for the selected years, first and second order

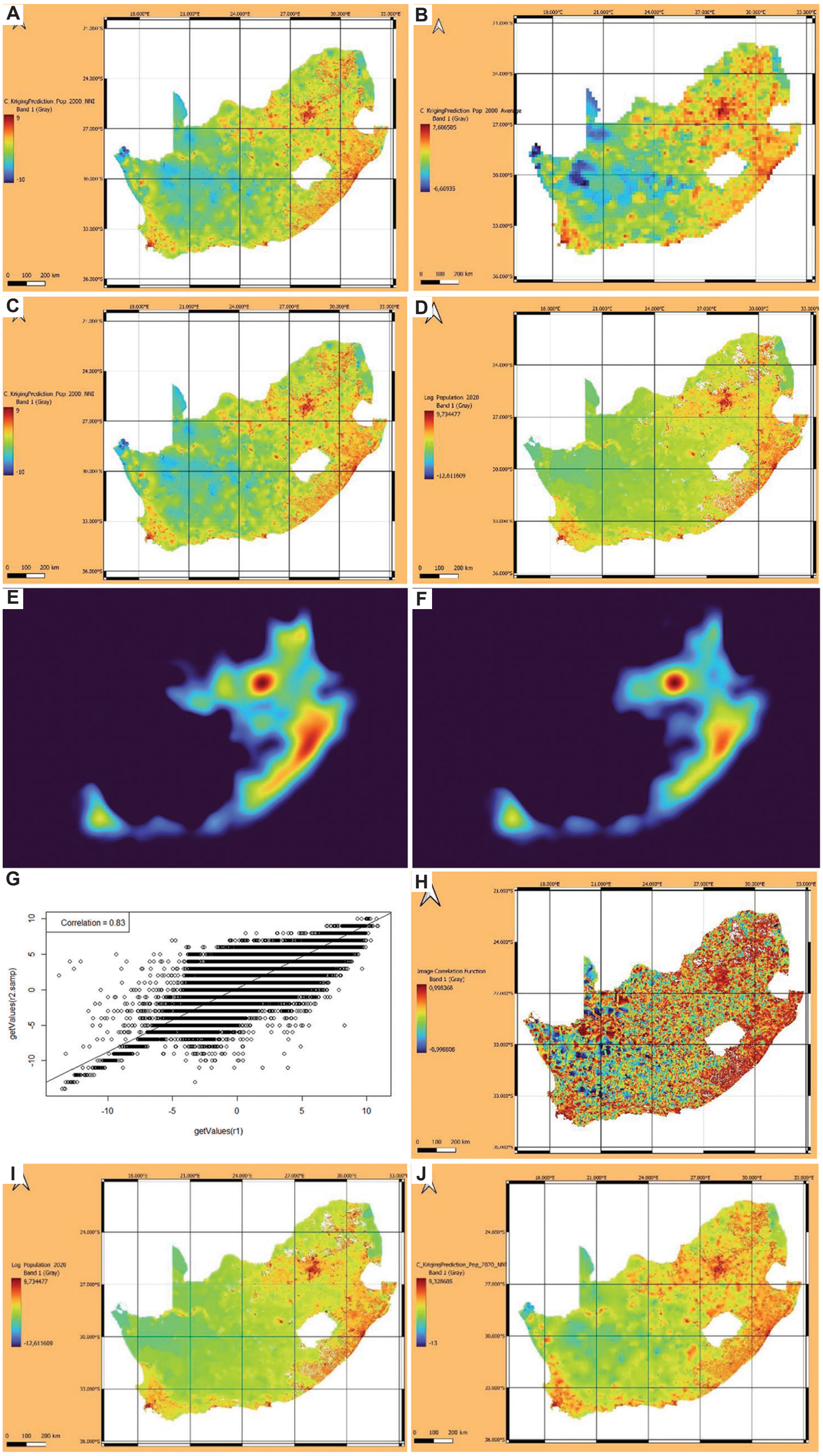
AIC	2000	2020
First order	455,639	455,265
Second order	454,905	454,253

Source: Authors' analysis using R-studio.

Appendix A4. Akaike information criterion test for the selected years, second and third order

AIC	2000	2020
Second order	454,905	454,253
Third order	449,574	448,279

Source: Authors' analysis using R-studio.



Appendix A5. (A-J) Spatial interpolation. Source: Authors' analysis using R in QGIS based on data from SEDAC (2024).

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RESEARCH ARTICLE

Geographic distribution of single motherhood in Nigeria: 2003 – 2018

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Abstract

The prevalence of single motherhood, associated with adverse maternal and child health outcomes, is now increasing rapidly across Nigerian states. The distribution of single mothers could vary widely across geographical settings in highly heterogeneous Nigerian states with diverse sociocultural, religious, and ethnic beliefs, which are some of the drivers of parenting styles. Using cross-sectional data from four waves of the Nigeria Demographic Health Survey, we analyzed the spatiotemporal patterns of single motherhood across Nigerian states. Within a Bayesian context, we considered a binomial likelihood for the single motherhood variable and included the categorical variables as linear effects. The metrical covariate, the age of the women, was modeled assuming a second-order random walk prior, while the state random effect was modeled using a Gaussian intrinsic conditional autoregressive prior. The findings indicate strong spatial clustering that shows a North-South divide over time, with high chances of single motherhood recorded in most southern states. These spatial distributions persisted after accounting for the observed covariates, indicating that the clustering serves as a proxy for other indicators that exert an unmatched influence on the prevalence of single motherhood across geographic settings. We found that Christian women are more prone to single motherhood compared with Muslim women. Similarly, educational attainment, household wealth index, urban residency, and ethnicity are predictors of single motherhood in Nigeria. Interventions to ease the burden of single motherhood in Nigeria could be more impactful if states in the southern fringe are given priority.

Keywords: Nigeria; Single motherhood; Spatial analysis; Bayesian inference

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1. Introduction

The family is the foundation on which every society is built, and the way it is structured has a significant impact on the behavior of people at the individual and communal levels. The growth and well-being of family members can be greatly impacted by family dynamics. Numerous sources bolster the argument that the effects of industrialization, urbanization, and modernization have transformed the family unit (Alaba *et al.*, 2015). Alternative family structures, including single-parent households, cohabitation, and homosexual couples, have proliferated in recent years. According to Karney *et al.* (2005), single-parent families are becoming more common and acknowledged as a type of family in many societies.

A single-parent household is a type of family setting in which the father or mother is solely responsible for the children, especially for their physical, social, and economic well-being. Recently, there has been a shift in family patterns and an increase in single-parent households worldwide, most of which are headed by women (Adewoyin *et al.*, 2020. The demographics of single parents vary on a case-by-case basis. Some single parents may have been in relationships that eventually terminated in divorce, separation, or the demise of a partner. Others may have been single parents from the beginning and may have had children through assisted reproduction, adoption, brief or casual sexual encounters, or other arrangements that entrust children into their care (Bernardi *et al.*, 2018; Hinton-Smith, 2016). Globally, single parenthood, which is an emerging trend, has been linked to negative results for the health of mothers and children (Adewoyin *et al.*, 2020).

Single mothers include those who are widowed, divorced, or separated or those who opted to adopt children while single. However, the concept of single motherhood has expanded to encompass women who support and care for their families singlehandedly due to issues related to their husbands' health, alcoholism, and other factors (Evans, 2011). Compared with single fathers, single mothers now make up three-quarters of all single-parent households, reflecting a sharp rise in the incidence of single parenting (Karunanayake *et al.*, 2021). Lancker *et al.* (2015) opined that single mothers are considered to be among the most vulnerable social groups. Risk factors such as financial instability, social isolation, lack of access to high-quality healthcare and childcare, or unfavorable housing and health circumstances are linked to the increasing prevalence of single motherhood (Duriancik & Courtney, 2019; Nieuwenhuis, 2020). The financial instability of single mothers is associated with low-income employment, a high percentage of greater reliance of self-employment, low educational attainment, insufficient skills, and advanced age (Zakaria, 2019). In addition, Fuji *et al.* (2024) corroborated that financial difficulties are more pronounced in single-mother families, which impacts the child's education, health, and self-esteem negatively in the short and long terms. According to London (2000), single parents find it difficult to manage the stress and frustration arising from having to fulfill numerous obligations while ensuring that their children are not negatively impacted by this stress. Due to the absence of a supportive partner who might share household duties, single mothers have less time to spend with their children because the majority cannot balance their family and career responsibilities; this can result in children experiencing emotional distress, social problems, and school dropout (Charon & Vigilant, 2002).

Due to financial constraints, unemployment, and social marginalization, single mothers occupy an unfavorable social position and experience ongoing stress, which has a detrimental impact on their health. Mackenzie (2023) affirmed that single mothers are stigmatized and subjected to discrimination in the media, political discourse, and the society at large. Notably, being a single mother can also be a choice for those who seek freedom and independence. Single mothers might use negative coping mechanisms, such as drug and alcohol abuse, cigarette smoking, and overuse of antidepressant medication, to mitigate stress. These coping mechanisms are detrimental to their mental and physical well-being.

The most populous nation in Africa, Nigeria is aptly dubbed the "Giant of Africa." However, a large population also poses certain challenges. Nigeria has one of the highest rates of single motherhood worldwide; moreover, the country has different ethnic groups and variations in single motherhood prevalence patterns and sociodemographic correlates (Adewoyin *et al.*, 2020). Despite deeply rooted cultural bias toward recognizing single parents, approximately 11% of Nigerian homes are headed by single parents; this value in the United States is about 16% (Owolabi, 2023). The distribution of single mothers shows huge geographic variations in Nigeria, ranging from about 2.9% in the North-West geopolitical zone to 20.3% in the South-South (Adewoyin *et al.*, 2020). In Nigeria, cultural stereotypes and religious beliefs serve as social barriers for single mothers (Essien & Bassey, 2012). Single mothers are frequently viewed as promiscuous in both social and religious contexts. Melah *et al.* (2003) opined that the society, especially in a patriarchal system such as that in Nigeria, sees a single mother as an arrogant, quarrelsome, or promiscuous person who was ejected by her spouse. This view is not limited to Nigeria. Single mothers are frequently denigrated in the society as morally bankrupt individuals who are unworthy of respect. Numerous studies have highlighted the demographic, sociocultural, and economic characteristics of individuals that influence the likelihood of single motherhood in different societies (Adewoyin *et al.*, 2020; Shamir & Shamir Balderman, 2024).

A few studies have considered the determinants of single motherhood in Nigeria and identified some of the factors listed above (Adewoyin *et al.*, 2020). Nonetheless, analysis that explores spatial variations can shed light on geographic variations across Nigeria and highlight places where single mothers are more likely to be found; such analysis can also aid protective interventions designed specifically for these individuals. This is particularly important in a highly heterogeneous country like Nigeria. However, a countrywide analysis often masks relevant local-level information (Alaba *et al*., 2015; Somo-Aina & Gayawan, 2019). Consequently, this study aimed to investigate the spatiotemporal changes in single motherhood in Nigeria based on data of the second administrative strata of the country. We extracted data from the Nigeria Demographic and Health Survey conducted in four waves and used a Bayesian generalized additive spatial model (Blangiardo & Cameletti, 2015) in which the statistical inference was made through a probabilistic approach for Bayesian inference. The findings from the study elucidate the dynamics of family formation relating to single motherhood across Nigerian states during the period under consideration.

2. Data and methods

2.1. Data source

We analyzed data on single motherhood from four waves of the Nigeria Demographic and Health Survey conducted in 2003, 2008, 2013, and 2018. The National Population Commission of Nigeria implemented these surveys with financial and technical assistance from The Demographic and Health Surveys Program. A two-stage sampling design was used in each wave to determine participating households for the survey. In the first stage, clusters (enumeration areas) were chosen from the census data of the country, and in the second stage, participating households were determined. Women aged 15 – 49 years found in the sampled households were eligible to participate in the survey, which entailed a detailed questionnaire regarding the demographic and health conditions of the women and their households. The response variable created for this analysis is a binary indicator that takes the value of 1 if the woman has never been married or was formerly married/living with a man and 0 if the woman is currently in a union or living with a man. The data set was restricted to women with at least one child, thus excluding single women who were not single mothers. We considered the following variables in our analysis: nature of the place of usual residence; the highest level of education; religion; ethnicity; household wealth index; whether the woman has access to newspapers, radio, and television at least once a week; and employment status of the woman. The state in which the woman resides at the time of the survey was considered as the spatial unit in the model. Administratively, Nigeria is divided into 36 states and a federal capital territory, Abuja, as reflected in Figure 1.

2.2. Statistical analysis

We considered a spatiotemporal model within a Bayesian framework that allows for the spatiotemporal analysis of the pattern of single motherhood in Nigeria. We assumed a binomial distribution for the random variable Y_{ij} that denotes the number of single mothers in state i during the j^{th} survey period, and n_{ij} is the corresponding number of women who participated in the survey. That is, $Y_{ij} \sim binomial(n_{ij}, p_{ij})$ for i= 1,…,37 and j=1,2,3,4; p_{ij} is the probability (prevalence) of single motherhood. We used the logit of the probability of the single motherhood outcome given as follows:

$$logit(p_{ij}) = \beta_0 + \nu\beta + \gamma_i + \vartheta_j + \delta_{ij} \quad \text{(I)}$$

Where β_0 is the model intercept, ν is a vector that collects all the categorical variables included as linear terms in the model, β is a vector of the linear parameter, and γ_i is the random effect for the state assumed to have a spatial structure and modeled using a Gaussian intrinsic conditional autoregressive prior with the spatially correlated random term for each state. This was determined as the sum of the values assigned as weight based on the neighborhood structure of the spatial units, formulated through an adjacency matrix that considers two states as neighbors if they share a common border. The term ϑ_i is a non-linear smooth function assumed for the metrical covariate age of the women and was modeled assuming a second-order random walk prior, δ_{ij} is a spatiotemporal random effect term, and the parameter vector δ is considered to have a Gaussian distribution with a precision matrix $\tau_\delta R_\delta$, where τ_δ is a structured matrix that indicates the type of relationship existing between the space and time components. More details about the model are provided in a previous study (Blangiardo & Cameletti, 2015). We used the deterministic approach to Bayesian inference and employed the integrated nested Laplace approximation available through the R-INLA package (Rue *et al*., 2009). Other estimation procedures such as using a Markov chain Monte Carlo simulation are also possible.

3. Results

Figures 2 and 3 present the maps of the estimated prevalence of single motherhood in Nigeria for each of the four survey waves. Figure 2 presents the results when no covariates are included in the model, whereas Figure 3 presents results that include all available covariates. The results show that in Nigeria, the distribution of single motherhood exhibits distinct spatial patterns, with significant regional variations during the years. Initially, in 2003, states in the South-South and South-East geopolitical zone, such as Rivers, Cross River, Akwa Ibom, Ebinyi, Enugu, and Bayelsa, showed

Figure 1. Map of Nigeria showing the distribution of states. The map was created by the authors.

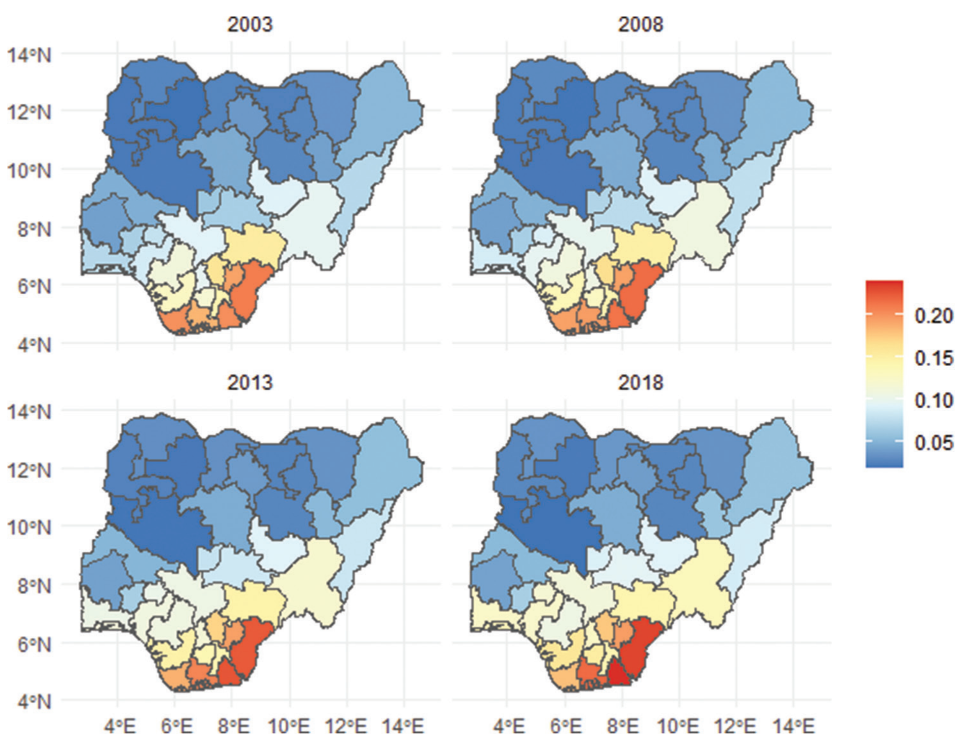

Figure 2. Maps of Nigeria showing the estimated spatiotemporal patterns of the prevalence of single motherhood in Nigeria based on a model that excluded the observed covariates. The maps were created by the authors with data sourced from the Nigeria Demographic and Health Surveys.

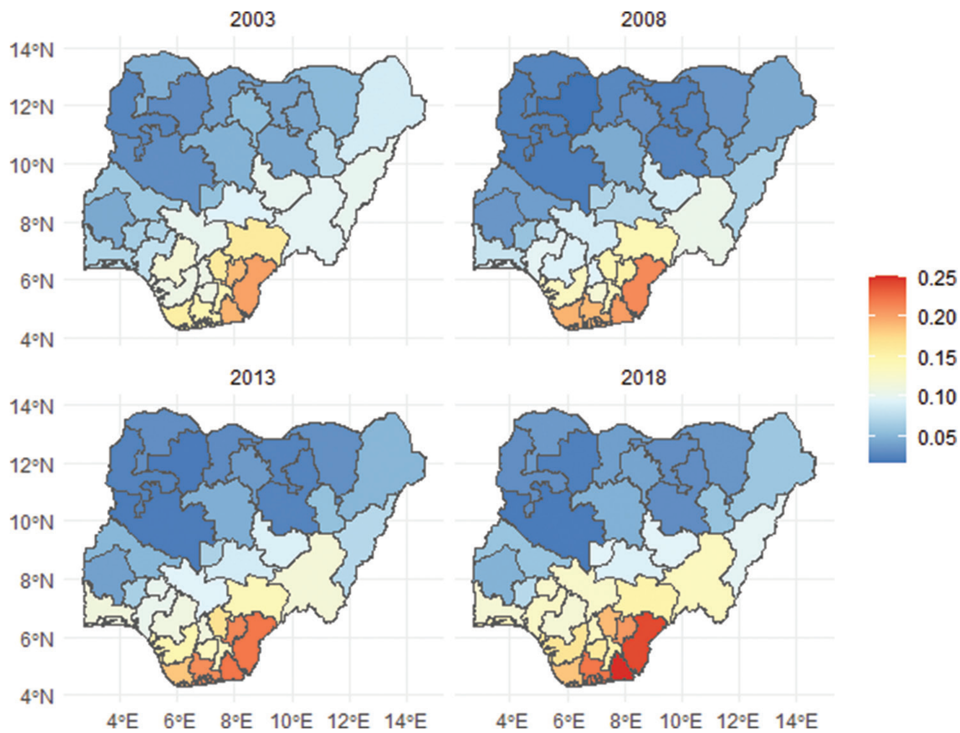

Figure 3. Maps of Nigeria showing the estimated spatiotemporal patterns of the prevalence of single motherhood in Nigeria based on a model that accounts for the observed covariates. The maps were created by the authors.

higher prevalence rates compared with northern states such as Niger, Zamfara, Bauchi, Jigawa, Sokoto, Katsina, and Yobe, where prevalence remained notably lower. Benue state in the North-Central region also displayed higher prevalence rates, diverging from the northern trends. In 2008, these spatial patterns persisted, with states in the South-South region maintaining high prevalence rates of single motherhood. Benue state continued to exhibit higher prevalence, aligning closer to the southern patterns than the northern trends. Northern states generally maintained lower prevalence rates, with variations observed in Taraba state, which showed increased prevalence compared with that in 2003. In 2013, the prevalence of single motherhood in the South-South became even more pronounced, particularly in states such as Cross River and Akwa Ibom. Taraba state in the North-East region exhibited increased prevalence. The South-West states, particularly Ekiti and Ondo, continued to display significant prevalence rates, but spatial patterns remained generally lower in the northern states. By 2018, the spatial patterns had intensified, with the South-South region, particularly Cross River and Akwa Ibom, exhibiting the highest prevalence rates of single motherhood in Nigeria. The state of rivers also showed notable prevalence. The South-West states, including Ogun, Lagos, Ondo, Ekiti, and Imo, as well as Abia in the South-East region, displayed significant prevalence rates. In contrast, the northern states continued to maintain lower prevalence rates, with states such as Niger, Zamfara, Bauchi, Jigawa, Sokoto, Katsina, and Yobe consistently showing the lowest prevalence rates. States in the South-South region, particularly Cross River, Akwa Ibom, and Rivers, continued to exhibit the highest prevalence rates. Considering the minimal difference between the maps in Figures 2 and 3, it is evident that the observed covariates had minimal effects on the spatiotemporal distribution of single motherhood in Nigeria.

Figure 4 presents the results for the age of women, which was estimated using a random walk prior that enabled the visualization of the functional relationship between age and the likelihood of being a single mother. The result shows that the likelihood of being a single mother peaked at about 18 years and declined thereafter with every unit increase in age until about age 30, at which point where the curve rises and the rising pattern continues for the rest of the reproductive age.

Table 1 presents the results of the linear parameters, showing the odds ratio (OR), standard errors, and 95% credible intervals (CI). Findings show that the odds of single motherhood are higher among women who live in urban centers than among those living in rural communities (OR = 1.662; 95% CI: 1.561, 1.770). Similarly,

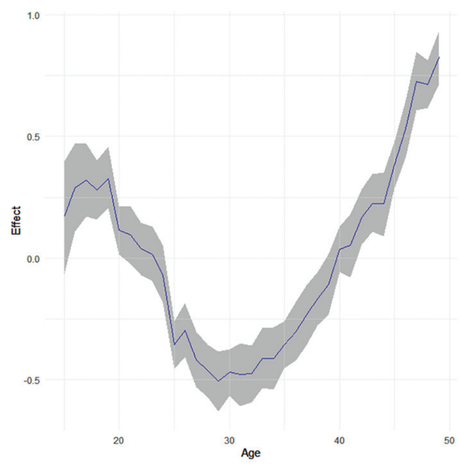

Figure 4. Non-linear relationship between women's age and likelihood of being a single mother. The chart was created by the authors.

the odds for single motherhood are higher among women who can access newspapers at least once a week compared with those without access, but it is about 22% lower for those who listen to the radio (OR = 0.788; 95% CI: 0.742, 0.837). The results for those who watch television are not significantly different. Women who practice Christian religion have higher odds of being single mothers (OR = 1.373; 95% CI: 1.179, 1.599), whereas the odds are lower for Muslim women (OR = 0.717; 95% CI: 0.614, 0.836). The findings on ethnicity demonstrate lower odds for the Hausa (OR = 0.638; 95% CI: 0.565, 0.720) and Igbo (OR = 0.731; 95% CI: 0.640, 0.835) ethnic groups, but the estimate for the Yoruba group is not significant. Furthermore, with respect to women who received no education, those who attained primary, secondary, or higher levels of education have higher odds of becoming single mothers. In the case of the wealth index, women from the poorer or middle-income wealth quintile have higher odds of being single mothers than those from richer households. However, the estimate for women from richer households is not significant. In terms of the survey period, the findings show lower odds of single motherhood in 2008 compared with 2003, but the estimates for 2013 and 2018 are not significantly different.

Table 1. Parameter estimates for the categorical variables included as linear effects

Variable	Odds ratio	Standard error	95% credible interval
Place of residence			
Rural	1		
Urban	1.662	0.033	1.561, 1.770
Working status			
No	1		
Yes	0.961	0.032	0.903, 1.022
Access to newspapers			
No	1		
Yes	1.103	0.038	1.025, 1.188
Access to the radio			
No	1		
Yes	0.788	0.031	0.742, 0.837
Access to television			
No	1		
Yes	1.054	0.035	0.985, 1.127
Religion			
None/traditional	1		
Christian	1.373	0.078	1.179, 1.599
Islam	0.717	0.079	0.614, 0.836
Ethnicity			
Others	1		
Hausa/Fulani	0.638	0.062	0.565, 0.720
Igbo	0.731	0.068	0.640, 0.835
Yoruba	1.017	0.068	0.891, 1.161
Educational attainment			
None	1		
Primary	1.351	0.041	1.249, 1.462
Secondary	1.646	0.044	1.510, 1.793
Higher	1.319	0.065	1.162, 1.497
Wealth index			
Poorest	1		
Poorer	1.186	0.046	1.084, 1.297
Middle	1.281	0.048	1.168, 1.405
Richer	0.974	0.054	0.877, 1.081
Richest	0.526	0.065	0.464, 0.597
Survey year			
2003	1		
2008	0.855	0.066	0.752, 0.971
2013	0.906	0.069	0.792, 1.037
2018	1.027	0.075	0.889, 1.190

4. Discussion

Nigeria has a high prevalence of single mothers (estimated at 11%), with the majority of them being young women (Adewoyin *et al*., 2020). This indicates that a considerable proportion of Nigerian women live vulnerable lives and face societal discrimination. To create intervention strategies to protect these women and their children, it is necessary to acquire a good understanding of the specific locations where they are concentrated in the country. Consequently, this study was conceived to quantify the spatiotemporal patterns of single motherhood in Nigeria. The choice of the Bayesian spatial model offers the opportunity to explore variables of different types; it allows us to establish the functional relationship with the response variable while simultaneously placing the spatial pattern in perspective. The findings indicate strong spatial clustering with a north-south divide in the likelihood of being a single mother, a pattern that persists throughout the period under consideration.

Interestingly, the spatial clustering obtained from the model that excluded the observed covariates persists even after controlling for the covariates. This finding reveals that the clustering serves as a proxy for other factors that exert an unmatched influence on the prevalence of single motherhood across Nigeria. The findings show a lower likelihood of single motherhood among women residing in the northern part of Nigeria but a higher likelihood in the southern states. This emphasizes the spatial inequality in social norms, culture, values, and economic development between various parts of the country. For instance, although multiple studies have affirmed the common practice of early marriage in northern Nigeria, the dissolution of marriage is uncommon in the traditional northern Nigerian marital system due to social customs and restrictions imposed by the dominant Islamic religion. Although Islamic law provides spouses with the right to terminate marital relationships and seek divorce, single motherhood is often not encouraged among the faithful (Chiroma *et al*., 2014). A study in Zaria, an ancient city in northern Nigeria, reported that although single parenting appears to be on the rise, its acceptance among the populace is limited (Anyebe *et al*., 2017). In the southern part of the country, premarital sexual activities are common among young men and women, which are attributed to peer pressure, the influence of pornography, and the desire for pleasure (Alo & Akinde, 2010; Okah *et al*., 2023). Unintended pregnancies and school dropouts have been identified as some of the consequences of such activities (Okah *et al*., 2023), considering the low prevalence of contraceptive use in Nigeria (Adebayo & Gayawan, 2022; Alaba *et al*., 2015). Moreover, modernization in southern Nigeria has affected many values of traditional societies by encouraging alternative family structures and increased rates of divorce and separation, which has prompted more women to embrace single motherhood.

Findings from the rural-urban differential show a high propensity for single motherhood among urban dwellers. These results corroborate those of Ononokpono *et al*. (2021), who revealed that rural women had higher chances of being in a union or cohabitation, but more urban women reported being formerly married. While adherence to values and norms regarding marriage and cohabitation could be more common in rural areas due to the greater importance given to traditions in these settings, women living in urban areas are often exempt from such traditions and values and at liberty to decide the type of family formation they desire. In addition, urban women are more likely to be empowered and enjoy greater autonomy than their rural counterparts; accordingly, increased levels of divorce and separation have been reported in urban areas (Takyi & Broughton, 2006). As Khan *et al*. (2022) argued, being a single mother in rural areas subject's women to more complex challenges compared with the experience of urban women due to limited opportunities to explore family structures and financial insecurity, all of which can deter rural women from considering single motherhood as an option.

The study further shows that education and household wealth index correlate with single motherhood in Nigeria. Specifically, women who attained primary or higher levels of education have higher odds of being single mothers. This result aligns with findings from other sub-Saharan African countries (Odimegwu *et al*., 2017). This is expected because educated women are more empowered and enjoy more autonomy. The findings also suggest that women with no education become single mothers due to the lack of marriage or cohabitation. These women could choose these marital options due to the economic challenges and financial responsibility that come with marriage. Other studies have shown that women from wealthier households are more likely to live as single mothers as these women are capable of caring for themselves and their children and are therefore unwilling to subject themselves to the patriarchal family system characterized by male dominance (Adewoyin *et al*., 2020; Odimegwu *et al*., 2017). However, our findings show that women from the wealthiest households have a lower likelihood of being single mothers.

In terms of ethnicity and religion, we found higher odds for single motherhood among Christians but lower odds among Muslims. Using only the 2018 NDHS data set, the study by Adewoyin *et al*. (2020) found no substantial difference in the likelihood of single motherhood based on religious affiliation; however, Anyebe *et al*. (2017) indicated that people from both Christian and Islamic religious groups considered being a single mother as unacceptable and thus unwelcoming. In Nigeria, religion generally has a moderating influence on union formation and family structure (Anaana *et al*., 2019, Ononokpono *et al*., 2021). However, alcohol consumption by both genders, which is more common among Christians; wrong choice of partners; and poor financial management have been identified as factors contributing to marital dissolutions and pushing more women to become single mothers among the Christian faithful in Nigeria (Anaana *et al*., 2019). Considering the lack of significant difference in the likelihood of single motherhood across Nigeria reported in the study by Adewoyin *et al*. (2020), in which data from only the most recent NDHS was used as against data from the four waves of the survey considered in this study, it would be worthy to consider trends in single parenting based on religious affiliation in the country. In the context of ethnicity, the lower odds reported among

Hausa and Igbo women might not be surprising because Hausa women are generally found in the northern fringe of Nigeria, where single motherhood has a lower prevalence; additionally, the majority of the Nigerian Igbo populace adheres to Catholicism, which is known for a more conservative stance on family structure (Adewoyin *et al*., 2020). Onyishi *et al*. (2012) showed that Igbo couples often find satisfaction in their relationship and thus stay together when they are blessed with children.

Finally, the higher odds for single motherhood among young women could be the result of having children out of wedlock due to unprotected premarital sexual activities earlier argued to be common among young men and women in the country (Okah *et al*., 2023). Such activities often lead to teenage pregnancy and single motherhood because the parties involved are oftentimes not ready for marriage. For older women, single motherhood could be propelled by widowhood, divorce, and separation. In parts of the country that have experienced protracted conflict and social unrest, such as the Boko Haram insurgency, many women would have lost their partners and would have thus been left to care for their children by themselves.

5. Conclusions

This study closely examined the impacts of different demographic and socioeconomic variables on the spatial distribution of single motherhood in Nigeria. State-specific clustering was identified using a Bayesian modeling technique. The findings show that in Nigeria, single motherhood is significantly associated with poverty, education level, age, and state of residency, with a notable north-south divide, where states in the southern part of the country have a higher prevalence. The maps generated in this study can help stakeholders and policymakers design different intervention programs to address discriminatory attitudes against single mothers and develop measures to reduce the prevalence of single motherhood in Nigeria.

The study has certain limitations. It remains impossible to make a causal inference from the findings due to the cross-sectional nature of the data set used in this study. The spatial units are the states of Nigeria, but each state is made up of several local government areas, constituting the third administrative level of the country. Subsequent analysis could consider this administrative level depending on data availability. Furthermore, the study included the categorical variables as linear terms, implying that their effects are constant across space. This assumption might not hold true in a culturally diverse setting such as Nigeria, where cultural and religious values strongly influence people's behavior. Consequently, future research could consider a varying coefficient model so that it would be possible to quantify the local variation in the effect of each variable.

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Conflict of interest

The authors declare that they have no competing interests.

Author contributions

Conceptualization: Ezra Gayawan
Formal analysis: All authors
Investigation: All authors
Methodology: Faith Eshofonie, Ezra Gayawan
Writing–original draft: All authors
Writing–review & editing: All authors

Ethics approval and consent to participate

The data analyzed were collected as secondary data from The DHS Program on request and so the researchers did not acquire any ethical approval or consent from the participants.

Consent for publication

Not applicable

Availability of data

Data analyzed in this study are publicly available and can be obtained on request from The DHS Program available at https://dhsprogram.com

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ACCSCIENCE PUBLISHING

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RESEARCH ARTICLE

Spatial variation in performance of socially marginalized students in high school leaving certificate examination 2022, in Assam, India

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Abstract

Education is one of the pre-eminent avenues for improving the socioeconomic status of marginalized communities. In India, performance in the High School Leaving Certificate (HSLC) Examination dictates the opportunities for obtaining higher education and building a successful career. Hence, the present study aims to explore the spatial variation in the performance of socially marginalized students from Assam in the HSLC Examination 2022, from the angle of gender, religion, and medium of instruction. Data obtained from the Board of Secondary Education, Assam, were used for calculating percentages, depicting spatial variation with the help of a choropleth map, and illustrating the gender gap graphically. A significant spatial variation in the performance of students in the HSLC examination was observed, with the range of variation being much wider for the socially marginalized students. In most of the districts, the socially marginalized students underperformed compared to all other students in general. Among the socially marginalized students, a gender gap in favor of males in the examination performance was detected in most of the districts in Assam, but in a few districts, an opposite phenomenon highlighting the gender gap in favor of females was evident. There were distinct spatial variations in the performance of the socially marginalized students in the HSLC examination across gender, religion, and medium of instruction. As education is an important pathway through which socially marginalized groups can elevate their socioeconomic status, there is an urgent need for the authorities to improve their performance in the HSLC examination.

Keywords: Academic performance; Assam; Gender disparity; Spatial variation; Education

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1. Introduction

Education is an important agent for the overall development of an individual as well as a region. The development of a country is contingent on the power of education to catalyze the growth and nurture of skilled professionals who contribute and implement innovative ideas for the betterment of their nation. Education is a means which produces desirable changes in human behavior, which have profound and positive implications on their way and quality of life. It is also vital for the balanced development of a region. At present, the exact socioeconomic progress of an area is gauged by the overall educational attainment, in addition to the literacy rate, which however does not necessarily reflect the real-life situation. Education helps individuals develop intellectual skills (Idris et al., 2012), enhance their judgment, reasoning capabilities, and power of exploration, acquire good habits and various other traits. Educational attainment has a great influence on occupational stratification, overall social status (Idris et al., 2012), socioeconomic mobility, and social stability (Tadese et al., 2022). Thus, studies on educational attainment hold considerable significance in dissecting the prevailing social situation and its impact on the overall status of a region.

Academic performance is one of the several components of academic success (Masud et al., 2019). In India, performance in the High School Leaving Certificate (HSLC) Examination has a determining effect on the opportunity to pursue a higher education and build a successful career. Education affairs in India are primarily governed by the state governments. The significant differences in terms of language, history, economic situation, and social structure presented by the states in India account for their distinct patterns of educational achievement (Rudolph & Rudolph, 1969). Educational achievement in India varies significantly across the country, depending upon the diversity of population composition and social groups (Karak & Sen, 2017). The stark disparities in achievements are evident among the socially marginalized communities such as the Scheduled Tribes (STs) (49.35%) and the Scheduled Castes (SCs) (56.46%), who have significantly lower literacy rates than the socially advanced communities (68.19%) of India (2011 Census).

Inequality is a notoriously conspicuous attribute of the Indian education system, reflected by a lopsided distribution of education resources. This can be exemplified by the presence of high tuition fee-charging private schools, with English as the medium of instruction and improved facilities, catering to the rich and privileged families; and the presence of government schools teaching in vernacular languages with insufficient facilities, poor infrastructure (Gouda *et al*., 2013), an insufficient number of teachers, and an uncongenial school environment, where most of the socially marginalized students study. Assam is no exception in this regard. There is a large-scale spatial variation in the performance of students at various levels of examination throughout the state due to differences in the availability of primary education and other basic amenities (Kumari, 2013) in Assam. Academic achievement also varies in terms of caste, gender, and other associated social background characteristics of the students (Mandal & Sarkar, 2020; Brey *et al*., 2019).

The demographic scenario in India is illustrated by vast disparities between different castes and communities in the social sphere (Maji & Sarkar, 2018). The diversity in the population composition, particularly with respect to ethnicity, accounts for the significant variations in the HSLC examination that varies from one community to another in a given region. Several Sustainable Development Goals (SDGs) offer simple guidelines to help achieve educational attainment, with SDG 4 envisaging inclusive and equitable quality education and encouraging lifelong learning opportunities for all; SDG 5 promoting gender equality; and SDG 10 aiming to reduce inequality within and among countries. To achieve these goals by 2030, it is crucial for us to improve the academic performance of students in different geographical regions at different levels of examination, aligning with the core vision of the entire education system (Das, 2021).

To achieve quality education against the backdrop of gender equality, focusing on improving the performance of students across all segments of society, particularly among the socially marginalized communities (SCs and STs) is necessary. The academic performance of the socially marginalized students remains alarmingly worse compared to those from the socially advanced communities in Assam. Hence, it is of utmost importance to study the status of, and the spatial variation in, the performance of the socially marginalized students in the HSLC examination to gain a sense of the underlying factors governing the progress of educational development in the state of Assam. This paper attempts to examine the spatial variation in the performance of the socially marginalized students in the HSLC examination held in Assam in 2022 from the angle of gender, religion, and medium of instruction.

2. Data and methods

In this study, we utilized raw data from HSLC and Assam High Madrassa School examination results of 2022 obtained from the Board of Secondary Education, Assam (SEBA). The data, which were in the comma-separated value format, were converted into the Statistical Package for the Social Sciences format for analysis. Data pertaining to the HSLC examination alone were extracted, while the rest was ignored. The raw data provided information on seven socioeconomic categories: (i) General, (ii) Other Backward Class, (iii) More Other Backward Class, (iv) SC, (v) ST (Plains), (vi) ST (Hills), and (vii) Tea Garden category. More Other Backward Class and Other Backward Class together constitute the backward classes, whereas the SC and ST categories, as per articles 341 and 342 of the Indian Constitution, belong to the lower socioeconomic strata and indigenous groups. For the present study, students belonging to SC and ST communities were construed as the "socially marginalized students" for convenience. Since the study aimed to portray the regional disparities among the marginalized students, the results were separately presented for the socially marginalized students and compared with the results of all the students in general (that is, students from all the categories).

2.1. Description of variables

2.1.1. Performance in the HSLC examination

Performance in the HSLC Examination was the main variable of interest in the present study. Information was available on whether a candidate had secured the "first," "second," or "third" division, had "failed," had been "expelled," had his/her result "withheld," or had been "fully absent." In this study, students who had secured the "first", "second" or "third" division were grouped as "passed." While calculating the pass percentage, the number of students who were in the "passed" category was used as the numerator, whereas the total number of students included in this study served as the denominator because the focus of this study was to find whether a candidate had sat through all the tests under the HSLC Examination.

2.1.2. Caste

Information was available on the following seven categories of caste, namely (i) "General," (ii) "Other Backward Class," (iii) "More Other Backward Class," (iv) "SC," (v) "ST (Plains)," (vi) "ST (Hills)," and (vii) "Tea Garden Category" (although it is not a recognized caste). The "SCs," the "STs (Plains)," and the "STs (Hills)" were merged to form the socially marginalized group in the present study. This variable was used as the proxy indicator of the socioeconomic standing of a student.

2.1.3. District

There were a total of 33 districts in Assam at the time of the declaration of the HSLC Examination 2022 results. In the present analysis, district was utilized as a variable to offer a spatial context in understanding the spatial variation of the HSLC Examination performance.

2.1.4. Gender

Data on two categories of gender, namely "Male" and "Female," were available in the dataset. This parameter was used to understand if there was a gender disparity across different socioeconomic strata in terms of performance in the HSLC Examination.

2.1.5. Religion

Information on the religion of the candidates was also available from SEBA. In 2022, the candidates were from "Hindu," "Islam," "Christianity," "Buddhism," "Jainism," "Sikhism," and "Others" religious backgrounds. Due to the relatively small number of candidates from the "Buddhism," "Jainism," and "Sikhism" religions, the students belonging to these religions were grouped under the "Others" category. Given its strong indicative power of the sociocultural background, religion was incorporated into the present analysis.

2.1.6. Medium of instruction

Assamese, Bengali, Boro, English, Hindi, and Manipuri languages are the media of instruction reported in the dataset. Data were tabulated for each medium of instruction except Manipuri.

2.2. Analytical approach

Data were cross-tabulated and percentages were calculated at the district level. Differentials across space and some of the other parameters were assessed by simple subtraction. Spatial variations in the HSLC Examination performance were classified into five categories based on the pass percentage of a district. These categories were 34.30 – 44.88 (very low), 44.88 – 55.46 (low), 55.46 – 66.04 (medium), 66.04 – 76.62 (high), and 76.62 – 87.20 (very high). For presenting this classification on a choropleth map, the latest shapefile of the map of India with administrative boundary up to the district level with the product code OVSF/1M/9 was obtained from the official website of the Survey of India, Department of Science and Technology. The map showcasing all districts in Assam, indicated clearly with levels of HSLC Examination performance, was then created using the Quantum-GIS software. The converted map was generalized into spatial segments as per the data. Since the map was prepared as a Lambert Conformal Conic Projection, there was a slight distortion and exaggeration of shape. To find if there was a clustering of performance of the students in the HSLC Examination, Local Indicators of Spatial Association (LISA) cluster maps and significance maps were prepared on GeoDA, and Moran's I value was determined. The gender gap in the pass percentage of the students, in general, and of the socially marginalized students, in particular, in Assam's HSLC Examination 2022 was presented graphically. The gender disparity in pass percentage was assessed by applying Sopher's Disparity Index considering higher value as X2 irrespective of gender.

2.3. Exclusion criteria

Data of students with the following characteristics were excluded from the analysis:

(i) *Having attended the Assam High Madrassa School Examination.* As the present study was devoted exclusively to exploring students' performance in the HSLC Examination, a total of 11245 students who had attended the Assam High Madrassa School Examination were dropped from the analysis.

(ii) *Belonging to the Tea Garden category.* A total of 15474 students belonging to the Tea Garden category were excluded from the analysis as they did not fit well into any of the castes accounted for in the study.

(iii) *Learning using Manipuri as the medium of instruction.* A total of 432 students who learned with Manipuri as the medium of instruction were excluded from the analysis (1 candidate of Manipuri medium belonged to the Tea Garden category).

(iv) *Belonging to the 'Children with Special Needs' category.* A total of 14 students belonging to this category were dropped from the analysis.

(v) *HSLC Examination absenteeism.* In total, 14305 candidates who were totally absent in the HSLC examination were excluded from the analysis.

Out of a total of 431,132 candidates, 389,663 were retained for the analysis after excluding the candidates who did not fit the requirements of the present study.

3. Results

3.1. Spatial variation

A total of 389,663 students appeared for the HSLC Examination in 2022, of whom 181,670 were males and 207,993 females. The total pass percentage for the year stood at 57.7% (55.7% and 60.0% for females and males, respectively) (Table 1). A significant spatial variation and gender disparity in the total pass percentage (Figure 1) were apparent from the result. Among the 33 districts, six recorded very low pass percentages, with the poorest performance documented in Chirang (34.30%). Ten districts had low pass percentages, with the poorest performance recorded in Udalguri (47.20%). Seven districts had medium pass percentages, with the lowest in Charaideo (57.1%). Five districts hold high pass percentages for the HSLC Examination 2022, with Baksa (66.7%) claiming the least-performing spot in the category. The remaining five districts hold very high pass percentages for the examination, with Dima Hasao, Dhemaji, and Sivasagar attaining pass percentages above 80. Among all the districts of Assam, Sivasagar stood out

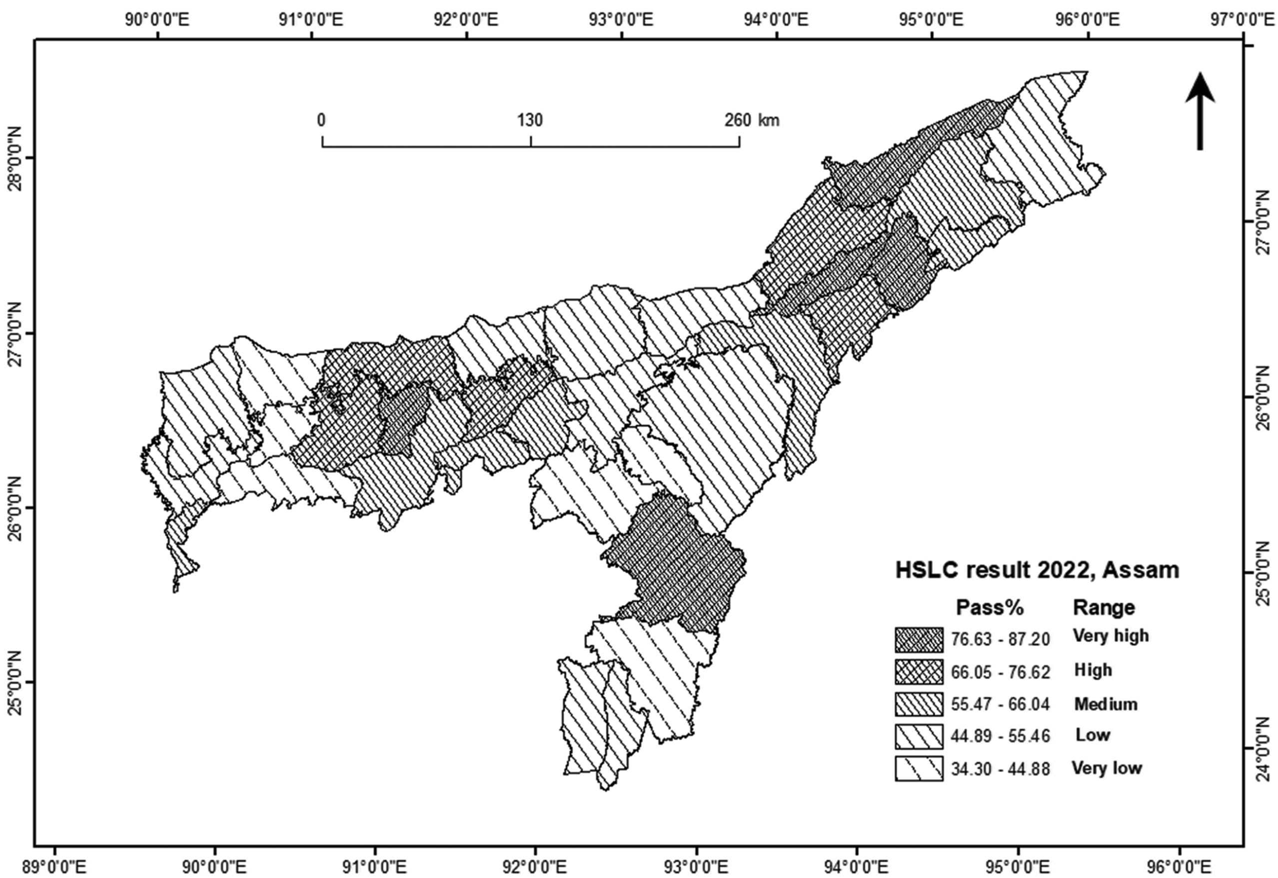

Figure 1. Spatial variation in pass percentage for high school leaving certificate examination 2022 in Assam

Table 1. Pass percentage of overall and socially marginalized students in HSLC examination 2022 in Assam by gender

Districts	Overall Students				Socially marginalized students			
	Total	Male	Female	Male-female disparity	Total	Male	Female	Male-female disparity
Baksa	66.7	66.9	66.5	0.01	68.2	67.9	68.6	0.01
Barpeta	70.1	72.8	67.7	0.11	63.1	64.4	62.0	0.04
Biswanath	54.1	57.1	51.4	0.10	54.7	57.1	52.5	0.08
Bongaigaon	43.1	43.0	43.1	0.00	34.0	34.1	34.0	0.00
Cachar	43.3	45.3	41.5	0.07	36.9	39.3	34.8	0.08
Charaideo	57.1	56.5	57.6	0.02	54.1	51.7	56.1	0.08
Chirang	34.3	34.6	34.1	0.01	38.7	38.4	39.1	0.01
Darrang	69.1	74.4	64.6	0.20	58.7	63.7	54.3	0.17
Dhemaji	85.5	85	86.0	0.04	86.5	85.6	87.4	0.07
Dhubri	48.2	50.6	46.1	0.08	33.4	31.8	34.7	0.06
Dibrugarh	59.5	59.4	59.6	0.00	60.1	58.8	61.4	0.05
Dima Hasao	81.3	81.6	81.1	0.01	81.7	81.9	81.6	0.01
Goalpara	41.2	43.9	39.3	0.08	39.9	38.1	41.3	0.06
Golaghat	64.6	66.2	63.0	0.06	60.4	62.5	58.5	0.07
Hailakandi	49.3	49.9	48.9	0.02	38.6	40	37.4	0.05
Hojai	37.4	40.7	35.0	0.11	30.3	33	28.1	0.10
Jorhat	70.5	70.7	70.3	0.01	69.8	70.5	69.2	0.03
K Anglong	50.3	52.7	48.0	0.08	48.5	50.3	46.7	0.06
Kamrup M	63.3	64.8	61.9	0.05	48.0	50.9	45.2	0.10
Kamrup R	64.9	66.4	63.7	0.05	49.5	49.0	49.9	0.02
Karimgaj	47.6	51.3	44.8	0.11	36.5	40.3	33.6	0.13
Kokrajhar	47.5	47.4	47.6	0.00	62.2	61.7	62.8	0.02
Lakhimpur	76.3	76.6	75.9	0.02	78.4	77.8	79.1	0.03
Majuli	77.3	77.3	77.4	0.00	73.9	73.4	74.4	0.02
Morigaon	59.7	63.4	57.0	0.12	55.1	55.9	54.5	0.02
Nagaon	49.3	54.7	45.6	0.16	40.9	45.2	37.3	0.14
Nalbari	79.2	81.9	76.8	0.14	71.9	75.5	68.6	0.15
Sivasagar	87.2	88.7	85.6	0.12	82.8	85.6	79.9	0.17
Sonitpur	51.0	53.3	49.2	0.07	55.1	57.4	53.1	0.08
S Salmara	58.3	66.8	51.2	0.28	39.2	39.5	39.0	0.01
Tinsukia	50.7	51.8	49.7	0.04	49.5	51.4	47.9	0.06
Udalguri	47.2	49.3	45.3	0.07	54.6	53.7	55.4	0.03
WKAnglong	42.8	45.4	40.4	0.09	41.1	44.2	38.3	0.11
Total	57.7	s	55.7	0.08	56.5	57.7	55.4	0.04

Notes: K Anglong: Karbi Anglong; Kamrup M: Kamrup Metro; Kamrup R: Kamrup Rural; S Salmara: South Salmara; WK Anglong: West Karbi Anglong.

as the best-performing district with almost nine out of ten students passing the examination (87.2%). No distinct clustering of districts was noted in the state (Figure 2). This is evident from the LISA cluster map as well as Moran's I value, which was only 0.236. Nevertheless, a significant clustering of low-low districts such as Kokrajhar, Dhubri, and Bongaigaon was evident, whereas Majuli, Jorhat, and Dibrugarh districts fell within the high-high cluster, and the Dima Hasao district fell within the high-low cluster.

The performance of the socially marginalized students varied from abysmally low in a few districts to very good in a few other districts. In the Hojai district, only three out of ten students passed the HSLC examination in

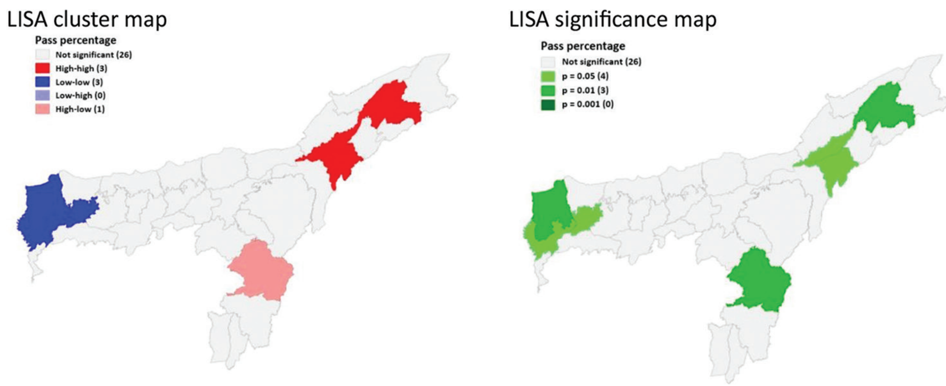

Figure 2. Spatial clustering of pass percentage for high school leaving certificate examination 2022 in districts of Assam

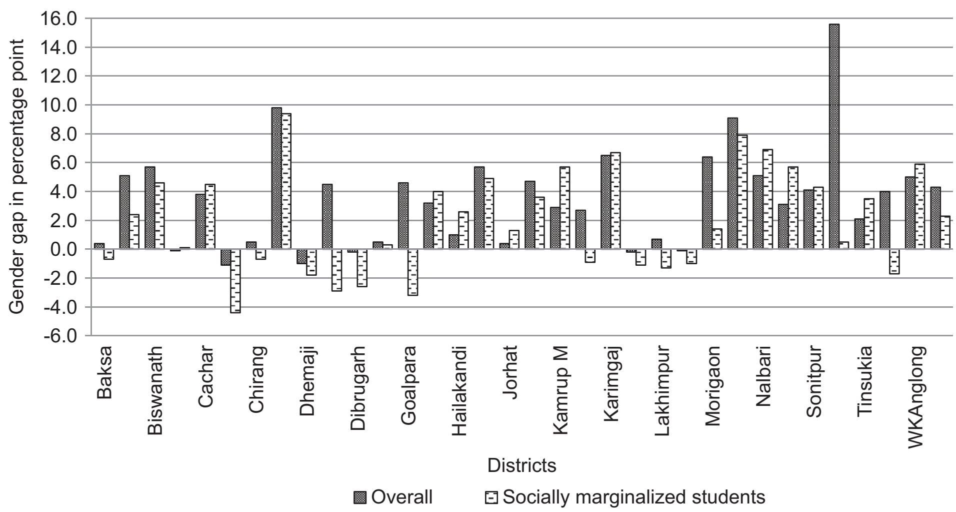

Figure 3. Gender gap measured in pass percentage points of overall and socially marginalized students in high school leaving certificate examination 2022 in Assam

Notes: K Anglong: Karbi Anglong; Kamrup M: Kamrup Metro; Kamrup R: Kamrup Rural; S Salmara: South Salmara; WK Anglong: West Karbi Anglong.

2022, whereas in Dhemaji, as many as about nine out of ten students could do so for the same examination. The performance of the socially marginalized students in 21 districts was below the overall pass percentage of the state. Interestingly, in the districts where the overall pass percentage was very high (Sivasagar, Dhemaji, and Dima Hasao), the performance of the socially marginalized students was found to be very good.

3.2. Gender gap

A striking difference was visible in the pass percentages of HSLC Examination 2022 between males and females in the state of Assam (Figure 3). The average difference between the male and female pass percentages stood at 4.3% points in favor of male students. A substantial variation across the districts was quite apparent. The highest gap (15.6% points) favoring males was observed in the South Salmara district, whereas the lowest gap (only 0.4% points) was observed in the Chirang, Baksa, Jorhat, and Dima Hasao districts. Six districts (Charaidao, Dhemaji, Kokrajhar, Bongaigaon, Dibrugarh, and Majuli) showed a negligible (with percentage points ranging from 0.1 to 1.1) difference in favor of female students. The Sopher's index value indicated that both South Salmara and Dhubri districts demonstrated the highest gender disparity in the examination performance. It is interesting to note that the districts that offer a conducive environment for female students to do well in the examination are a blend of districts with very low and very high pass percentages, indicating that there is no distinguishable pattern to explain examination performance between the two genders from the angle of the overall pass percentage.

In terms of performance of the socially marginalized students in the HSLC Examination, a very interesting picture emerged. The gender gap among them was found to be somewhat nominal (2.3% points) as compared to the overall gender gap (4.3% points) of the state. However, a substantial spatial disparity prevailed across the districts (Figure 3). A gender disparity in favor of males (ranging from 0.1 to 9.4 percentage points) was evident in 21 districts. The highest gender gap and disparity in favor of males were observed in the Darrang district, whereas the lowest gap was seen in the Bongaigaon district. In 12 districts, the gender gap was in favor of female students (ranging from 0.7 to 4.4% points). The Charaidao district showed the highest gender gap in favor of females, while the Baksa and Chirang districts presented a nominal gap.

3.3. Spatial disparity by religion

An attempt was made in this study to understand the spatial variation in performance in the HSLC Examination by candidates' religions. In the state as a whole, the performance of students belonging to the Hindu religion (59.3%) was comparatively better than that of the Christian (57.3%) and Muslim (54.5%) students (data not shown). Among students from the Hindu religion, the performance varied from 35.6%.

Among the socially marginalized students, Christian students (64.1%) considerably outperformed the Hindu students (55.9%) and those under the "Others" category (62.4%). Hindu students who had the poorest performance in the examination were concentrated in Hojai (30.2%), whereas those with the best performance originated in Dhemaji (86.5%). Chirang district recorded the lowest pass percentage for the socially marginalized Christian students (37.9%), whereas the highest percentage was noted in South Salmara, Morigaon, and Majuli districts (100%). These results indicate that there was a significant spatial variation in the HSLC Examination 2022 performance across all the religious groups in Assam.

3.4. Spatial variation by medium of instruction in the school

In Assam, English-medium students performed much better than students from other media of instruction (Table 2). However, there exists a spatial variation across the districts. Majuli (99.4%) and Sivasagar (98.1%) recorded the highest pass percentage, while West Karbi Anglong recorded the lowest pass percentage (53.8%). For Assamese-medium students, the highest performance was recorded in Sivasagar (85.8%) and the lowest in Hailakandi (22.2%). For Bodo-medium students, a 100% pass rate was recorded in Cachar, Hojai, Kamrup Metro, and West Karbi Anglong. The performance of Bengali-medium students varied from extremely low in Barpeta (14.4%) to substantially high in Lakhimpur (60%). Similarly, a huge spatial variation was observed in the performance of Hindi-medium students, with Dhubri showing the poorest (14.8%) performance and Dima Hasao the highest (100%).

In the case of the socially marginalized students, performance varied significantly across the media of instruction in school. It should be noted that absenteeism for the HSLC Examination with Assamese, Bengali, Bodo, and Hindi as the media of instruction was detected in several districts. In contrast, students with English as the medium of instruction appeared for the examination in all the districts of Assam. English-medium students outperformed their vernacular counterparts (Table 2). In terms of spatial variation, the highest pass percentage among the English-medium students was observed in Majuli district (99.4%), followed by Sivasagar (98.6%) district, whereas the lowest pass percentage was observed in West Karbi Anglong district (50.6%), followed by the East Karbi Anglong district (56.9%). In the case of Assamese as the medium of instruction, the highest pass percentage was recorded in Dhemaji district (84.7%), followed by Sivasagar district (81.9%), while the lowest pass percentage was recorded in Chirang district (23.0%) and West Karbi Anglong district (26.5%). In the case of Bodo-medium students, a 100% pass rate was recorded in West Karbi Anglong and Kamrup Metro districts, but a significantly low pass rate was documented in Bongaigaon district (17.9%).

4. Discussion

In India, poor academic performance is an important concern that is often raised in the context of school education. Despite high enrollment and attendance rates, relevant learning outcomes at all levels differ across the society. The performance of students who are socially excluded is much worse than that of their peers. The root causes of the poor academic performance of the socially marginalized students have been studied in many parts of India (Sethi *et al.*, 2013; Arumugam & Bhat, 2020). Studies (Maji & Sarkar, 2018; Chaliha & Bhuyan, 2016; John *et al.*, 2020; Das, 2021) have consistently shown that socioeconomic status (Masud *et al.*, 2019; Sirin, 2005), educational attainment of parents (Cooperman *et al.*, 2016), and family distress significantly influence students' overall academic performance. One study (John *et al.*, 2020) argues that students from socially marginalized backgrounds are likely to have poor educational performances because of unfavorable home environments. According to other researchers, poor educational performance is caused by factors such as low expectations, poor aspirations, a lack of delayed gratification, and economic problems

Table 2. Pass percentage of overall and socially marginalized students in HSLC Examination 2022 in Assam by medium of instruction in the school

District	Overall students					Socially marginalized students				
	Assamese	Bengali	Bodo	English	Hindi	Assamese	Bengali	Bodo	English	Hindi
Baksa	60.5	NA	72.8	92.6	NA	56.6	NA	72.8	94.5	NA
Barpeta	69.1	14.4	71.2	95.1	32.3	60.6	7.9	71.2	92.1	20.0
Biswanath	50.3	23.1	54.5	89.3	36.8	51.7	0	54.5	89.3	33.3
Bongaigaon	41.4	33.9	17.9	88.7	37.7	31.7	24.8	17.9	84.7	22.4
Cachar	38.5	35.5	100.0	87.1	35.2	32.0	30.3	NA	84.6	50.0
Charaidao	54.5	31.3	NA	80.0	26.2	51.4	NA	NA	81.0	50.0
Chirang	26.0	NA	39.2	77.8	NA	23.0	23.8	39.3	77.8	NA
Darrang	68.8	39.4	66.2	94.4	27.3	56.0	33.3	66.1	93.3	25.0
Dhemaji	83.8	NA	93.4	93.5	72.4	84.7	NA	93.4	94.1	90.9
Dhubri	47.7	23.3	77.8	84.3	14.8	32.5	17.2	77.8	82.1	7.1
Dibrugarh	54.3	42.7	NA	86.9	35.7	56.4	45.7	NA	85.2	25.4
Dimahaso	65.3	47.2	NA	86.6	100.0	68.2	45.8	NA	86.3	100.0
Goalpara	36.5	NA	35.2	74.1	37.5	29.5	NA	34.9	68.3	50.0
Golaghat	60.8	57.7	38.7	87.0	71.4	58.3	66.7	38.7	82.5	54.5
Hailakandi	22.2	45.4	NA	89.0	NA	NA	32.8	NA	85.1	NA
Hojai	33.8	25.6	100.0	82.6	25.8	26.9	24.8	NA	72.4	26.2
Jorhat	68.8	54.4	NA	86.6	25.0	69.1	70.0	NA	84.9	10.7
K Anglong	31.7	51.0	55.2	60.8	23.5	25.4	47.7	55.2	56.9	16.4
Kamrup M	55.6	47.9	100.0	86.9	39.9	40.2	51.3	100.0	81.5	35.1
Kamrup R	64.2	52.9	42.3	84.4	47.4	47.8	100.0	42.3	72.0	60.0
Karimganj	56.7	43.9	NA	86.6	NA	NA	33.5	NA	87.4	NA
Kokrajhar	35.2	34.4	66.6	86.5	26.1	33.1	29.3	66.7	88.0	47.6
Lakhimpur	75.6	60.0	62.2	93.5	88.4	78.0	25.0	62.2	96.8	100.0
Majuli	75.9	NA	NA	99.4	NA	71.8	NA	NA	99.4	NA
Morigaon	59.4	22.6	46.7	90.7	19.0	54.8	17.4	46.7	89.5	12.5
Nagaon	46.5	47.4	NA	87.4	51.3	37.1	34.8	NA	85.4	58.8
Nalbari	78.7	NA	75.6	96.5	NA	71.2	NA	75.6	92.9	NA
Sivasagar	85.8	NA	NA	98.1	81.6	81.9	NA	NA	98.6	NA
Sonitpur	43.2	59.3	61.2	89.8	35.2	45.5	59.5	61.3	88.9	25.0
S Salmara	56.4	NA	NA	92.5	NA	32.9	NA	NA	88.9	NA
Tinsukia	42.8	42.7	NA	79.4	40.1	43.1	33.0	NA	83.1	31.8
Udalguri	36.3	46.8	55.4	81.7	NA	41.0	37.3	55.5	84.3	NA
WK Anglong	30.1	NA	100.0	53.8	31.1	26.5	NA	100.0	50.6	6.5
Total	56.7	39.7	60.7	81.6	36.8	54.7	31.9	60.8	73.8	29.5

Notes: K Anglong: Karbi Anglong; Kamrup M: Kamrup Metro; Kamrup R: Kamrup Rural; S Salmara: South Salmara; WK Anglong: West Karbi Anglong.

(Trueman, 2015). This may hold true in the case of socially marginalized groups of Assam as well.

This paper examined the overall performance of socially marginalized students in the HSLC Examination conducted by SEBA in 2022. We found that there was a huge spatial variation in the HSLC Examination performance of students, who were classified into different socio-economic strata, across the 33 districts of Assam. One of the pertinent differentials in academic performance is known to be gender variation. This study revealed that the number of female students who sat through the

HSLC Examination in 2022 in Assam was higher than that of male students, but in terms of performance, male students outperformed their female counterparts in most of the districts. This unbalanced phenomenon may be attributed to the less priority given to the education of female students, rigidly defined gender roles, and outdated traditions (Nagar, 2021).

The huge spatial variation that emerged may be due to the existing differences in the socio-economic conditions and infrastructure among the districts. Spatial variation in examination performance even extends to the socially marginalized students, whose striking performance variations across districts emerged as one of the features of the HSLC Examination in Assam. Nonetheless, the gender gap in HSLC Examination performance appeared to be slightly less pronounced among the socially marginalized students than among all the students in general. With the diminishing gender discrimination among the socially marginalized communities, especially the tribal communities, the education of female students is given equal importance, same as that of male students.

Religion is considered one of the strongest sociocultural parameters affecting human behavior and practices. It may also have a multifaceted influence on the performance of students in crucial examinations. The poorer performance of the students from religions other than the Hindu religion may be due to their economic condition. However, the performance of the socially marginalized Christian students was found to be better than that of the students of other religions. This may be due to the fact that some of these students have access to good education systems, such as missionary schools.

The medium of instruction is another important factor that influences the academic performance of students. The presence of students enrolled in English-medium schools in every district of Assam indicates a strong preference for such schools (Upadhaya, 2017). Educated parents and parents who can afford an English education prefer sending their children to English-medium schools for better academic performance and job prospects. The results of the present study also revealed that irrespective of social status, students studying in English-medium schools could achieve higher academic performance in comparison to those studying in vernacular schools (Assamese, Bengali, and Bodo). Some plausible reasons accounting for the better performance of students from English-medium schools include better school infrastructure and motivation from parents, students, and teachers. However, an important point to underline is that schooling cost is positively related to the performance of the students irrespective of place of residence and economic status (Gouda *et al*., 2013).

For promoting equality of opportunities and outcomes in SDGs, special attention should be given to social groups in vulnerable situations, such as SCs or STs communities, to improve their educational access and attainment. Since academic performance is the benchmark of a student's competency and level of efficiency in their academic work, it is the most important indicator for predicting the student's academic progress and future career. The growing emphasis on educational equality for socially marginalized communities must be given special consideration to reduce educational disparities. Thus far, the Indian government has developed and implemented caste- and ethnicity-based affirmative policies and activities to promote equality in education. There are additional aspects that require special attention to make a decisive intervention to improve this situation so that all children, regardless of religion, caste, class, gender, or location, receive an education of equivalent quality for better academic performance. Hence, there is a need to comprehend the educational performance of socially disadvantaged students for policy implications.

5. Conclusion

Education is an indispensable tool for bailing out socially marginalized students and their communities where they belong to from socioeconomic backwardness. Education, especially higher education, can not only enlighten their minds but also bring economic prosperity to them. HSLC Examination is the only gateway through which everyone in India has to pass through before pursuing higher education since there is no other alternative one can adopt to bypass HSLC Examination. In Assam, the performance of socially marginalized students is comparatively poorer than the overall performance in the state. Hence, it is imperative to take the necessary steps to improve their performance in the HSLC examination and reduce spatial disparity across the districts in Assam. Furthermore, there is a need to reduce the gender disparity across all segments of the society in the state.

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Conflict of interest

The authors declare that they have no competing interests.

Author contributions

Conceptualization: Heya Brahma, Sibani Basumatari, Jeemina Baglari, Pralip Kumar Narzary
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Writing – original draft: All authors
Writing – review &editing: All authors

Ethics approval and consent to participate

Ethics approval was not required for this work since we used secondary data at the aggregate level and without any identifier.

Consent for publication

Not applicable.

Availability of data

The raw unit-level dataset used in this study is not publicly available, and the authors do not have the authorization to disclose this dataset. However, the tabulated data are available in the form of a report, which is publicly available at: https://site.sebaonline.org/downloads

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RESEARCH ARTICLE

Unmet health-care needs among older adults living alone in Thailand

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Abstract

The present study examined unmet health-care needs (UHN) among older adults living alone in Thailand. This study had two specific objectives: (i) to analyze the effect of living alone on UHN using a matched sample obtained from a propensity score matching method and (ii) to analyze the sociodemographic determinants of UHN using the entire sample of data. Descriptive analysis and logistic regression were employed, along with Thailand's 2019 Health and Welfare Survey dataset. The findings indicated that older people living alone experienced 1.613 (confidence interval [CI]: 1.066 – 2.440) times more UHN than those living with others (Objective 1). Moreover, older people with low incomes and chronic diseases experienced 1.391 (CI: 1.015 – 1.923) and 5.629 (CI: 4.375 – 7.243) times more UHN than their counterparts (Objective 2). Non-medical costs and a lack of social support facilitating access to health care (e.g., a lack of caretakers to bring older people to health-care providers and a lack of affordable transportation options) may have been the primary causes of the high UHN rate for these groups, as indicated in previous studies. Thus, the government should continue its efforts to alleviate these issues. Specifically, the existing community health volunteer program should prioritize older people living alone who need caretakers during illness. Local health authorities should support the program by offering health emergency vehicles, especially to those living outside major cities with limited transportation options to access health-care providers. The government should also increase the old-age allowance to enhance the financial independence of older people and extend the current telemedicine services to district hospitals and community health centers. Such measures have significantly improved health-care access for low-income older people who do not have extra resources to travel to health-care providers and chronically ill older people who need regular health care in Thailand.

Keywords: Older people; Living arrangements; Living alone; Unmet health-care needs; Health-care access; Propensity score matching

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1. Introduction

Thailand is currently experiencing a rapidly aging population. In 2021, people aged 65 years or older accounted for approximately 15% of the total population, which represented the highest percentage among the 11 Southeast Asian countries

(World Bank, 2023). This percentage is expected to grow to approximately 27% by 2040 (United Nations, 2022), indicating that one in every four Thai people will be older in less than two decades.

Along with the rapid increase in the older population, the number of older people living alone is also increasing. A recent study using national survey data showed that approximately 13.3% of the older population lived alone in 2017 (Meemon & Paek, 2020), which was almost four times higher than the 3.6% reported in 1994 (National Statistical Office of Thailand, 2018). The estimate of 3.6% was based on an age range of 60 years and above; thus, the actual increase in the percentage of older people living alone would be far higher than four times, given the increased minimum age of 65 years.

One of the social challenges related to the increase in the older population is ensuring adequate health-care access for this group, as they have greater health-care demands than younger generations but fewer economic and social resources to meet these demands (Meemon & Paek, 2019). Thailand has provided almost free health care for the entire population since universal health coverage began in 2002. Previous longitudinal studies have indicated that access to health care (e.g., outpatient visits and inpatient admissions from public health-care providers) has significantly increased after the introduction of universal health coverage. Furthermore, the increase was significantly higher among people with low socioeconomic status, such as low-income and older people (Gruber et al., 2014; Health Insurance System Research Office, 2012; Meemon & Paek, 2018).

Nevertheless, socioeconomic inequalities in health-care access have been consistently found in previous cross-sectional studies. Multiple previous studies have indicated that access to health care has been significantly lower among older people than among younger people (Chongthawonsatid, 2021; Meemon & Paek, 2019; Thammatacharee *et al.*, 2021) and socioeconomically unequal among older people (Meemon & Paek, 2019; Osornprasop & Sondergaard, 2016). Moreover, other studies have identified that non-medical costs and a lack of social support facilitating access to health care (e.g., a lack of caretakers to bring older people to health-care providers and a lack of affordable transportation options) are the main reasons for older people' poor health-care access (Kullanit & Taneepanichskul, 2017; Srisatidnarakul & Bunthumporn, 2020).

These findings raise concerns about health-care access for older people living alone, who probably lack the resources needed to access health care that can be acquired from family members. According to the convoy model of social support, family members can act as a "convoy" that helps older family members cope with life challenges by providing economic and non-economic support, such as care during illness and transportation support for health-care access. According to this model, co-residence with the family is one of the most important social structures supporting older people (Antonucci & Akiyama, 1987; Li *et al.*, 2018; Samanta *et al.*, 2015).

This view is particularly evident in developing countries, including Thailand, that have underdeveloped social welfare systems for older people. In these countries, families are the main source of economic and non-economic support to ensure that the day-to-day needs of older people are met (Kamiya & Hertog, 2020; Rattanamongkolgul *et al.*, 2012; Samanta *et al.*, 2015; Thanakwang *et al.*, 2014). Thus, considering the increasing number of older people living alone in Thailand, it is crucial to evaluate the effect of living arrangements on health-care access in this group to develop a policy that provides them with adequate access to health care.

1.1. Literature review

Although access to health care and its influencing factors among older people have been extensively studied in Thailand, the issue of health-care access for older individuals living alone has received less attention. Two studies analyzed the relationship between living arrangements and health-care access among older adults in Thailand (Osornprasop & Paek, 2020; Osornprasop & Sondergaard, 2016). These studies showed that older people living alone have a lower socioeconomic status and less access to health care than those not living alone.

Specifically, Meemon & Paek (2020) reported that older people living alone were observed to be older, female, and more likely to have a lower income, education level, and a higher prevalence of chronic diseases compared to those who do not live alone. Approximately 40% of older people living alone live below the national poverty line. This percentage was approximately three times lower for older adults who did not live alone. In terms of access to health care, the prevalence of unmet health-care needs (UHN), which is a situation in which individuals need health care but cannot access it, was around 4% among older people living alone. This prevalence was approximately two times higher than among those who did not live alone. Moreover, low-income and chronic diseases were positively associated with UHN.

This subject has also been investigated in many previous studies in other countries. Contrary to the findings from Thailand, those from other countries show that older people living alone use health-care services – based on, for example, the probability of hospital admission or the length of hospital stay – more than those not living alone (Dreyer *et al*., 2018; González-González *et al*., 2011; Guzman *et al*., 2004; Mu *et al*., 2015; Turner *et al*., 2016). These inconsistent findings between Thailand and other countries are probably due to the different measures of health-care access. That is, the use of health-care services analyzed in previous studies in other countries presumed equal access to health care (i.e., these studies assumed that all participants could easily access health care).

Previous studies have provided a comprehensive understanding of access to health care for older adults living alone. However, since they made limited efforts to control for confounding effects, it remains unclear whether the high rate of UHN among older people living alone is due to their living arrangement or socioeconomic status, taking previous findings from Thailand as an example. Specifically, the positive association between living alone and UHN may have been confounded by income. We assumed two conditions: (i) low income is associated with a high prevalence of UHN while living alone is not and (ii) older people living alone have lower incomes than those not living alone. Under these conditions, older people living alone are likely to have more UHN than those not living alone. However, the positive association between living alone and UHN could be due to income rather than living arrangements. Thus, a study that addresses the issue of confounding effects is needed to evaluate the precise relationship between living alone and UHN.

In addition, as mentioned previously, multiple studies in Thailand have indicated socioeconomic inequalities in health-care access among older adults. However, most of these studies were conducted using a relatively limited number of samples from particular regions (Kullanit & Taneepanichskul, 2017; Osornprasop & Sondergaard, 2016; Srisatidnarakul & Bunthumporn, 2020). Thus, a study using nationally representative data is needed to verify whether these findings are generalizable to the entire nation of Thailand.

Therefore, the present study used Thailand's 2019 Health and Welfare Survey (HWS) dataset to investigate UHN among older people living alone in Thailand. Specifically, this study has two objectives. The first objective was to analyze the effect of living alone on UHN after adjusting for potential confounding effects. To adjust for confounding effects, we employed a propensity score matching (PSM) method and equalized sociodemographic characteristics between older people living alone and those not living alone (Austin, 2011; Baek *et al*., 2015). The second objective was to analyze the sociodemographic determinants of UHN using the entire sample of data.

2. Methods

2.1. Data and sample

This study employed a cross-sectional design, employing data from a nationwide 2019 HWS dataset. The HWS dataset, a biannual survey dataset released by the National Statistical Office of Thailand, includes a nationally representative sample with comprehensive sociodemographic and essential health information about the entire Thai population. The National Statistical Office carried out the HWS in 2021 during the COVID-19 pandemic but did not release it. Thus, the 2019 HWS dataset used in this study was the most recent dataset at the time this study was conducted.

In this study, individuals aged 65 years or older were defined as older people. Among all older people in the 2019 HWS dataset, those who reported needing health care during the past month were selected as the study sample for the analysis. This study included two separate samples for each research objective: a matched sample obtained using the PSM method for the first objective and an entire sample of data for the second objective.

The matched sample was obtained using the PSM method using 1:1 matching with a caliper width of 0.05. Propensity scores were estimated from a binary logistic regression (BLR) analysis using living arrangement (living alone versus not living alone) as the dependent variable and all other socio-demographic variables as the independent variables. A caliper width of 0.05 was determined after evaluating the equality between the groups and the number of matched pairs (Austin, 2011; Baek *et al*., 2015). We repeated the PSM method by decreasing the caliper width by 0.025 from 0.2, which is the optimal caliper width suggested by Austin (2011). When the caliper width was set higher than 0.05, some variables, such as income and education, were not statistically equal between older people living alone and those not living alone. Meanwhile, when the caliper width was set below 0.05, the number of matched pairs decreased significantly, indicating that only particular groups of older people (e.g., high-socioeconomic older people) were matched between the two groups. A caliper width of 0.05 ensured both the number of matched pairs and the level of equality between the two groups.

The original 2019 HWS dataset included 4,611 older people who needed health care during the past month, 746 of whom were living alone and 3,865 of whom were not. After the PSM was performed, 733 matched pairs were obtained, accounting for approximately 98% of the original dataset of older people living alone.

2.2. Variable selection and measurement

The dependent variable (UHN) was assessed as a binary variable, where the response options were "yes" and "no." The 2019 HWS dataset posed two questions to assess the UHN of respondents: (i) "during the past 1 month, was there ever a time when you felt that you needed health care?: yes or no" and (ii) "If yes, did you receive it?: received or not received". Among older people who answered "yes" to Question 1 (i.e., the study sample), those who answered "not received" to Question 2 were categorized into the "yes" group, and those who answered "received" to the question were categorized into the "no" group. Living arrangement (independent variable) was also measured as a binary variable, with options of "living alone" or "not living alone."

In addition, following Aday & Andersen's (1974) access to the medical care model as well as variable availability in the data, this study's analysis included six sociodemographic variables as control variables. According to Aday and Andersen's model, the factors affecting health-care access are divided into predisposing, enabling, and need-for-care factors. Predisposing factors are the demographic and sociocultural characteristics of individuals before the onset of illness. Enabling factors are individual- and community-level resources that facilitate access to health care. Need-for-care factors are perceived (subjective) and evaluated (objective) health problems or illness levels that generate the need for health care. In the present study, three sociodemographic variables (age, sex, and education), two socioeconomic variables (income and place of residence), and the presence of chronic diseases were selected as predisposing, enabling, and need-for-care factors, respectively, and used as control variables in the analysis.

Age and income were measured using tercile scales that divided the sample into three equal proportions. A higher tercile indicates higher income and older age. To measure the income tercile, we used the equivalence scale income, which is income adjusted for a one-person household. Equivalent income was computed using Equation I (Organization for Economic Co-operation and Development, 2008):

$$\text{Total household income} \div \sqrt{\text{household members}} \qquad \text{(I)}$$

The income thresholds for Terciles 1 and 2 (T1 and T2) were 3,536 and 8,660 baht (equivalent to approximately 106 and 260 USD, respectively, based on a baht-USD exchange rate of 1 bath = 0.03 USD). The age thresholds for T1 and T2 were 70 and 77 years old, respectively.

The remaining control variables were measured as binary variables: sex (male versus female), education (primary school or lower versus secondary school or higher), chronic disease (yes versus no), and place of residence (urban versus rural).

2.3. Statistical analysis

A descriptive analysis was performed to summarize the study samples and variables. In the analysis, the bivariate association between the dependent variable (UHN) and each independent and control variable was investigated using the Chi-squared test. In addition, since UHN was a binary variable, a BLR analysis was used to examine how the independent and control variables were associated with UHN.

We developed two separate BLR models: one using the matched sample after the PSM method and another using the entire sample before the PSM method. The BLR model using the matched sample aimed to accomplish the first research objective (i.e., to investigate the effect of living alone on UHN after controlling for potential confounding effects). The BLR model using the entire sample aimed to accomplish the second research objective of this study (i.e., to investigate the sociodemographic determinants of UHN). The performance of the BLR models was examined using Hosmer–Lemeshow goodness-of-fit test (Hosmer & Lemeshow, 2000).

In addition, multicollinearity among the independent and control variables was examined using the variance inflation factor and cross-comparison between the crude and adjusted odds ratios (aORs). The variance inflation factor score ranged from 1.002 to 2.339, and there were no large directional switches between the crude and aORs, suggesting that multicollinearity was not an issue (Menard, 2002).

In this study, statistical significance was set at a p-value of 0.05. For the BLR models, the odds ratio and 95% confidence interval (CI) were used to determine the directional relationship and statistical significance, respectively. All analyses were conducted using the SAS version 9.2 software.

3. Results

3.1. Descriptive analysis

Table 1 reveals the descriptive analysis results. According to the results derived from the matched sample (i.e., the sample obtained by the PSM method), all p-values of the Chi-squared tests were higher than 0.05, indicating that all sociodemographic characteristics were statistically equal between older people living alone and those who did not.

The results derived from the matched sample revealed that the prevalence of UHN was significantly higher in

Table 1. Descriptive statistics of the study samples and variables (%)

Variables	Entire sample (*N*=4,611)		X^2 test *p*-value	Matched sample (*N*=1,466)		X^2 test *p*-value
	Living alone			Living alone		
	Yes (*n*=746 [16.18%])	No (*n*=3,865 [83.82%])		Yes (*n*=733 [50%])	No (*n*=733 [50%])	
Unmet health-care needs						
Yes	8.98	5.54	<0.001*	9.14	5.87	0.017*
No	91.02	94.46		90.86	94.13	
Income tercile						
T1	58.31	25.17	<0.001*	57.57	57.57	0.550
T2	28.02	37.13		28.51	26.74	
T3	13.67	37.70		13.92	15.69	
Age tercile						
T1	33.65	39.59	<0.001*	34.24	32.33	0.708
T2	31.64	30.53		31.65	31.92	
T3	34.72	29.88		34.11	35.74	
Sex						
Male	28.42	41.76	<0.001*	28.92	27.56	0.562
Female	71.58	58.24		71.08	72.44	
Education						
Primary or lower	78.28	78.65	0.821	79.67	79.26	0.846
Secondary or higher	21.72	21.35		20.33	20.74	
Chronic disease						
Yes	83.29	79.36	0.010*	79.67	80.49	0.695
No	16.71	20.64		20.33	19.51	
Place of residence						
Rural	46.65	44.94	0.391	47.20	45.70	0.565
Urban	53.35	55.06		52.80	54.30	

Note: *$p<0.05$.
Abbreviation: T: Tercile.

older people living alone than in those not living alone (9.14% versus 5.87%). This result means that living alone significantly increased the chance of experiencing UHN among older people, regardless of differences in their sociodemographic characteristics.

The results obtained from the entire sample of data indicate that older people living alone have significantly poorer sociodemographic situations than those not living alone. Specifically, the living-alone group, compared to the non-living-alone group, comprised a higher proportion of older people with low incomes and chronic diseases; they also tended to be older and female. These sociodemographic inequalities are consistent with previous findings (Meemon & Paek, 2020; Osornprasop & Sondergaard, 2016).

3.2. BLR analysis

Tables 2 and 3 reveal the results of the BLR models using the matched sample and the entire sample, respectively. The *p*-values of Hosmer–Lemeshow goodness-of-fit test for both models were greater than 0.05, suggesting that the BLR models did not show a lack of fit with the data.

Table 2 shows the results of the BLR model using the matched sample, which was considered in line with the first research objective of this study (i.e., to analyze the effect of living arrangements on UHN after controlling for potential confounders). The results indicate that living alone positively affects UHN, with an aOR of 1.613 and a CI of 1.066 – 2.440. This AOR means that among older people who needed health care, those living alone were 1.613 times more likely not to have access to it than those not living alone. Similar to the descriptive analysis results, this result also indicates that living alone significantly increases the probability of experiencing UHN among older people, regardless of differences in sociodemographic characteristics.

Table 3 reveals the results of the BLR model using the entire sample, which was considered in line with the second

Table 2. Binary logistic regression analysis using matched sample (*n*=1,466)

Variables	COR	95% CI	AOR	95% CI	VIF
Living alone (yes *vs.* no)	1.614*	(1.085, 2.402)	1.613*	(1.066, 2.440)	1.002
Income (T1 *vs.* T3)	3.280*	(1.407, 7.648)	3.001*	(1.235, 7.291)	2.339
Income (T2 *vs.* T3)	3.017*	(1.241, 7.333)	2.692*	(1.069, 6.779)	2.246
Age (T1 *vs.* T3)	1.020	(0.621, 1.674)	0.919	(0.541, 1.560)	1.342
Age (T2 *vs.* T3)	1.429	(0.895, 2.283)	1.324	(0.808, 2.169)	1.317
Sex (male *vs.* female)	1.203	(0.792, 1.828)	1.096	(0.704, 1.706)	1.013
Education (low *vs.* high)	1.176	(0.712, 1.943)	0.975	(0.572, 1.662)	1.076
Chronic disease (yes *vs.* no)	6.597*	(4.406, 9.877)	6.478*	(4.286, 9.791)	1.021
Place of residence (rural *vs.* urban)	1.121	(0.760, 1.654)	0.824	(0.542, 1.252)	1.051
Hosmer–Lemeshow GOF test					
X^2 score (df)			14.035 (8)		
p-value			0.081		

Note: *p<0.05.
Abbreviations: AOR: Adjusted odds ratio; CI: Confidence interval; COR: Crude odds ratio; Education (low *vs.* high): Primary or lower *vs.* secondary or higher; GOF: Goodness-of-fit; T: Tercile; VIF: Variance inflation factor.

Table 3. Binary logistic regression analysis using the entire sample (*n*=4.611)

Variables	COR	95% CI	AOR	95% CI	VIF
Living alone (yes *vs.* no)	1.683*	(1.264, 2.242)	1.404*	(1.027, 1.919)	1.096
Income (T1 *vs.* T3)	1.850*	(1.352, 2.532)	1.398*	(1.008, 1.950)	1.512
Income (T2 *vs.* T3)	1.535*	(1.121, 2.101)	1.383*	(1.013, 1.896)	1.385
Age (T1 *vs.* T3)	0.845	(0.631, 1.131)	0.792	(0.585, 1.072)	1.399
Age (T2 *vs.* T3)	0.941	(0.696, 1.272)	0.913	(0.669, 1.246)	1.390
Sex (male *vs.* female)	0.876	(0.682, 1.124)	0.814	(0.627, 1.056)	1.016
Education (low *vs.* high)	0.981	(0.732, 1.315)	0.922	(0.679, 1.251)	1.037
Chronic disease (yes *vs.* no)	5.701*	(4.448, 7.307)	5.629*	(4.375, 7.243)	1.016
Place of residence (rural *vs.* urban)	1.294*	(1.016, 1.647)	1.148	(0.892, 1.477)	1.033
Hosmer–Lemeshow GOF test					
X^2 score (df)			10.601 (8)		
p-value			0.225		

Note: *p<0.05.
Abbreviations: AOR: Adjusted odds ratio; CI: Confidence interval; COR: Crude odds ratio; Education (low *vs.* high): Primary or lower *vs.* secondary or higher; GOF: Goodness-of-fit; T: Tercile; VIF: Variance inflation factor.

research objective (i.e., to analyze the sociodemographic determinants of UHN). The results indicated that three variables (living arrangement, income, and chronic disease) were significantly related to UHN.

Specifically, living alone was positively associated with UHN, with an AOR of 1.404 and a CI of 1.027 – 1.919. This AOR means that older people living alone experienced 1.404 times more UHN than those not living alone. Regarding income, older people in the lowest (T1: below 3,536 baht or below 106 USD) and mid-level income terciles (T2: 3.536 – 8.660 baht or 106 – 260 USD) experienced 1.398 (CI: 1.008 – 1.950) and 1.383 (CI: 1.013 – 1.896) times more UHN, respectively, than those in the highest tercile (T3: above 8,660 baht or 260 USD). Further, older people with a chronic disease were 5.629 (CI: 4.375 – 7.243) times more likely to encounter UHN than those without a chronic disease. These sociodemographic inequalities in UHN are consistent with previous results (Meemon & Paek, 2020; Osornprasop & Sondergaard, 2016).

4. Discussion

The present study examined UHN among older people living alone in Thailand using the national 2019 HWS dataset. This study has two specific objectives: the first was to analyze the impact of living alone on UHN using a matched sample obtained from the PSM method and the second objective was to analyze the sociodemographic determinants of UHN using the entire sample of data.

The results related to the first objective indicate that living alone has a positive effect on UHN. The BLR model using the matched sample (Table 2) shows that older people living alone experienced 1.613 (CI: 1.066 – 2.440) times more UHN than those not living alone. This result indicates that living alone could significantly increase the probability that older people will experience UHN, regardless of differences in sociodemographic characteristics.

This finding is consistent with previous studies in Thailand (Meemon & Paek, 2020; Osornprasop & Sondergaard, 2016). Furthermore, this study's use of a PSM method to adjust for potential sociodemographic confounders provided a precise estimate of the relationship between living arrangements and UHN, which could improve the existing knowledge about the health-care accessibility of older people living alone in Thailand.

The unavailability of caretakers may have been the primary cause of the high rate of UHN among older people living alone, as indicated in previous studies (Meemon & Paek, 2019; Osornprasop & Sondergaard, 2016). In general, access to health care significantly decreases for older people because the decline in physical function, which is a common feature of older people, makes it difficult for them to travel independently to health-care providers (Sibbritt *et al*., 2007). In Thailand, family members often serve as caretakers, ensuring health-care access for older people (Rattanamongkolgul *et al*., 2012; Thanakwang *et al*., 2014). However, this family support is limited for older people living alone compared to those living with family members, which may increase the probability that older people living alone will experience UHN.

To address this issue, the government should strengthen the existing community health volunteer (CHV) programs. As a formal part of Thailand's primary health-care system, CHVs have been connecting community members with mobility limitations (e.g., people with disabilities and bedridden patients) and health-care providers (Kowitt *et al*., 2015). The CHV program should also prioritize older people living alone who need caretakers during illness. Local health authorities should assist with the CHV program by offering health emergency vehicles, particularly for older people who live outside major cities and have limited transportation options to access health-care providers.

Regarding the second objective, the results revealed that inequality in access to health care among older people exists based on their income and whether they have a chronic disease. Specifically, the BLR model using the entire sample of data (Table 3) shows that older people with a low income and chronic disease encountered 1.391 (CI: 1.015 – 1.923) and 5.629 (CI: 4.375 – 7.243) times more UHN than their counterparts.

The lack of affordable transportation options for older people with low incomes may be a significant reason for the UHN, as indicated in previous studies (Kullanit & Taneepanichskul, 2017; Srisatidnarakul & Bunthumporn, 2020). The old-age allowance (OAA) universal pension for people aged 60 years or older is the main source of income for most older people in Thailand. Some low-income people depend on OAA as their only source of income. These low-income individuals usually spend their entire monthly allowance on room rent and food and, therefore, do not have extra resources to travel to health-care providers. Public transportation (e.g., public buses and taxis), which is relatively affordable, is available only in Bangkok (the capital city of Thailand) and neighboring major cities. Older people living outside these major cities must rent private vehicles to access health-care providers. However, renting private vehicles is not affordable for many older adults, especially those with low incomes (Osornprasop & Sondergaard, 2016).

Thus, in addition to our previous recommendation for vehicle support from local health authorities, the government should improve financial independence to alleviate the UHN of low-income older people. According to a simulation analysis performed by Meemon & Paek (2020), when the present OAA of 600 – 1,000 baht (equivalent to 18 – 30 USD) increased to 3,500 baht (equivalent to 105 USD), the probability of encountering UHN decreased significantly, which should be considered by the government.

In addition, the high rate of UHN among older people with chronic diseases is likely attributed to their increased frequency of visits to health-care providers, potentially resulting in an increased probability of experiencing UHN than those without chronic diseases. Telemedicine can be a measure to improve access to health care for older people who need regular health care, such as those with chronic or congenital diseases. In Thailand, telemedicine services have been implemented in major central-level hospitals since the COVID-19 pandemic in 2020 and have been reported to substantially increase health-care accessibility, particularly for chronic patients (National Health Security Office, 2020). Therefore, the government should extend telemedicine services to district-level hospitals and community-level health centers to alleviate the high rate of UHN among older people with chronic diseases.

Although this study proposes specific recommendations based on the key findings above, these recommendations constitute short-term measures. In the long term, the government should continue to improve the shortage of health-care infrastructure and resources, a well-known factor that hampers access to health care (Antos, 2007; Paek *et al*., 2016).

Finally, this study has several limitations that should be addressed in future studies. First, the PSM method used in this study should be improved by including more diverse factors (e.g., disability status and geriatric factors such as an activity of daily living index) that are more directly related to access to health care to further alleviate selection bias and more precisely evaluate the impact of living alone on UHN. The HWS dataset and other data sources, such as the National Survey of Older Persons in Thailand, will need to be merged for this purpose.

Second, in this study, UHN was measured using self-reported data, with respondents directed to assess their needs for health care based on their personal perceptions. Thus, they should be aware of their health-care needs and willing to report them. Such subjective measures inevitably include issues of limited recall and social desirability biases. Objective measures of UHN (e.g., UHN adjusted for objective health outcomes evaluated by health professionals) can be employed in the future as alternative or complementary measures to improve the issues associated with subjective UHN (Howe Hasanali, 2015; Newacheck *et al*., 2000).

Third, the simplistic categorization of living arrangements (living alone versus not living alone) used in this study should be further subdivided and analyzed in future studies. The initial plan of this study was to divide living arrangements into three categories: living alone, living with a spouse, and living with a spouse and adult children. However, because of the relatively small number of older people living alone in the HWS dataset, the PSM method cannot provide stable matched pairs.

This issue also occurred when measuring the independent and control variables. For instance, subdivided income (such as quintile and quartile income) and age did not allow the PSM to offer stable marched pairs. Furthermore, regarding chronic diseases, the HWS dataset designated 32 diseases (e.g., diabetes, hypertension, and cancer) as chronic diseases. We initially categorized the chronic diseases according to their severity. However, this does not allow the PSM method to offer stable matched pairs. In addition, because the HWS required respondents to select only their primary chronic disease, we could not classify chronic patients according to the number of chronic diseases, which, as indicated in previous studies, are significantly related to access to health care. The National Statistical Office of Thailand should consider this issue in future HWSs. Finally, a longitudinal study should be performed to evaluate how the cross-sectional effect of living arrangements on UHN found in this study changes over time.

5. Conclusion

The present study examined UHN among older people living alone in Thailand using the national 2019 HWS dataset. This study had two specific objectives. The first was to analyze the impact of living alone on UHN using a matched sample obtained from a PSM method. The second objective was to analyze the sociodemographic determinants of UHN using the entire sample of data. The findings related to the first objective indicate that older people living alone experienced 1.613 (CI: 1.066 – 2.440) times more UHN than those living with others. The findings regarding the second objective reveal that older people with low incomes and chronic diseases experienced 1.39 (CI: 1.015 – 1.923) and 5.63 (CI: 4.375 – 7.243) times more UHN than their counterparts.

Non-medical costs and a lack of social support facilitating access to health-care (e.g., a lack of caretakers to bring older people to health-care providers and a lack of affordable transportation options) may have been the primary causes of the high rate of UHN for these groups, as indicated in previous studies. Thus, the government should continue its efforts to alleviate these issues. Specifically, the existing CHV program should prioritize older people living alone who need caretakers during illness. Local health authorities should support the program by offering health emergency vehicles, especially for those living outside major cities with limited transportation options to access health-care providers.

The government should also increase the OAA to enhance older people's financial independence and extend current telemedicine services to district hospitals and community health centers; such measures have been found to improve health-care access for low-income older people who do not have extra resources to travel to health-care providers and chronically ill older people who need health care regularly in Thailand. Although this study proposes specific recommendations based on the main findings above, these recommendations represent short-term measures. In the long term, the government should continue to resolve the shortage of health-care infrastructure and resources, which are well-known factors hampering access to health care.

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Conflict of interest

The authors declare that they have no competing interests.

Author contributions

Conceptualization: All authors
Data curation: Seung Chun Paek
Formal analysis: Seung Chun Paek
Investigation: All authors
Methodology: All authors
Writing – original draft: Seung Chun Paek
Writing – review & editing: All authors

Ethics approval and consent to participate

This study was granted "Exemptions from IRB review" by the Research Ethics Committee of the Faculty of Social Sciences and Humanities, Mahidol University (Certificate of Exemption No.: 2023/011.2306).

Consent for publication

Not applicable.

Availability of data

The data that support the findings of this study are available from the National Statistical Office of Thailand, but restrictions apply to the availability of these data, which were used under license for the present study, and so are not publicly available. However, the data are available from the corresponding authors upon reasonable request and with permission from the National Statistical Office of Thailand.

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RESEARCH ARTICLE

Indian family relationships, marriage, and career choices in the context of globalization: A multigenerational evaluation

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Abstract

The present study aims to explore and compare changes in Indian family relationships, marriage, and career choices from the perspectives of three different generations. A total of 30 participants, 10 from each of the three generational groups participated in the study: 61 years and above (pre-globalization generation [Pre-G]), 40 – 60 years (transition generation [Trans-G]), and 18 – 30 years (contemporary young generation [Cont-G]). Data were collected through semi-structured interviews conducted in February and March 2023. Thematic analysis revealed several major changes perceived by the participants, including the shift from joint families to nuclear families, changes in filial piety, an increased sense of individual autonomy, a more egalitarian nature of families, an increase in the number of working women, a decrease in the quality of family relationships, more authoritative parenting, positive in-law relationships, changes in the nature of marriages, changes in the process of mate section, and changes in decision-making about education and career. The comparison of perspectives across the three generations showed distinct differences. The older generation was critical but showed a readiness to accept changes. The middle generations viewed the changes negatively and exhibited high resistance. In contrast, the younger generations viewed the changes as liberating and were willing to embrace them. The implications for family policies and cross-cultural research are discussed.

Keywords: Globalization; Indian families; Parent-child relationship; Marriage; Career choices

1. Introduction

Globalization refers to several phenomena, including the emergence of a single global marketplace with expanding free trade between countries, the movement and sharing of information, and the creation of connections and human links worldwide without being restricted by national borders (Čiarnienė & Kumpikaitė, 2008). It has increased the interconnection and interdependence of nations and regions globally, facilitating the spread of ideas and values across borders. Globalization has profoundly affected many facets of modern society, such as politics, economics, technology, and culture. It has been notably influential in developing nations like India, prompting substantial societal and cultural transformations (Naidu, 2006). These cultural changes are reflected in various aspects, such as traditional practices, family dynamics, media, people's values, lifestyles, and attitudes.

Previous studies have shown that globalization has brought changes in family structures with the adoption of more individualistic and nuclear family models (Parreñas, 2005), changes in family values and norms, and marriage systems (Ghosh, 2011; Rahman & Zhang, 2017; Yang & Neal, 2006; Imam-Tamim *et al*., 2016; Niedomysl *et al*., 2010; Rao & Rao, 1976), career development and choices (McMahon *et al.*, 2012; Pan, 2005; Gill, 2013), parent-child relationships (Prevoo & Tamis-LeMonda, 2017; Fatema, 2014), and traditional intergenerational dynamics (Chen & Farrell, 2006) worldwide. Globalization has also influenced India's economic (Ghosh, 2011), cultural, religious, and social structure (Naidu, 2006; Patole, 2018). Existing research has found that globalization has impacted different dynamics of Indian families, such as family structure, relationships, marriage, and child-rearing practices (Derné, 2005; Gogineni *et al*., 2018; Kumar, 2023), and has changed people's lifestyles and living standards (Chawla & Mohapatra, 2017). However, previous research has not explored the changes perceived by individuals of different generations who confronted the effects of globalization at different time points in their lives. Specifically, the present study focuses on transitions in family relationship dynamics, marriage, and career choices.

1.1. Globalization and cultural changes

Globalization has greatly impacted cultural systems, as explained by various theories. Homogenization theory proposes that globalization can either lead to the emergence of a uniform culture, erasing local distinctions (Tomlinson, 1999), or result in the spread of the dominant culture (e.g., Western culture) by suppressing all other local cultures (as indicated by cultural imperialism theory proposed by Demont-Heinrich [2011]). In addition, hybridization theory suggests that globalization fosters the blending of cultures, giving rise to hybrid forms that transcend pure local or global characteristics (Canclini, 1995). Glocalization theory posits that globalization leads to simultaneous global and local cultural changes, with global influences adapting and integrating into local contexts (Robertson, 1995).

The impact of globalization could take any of the forms proposed by these theories. However, it is apparent that globalization has a significant social and cultural influence on society as a whole and its practices, which can be seen even in nuanced cultural elements such as language, clothing trends, and cuisine. The dominance of Western culture, particularly American culture, through media, technology, and consumer products, has influenced people's values, lifestyles, and attitudes worldwide. Global fast-food chains such as McDonald's, KFC, and Starbucks have supplanted traditional cuisines (Schlosser, 2012). In India, people increasingly prefer Western clothing to traditional Indian apparel, which is now often reserved for religious festivals and celebrations (Jalal & Husain, 2018). Spoken language and communication media have also been altered by globalization, with English now dominating the world's business, education, and international communication (Pennycook, 2006). The author argued that the acceptance of English loanwords and phrases in regional languages has resulted in changes in language use and proficiency, which may affect regional languages and cultural identities.

1.2. Five "scapes" of globalization

The cultural dimensions of globalization, as proposed by Appadurai (1996), are explained through five "scapes" or flows, which illustrate the global movement of cultural elements and the resulting cultural transformations.

(i) Ethnoscape: The global movement of people to different places for multiple purposes (e.g., immigrants, tourists, studying abroad, etc.) exposes individuals to new cultures and enables them to actively participate in reshaping the cultures they encounter.
(ii) Mediascape: The influence of media (e.g., news, pictures, audiovisual narrative, etc.) allows people to experience distant cultural realities across time and space
(iii) Technoscape: The flow of technological advancements across boundaries radically affects people's everyday lives.
(iv) Financescape: This refers to the fluid movement of currencies and financial resources from one country or region to another (International stock exchange, foreign direct investments, international banks, etc.).
(v) Ideoscape: The small-scale to large-scale exchange of ideas (e.g., sharing personal views through social media to spread Marxist ideology) facilitates cultural changes across different cultures and borders.

It would be reasonable to conclude that all of the changes discussed in this paper have their roots in globalization, even though numerous proximate causes exist for each of these changes. For example, the demographic transition (DT) theory – one of the most widely accepted theories of population growth – posits a changing pattern of mortality, fertility, and growth rates as societies move from one demographic regime to another (Notestein, 1945). The theory suggests that populations grow along four or possibly five stages: High birth and death rates (Stage 1), declining death rates leading to population growth (Stage 2), declining birth rates (Stage 3), low rates of both birth and death (Stage 4), and finally fertility rates transitioning to below-replacement levels (Stage 5). Although this model originated in Western countries and presents difficulties when applied to countries like India, which have different sociocultural and economic circumstances (Chesnais, 1992), it can be observed that India is transitioning from Stage 2 to Stage 3 (Purohit, 2023). The second demographic transition (SDT) theory, jointly formulated by Lesthaeghe & Van de Kaa in 1986, distinguished itself from the first DT by shifting the focus from smaller family size to fertility postponement. The basic features of SDT include high divorce rates and a rise in cohabitation, a shift in family relations from "king-child with parents" to "king-couple with child," and a shift from preventive contraception to self-fulfilling contraception (Van de Kaa, 1987, 2003). This shift reflects a transition in societal norms from altruistic to individualistic values, with an increased emphasis on female emancipation and individual autonomy in family formation behavior (Lesthaeghe, 1995). However, SDT has disregarded the potent force of globalization, which has critical implications for understanding the changes in family dynamics and fertility rates observed in recent decades (Mills & Blossfeld, 2013). In light of this, the present study aims to understand the transitions in family dynamics from the perspective of globalization.

1.3. Changes in family relationships

The impact of globalization is not exclusive to large-scale phenomena such as language, media, and technology; it also influences the smallest unit of society – the family – affecting its interpersonal dynamics, marital systems, and career choices (Trask, 2011). Individuals and families have moved from rural to urban areas and from developing to developed countries in search of better opportunities and resources. This migration has resulted in changes in traditional family structures and roles (Parreñas, 2005; Trask, 2011), conventional intergenerational dynamics, and challenges in maintaining close bonds and transmitting cultural values across generations (Parreñas, 2005). India's earlier joint family system has now considerably reduced, with the emergence of nuclear families on the rise. According to data provided by Kantar (a global media and data consulting company), the proportion of nuclear families in India increased from 37% in 2008 to 50% in 2022 (Ambwani, 2023). In Southern India, nuclear households constitute over 69%, compared to 50% in 2008. These data indicate a shift from traditional kinship networks and extended families to more individualistic nuclear family models (Coontz, 2006).

Furthermore, women's increased participation in the workforce due to increased economic opportunities has changed traditional roles and expectations for men and women (Hondagneu-Sotelo, 2003). Previously, women were expected to handle household duties and nurture children, while men were responsible for financial matters and family decision-making. In the past, men were the sole income earners in families. Today, however, both men and women work to support their families, sharing household responsibilities (Biernat & Wortmen, 1991; Oláh *et al.*, 2021). Even in regions like Southeast Asia and the Middle East, where traditional family roles were stringent, family arrangements where men take part in household duties are becoming more common as women's responsibilities continue to change (Moghadam, 2003).

Family dynamics have also changed considerably in India. For instance, egalitarianism in families is increasing, where every family member has a say in the decision-making process. Before the globalization era, Indian families were patriarchal, with older male family members making significant decisions and younger ones expected to demonstrate filial piety (Newbigin, 2010). However, with the erosion of gender roles and the emergence of women's individuality and autonomy, there are signs of a shift in family dynamics (Patole, 2018). Women's attainment of financial independence has significantly contributed to their current status as equal partners in family decision-making (Kabeer, 1999).

Another aspect of change concerns the parent-child relationship. Cultural adaptation through migration and exposure to global media has caused changes in parenting practices and parent-child relationship dynamics. Changing attitudes toward child-rearing includes shifting cultural norms around child discipline, education, and gender roles. Technological advancements like the internet and social media have transformed communication and interactions between parents and children (Livingstone, 2009). For example, increased internet and social media use by parents and children has led to decreased communication and quality time spent together at home (Wong *et al.*, 2020).

1.4. Changes in the marital system

From a global perspective, significant demographic changes concerning marriage have emerged. Education has led to individuals having more autonomy in mate selection (Banerji, 2008) and has contributed to delays in marriage (Das & Rout, 2023). New educational norms that encourage attaining education and skills before marriage have raised the age of marriage for young people (Bhadra, 2000). In addition, fertility rates are decreasing globally as young people delay marriage and having children (Jones, 2007). Lower fertility rates are also a common result of the pressures modern nations face in balancing work and childcare. This problem is exacerbated by increased levels of fecundity at older ages (Martin, 2017). Das & Rout (2023) found that education, wealth quintile, and mass media are major controlling factors for the delayed age of marriage.

Furthermore, an increase in the number of women in the workforce has resulted in more dual-earner families. As a result, women who can support themselves financially are less likely to stay in abusive and toxic relationships or to marry at all (Strube & Barbour, 1983). Consequently, divorce rates and the number of female-headed households have increased globally (Trask, 2011). In a similar line, statistics show that India's divorce rate has also significantly increased (Jacob & Chattopadhyay, 2016).

Another notable change is a decrease in the prevalence of arranged marriages (Allendorf & Pandian, 2016; Kanth *et al*., 2023) and a subsequent increase in love marriages (Ghosh, 2011; Ganth & Kadhiravan, 2017). In the past, arranged marriages were more prevalent compared to love marriages in India, with parents' preferences considered more important in planned weddings than those of the bride and groom (Allendorf & Pandian, 2016). However, many recent studies show that a hybrid style of marriage – involving both children and parents in partner selection – is increasingly preferred in India (Allendorf & Pandian, 2016; Kanth *et al*., 2023). The traditional role of matchmakers has reduced with the increasing use of matrimonial sites and dating apps, as well as the increased influence of technology (Agrawal, 2015). Furthermore, globalization has led to a greater degree of Western influence in India, increasing the number of live-in relationships – a practice common in Western culture but traditionally uncommon in Indian culture, where weddings are revered as sacred unions (Joshi & Singh, 2023). In addition, the modernization of youth has piqued their preference for having live-in relationships, as opposed to traditional marriage customs (Chakravorty, 2022).

1.5. Changes in career choices

People's career attitudes and behaviors reflect their adaptation to global economic, social, political, and environmental changes due to globalization (Tams & Arthur, 2007). The intricate interplay of globalization, technological integration, international aspirations, and evolving migration patterns has been noted in the literature, causing changes in career choices. There is a discernible surge in the aspiration of students and parents to pursue higher studies in foreign countries (Tereshchenko & Archer, 2014), especially in Western countries, and migration across borders for education and employment among youth has significantly increased during the 21st Century (Marsh & Oyelere, 2018). Family members often encourage students' decisions to study abroad (Kõu *et al*., 2017), with international recognition being the main motivation (Kakkad & Madhu Nair, 2015).

One of the main factors influencing young people's career choices is parental wishes, especially in a country like India, where children are financially dependent on their parents (Malik, 2017). It has also been observed that due to globalization, the emergence of nuclear families and a decreased number of children has led parents to devote more attention to each child, enhancing their influence over their children's career decisions (Sawitri *et al*., 2014). Other changes ushered by globalization in higher education include the widespread adoption of internet connectivity and the integration of mobile phones to support educational endeavors (Pandey, 2023).

1.6. Justification for the present study

Numerous studies have been published about myriad changes in Indian sociocultural aspects, including changing family systems, marriage, and career choices due to globalization. However, the majority of existing studies are either conceptually written from a sociological perspective, lacking empirical examination using primary data generated through surveys or interviews, or are older studies. Furthermore, the present study collected data from three different generations. The perspectives and understanding of changes provided by the participants are based on their own lived experiences and observations. As globalization influences even the basic units of society, apart from large-scale economic changes, it is crucial to conduct an empirical exploration of the influences of globalization through the experiences and observations of the common man. Moreover, a comparison of multiple generations who started their lives before globalization, those who confronted globalization effects in their young adulthood, and those born after globalization adds to the novelty of the study. For example, the introduction of the information technology and information technology-enabled services fields, which brought significant changes, would have caused a tremendous shift in the younger generation's lives compared to older generations who were in their 30s when globalization was introduced. Given the above gaps in the literature, the present study aims to obtain a comprehensive understanding of the changes in family relationships, marriage, and career choices through the consolidation of the perspectives of three different generations. Hence, the objectives of the present study are:

(i) To explore the various aspects of transitions in Indian family relationship dynamics, marriage, and career choices.
(ii) To compare the perspectives of three generations on these changes since they confront the effects of these changes at different points in their lives.

2. Method

2.1. Participants

Given the multigenerational nature of the study, participants representing three generations based on the period that they encountered globalization in India were enrolled. The first generation comprises senior citizens (aged 61 years and above) who confronted globalization during their late 30s, after completing their education, establishing their careers, and getting married. This group is referred to as pre-globalization generation (Pre-G) in the present study. The second generation consists of middle-aged participants (aged 40 – 60 years) who went through their schooling and formative years in a pre-globalized India but were exposed to globalization during their young adulthood. Their personal and professional development coincided with India's transformation due to globalization, and they are referred to as the transition generation (Trans-G) in this study. The third generation consists of individuals aged 18 – 30 who were born and grew up in India after the introduction of globalization, referred to as the contemporary young generation (Cont-G). The age group 31 – 39 was excluded from the study because their responses overlap with those of the Cont-G and Pre-G. Thus, they neither distinctly represent the last generation, Cont-G, nor the first generation, Pre-G.

The study was conducted in the south Indian state of Kerala. Interviews were conducted in Kerala's native language – Malayalam. Participants were approached through a convenient sampling technique. The authors decided a priori to collect data from 10 participants for each generation (N = 30), following Braun & Clarke's (2013) approach for thematic analysis, which suggests that 6 – 10 interviews are acceptable for small projects where data is collected through interviews. In addition, the authors decided a priori to conduct more than 10 interviews if saturation was not achieved. However, the data reached saturation after collecting 10 interviews. As a stopping criterion (Francis *et al.*, 2010), two more interviews were conducted for each group, and it was confirmed that no new themes or ideas were emerging. Therefore, data collection was concluded. The sociodemographic profiles of the participants are presented in Table 1.

2.2. Inclusion criteria

The inclusion criteria for the participants in this study are as follows:

- All participants must be continuously residing in India in an intact family structure (living in a nuclear or joint family system).
- Individuals aged 61 years and above (Pre-G) must be married and have children and grandchildren.
- Individuals who are aged 40 – 60 years (Trans-G) must be married and have children.

Participants who failed to meet the inclusion criteria were excluded from the study.

2.3. Procedure

A semi-structured interview format was employed, featuring a comprehensive list of open-ended questions. An independent panel of two reviewers examined the interview questions to ensure they addressed the study's objectives. Online flyers and notifications were shared through social media to recruit participants. Interested individuals who responded were subsequently contacted.

Eight pilot interviews were conducted to evaluate the feasibility and duration of the interviews and to gather feedback from participants to improve the study design. Ten participants from each generation were interviewed, with the option to choose between face-to-face or telephone interviews. Among the 30 participants, 22 were interviewed face-to-face, and eight were interviewed through telephone. Face-to-face interviews took place at the participants' homes, as all participants preferred this location when asked about their convenience. All interviews were conducted in Kerala during February and March 2023 by the first and second authors. The researchers prepared an interview guide with six sections: introduction, changes in parent-child relationships, changes in marriage, changes in career choices, changes in family dynamics, and conclusion (Appendix A1). The interviews lasted for 12 – 50 min, averaging around 30 min. The interview sessions were audio-recorded with permission and later manually transcribed by the lead researchers. To ensure anonymity, participant's names were concealed by assigning a unique ID to each.

2.4. Data analysis

The authors adhered to Braun & Clarke's (2006) six-phase data analytic approach. Four separate coders worked on the data analysis procedure. First, to familiarize themselves with the data and concepts, each coder thoroughly studied the transcribed data independently. Second, using the conventional paper-pen method, coders began classifying the data by carefully reading over the verbatim

Table 1. Demographic characteristics of participants

Sl. No.	Unique ID	Group	Sex	Age	Education	Occupation	Residence	Marital status	No. of children	Type of family	No of siblings
1.	ID_01	Pre-G	M	81	10th grade	Farmer	Rural	Married	2	Nuclear	2
2.	ID_02	Pre-G	F	87	Graduate	Retired (Teacher)	Rural	Married	3	Joint	6
3.	ID_03	Pre-G	M	75	Postgraduate	Retired (Teacher)	Urban	Unmarried	0	Joint	5
4.	ID_04	Pre-G	M	77	10th grade	Retired (Air force)	Rural	Married	3	Nuclear	2
5.	ID_05	Pre-G	M	66	Postgraduate	Retired	Urban	Married	1	Nuclear	1
6.	ID_06	Pre-G	M	64	Postgraduate	Retired	Rural	Married	3	Nuclear	3
7.	ID_07	Pre-G	M	77	Postgraduate	Retired (Teacher)	Urban	Married	2	Nuclear	2
8.	ID_08	Pre-G	F	69	10th grade	Retired	Urban	Married	2	Nuclear	11
9.	ID_09	Pre-G	F	81	Postgraduate	Retired (Teacher)	Urban	Married	3	Nuclear	10
10.	ID_10	Pre-G	F	67	10th grade	Retired	Urban	Married	3	Nuclear	13
11.	ID_11	Tran-G	M	60	Graduate	Business	Rural	Married	2	Nuclear	3
12.	ID_12	Tran-G	M	58	Graduate	Farmer	Rural	Married	3	Nuclear	3
13.	ID_13	Tran-G	M	48	Postgraduate	Bank manager	Rural	Married	1	Nuclear	2
14.	ID_14	Tran-G	M	52	Graduate	Farmer	Rural	Married	2	Joint	6
15.	ID_15	Tran-G	M	46	Postgraduate	Bank manager	Urban	Married	2	Nuclear	3
16.	ID_16	Tran-G	F	46	Postgraduate	Teacher	Rural	Married	2	Nuclear	2
17.	ID_17	Tran-G	F	47	Postgraduate	Teacher	Rural	Married	2	Nuclear	3
18.	ID_18	Tran-G	F	45	Postgraduate	Homemaker	Rural	Married	1	Joint	5
19.	ID_19	Tran-G	F	46	Graduate	Business	Rural	Married	2	Nuclear	1
20.	ID_20	Tran-G	F	44	Postgraduate	Teacher	Rural	Married	1	Nuclear	8
21.	ID_21	Cont-G	M	22	Graduate	Student	Rural	Unmarried	0	Joint	3
22.	ID_22	Cont-G	M	23	Graduate	Student	Urban	Unmarried	0	Nuclear	0
23.	ID_23	Cont-G	M	23	Graduate	Student	Rural	Unmarried	0	Nuclear	1
24.	ID_24	Cont-G	M	23	Graduate	Student	Urban	Unmarried	0	Nuclear	2
25.	ID_25	Cont-G	M	23	Graduate	Student	Rural	Unmarried	0	Nuclear	1
26.	ID_26	Cont-G	F	25	Graduate	Student	Urban	Unmarried	0	Nuclear	2
27.	ID_27	Cont-G	F	24	Graduate	Student	Urban	Unmarried	0	Nuclear	2
28.	ID_28	Cont-G	F	22	Graduate	Student	Rural	Unmarried	0	Nuclear	3
29.	ID_29	Cont-G	F	27	Postgraduate	Student	Rural	Unmarried	0	Nuclear	2
30.	ID_30	Cont-G	F	25	Graduate	Student	Rural	Unmarried	0	Nuclear	2

Notes: Pre-G: Pre-globalization generation; Cont-G: Contemporary young generation; Trans-G: Transition generation; F: Female; M: Male.

transcripts, noting pertinent quotes, and simultaneously assigning codes. Following the completion of independent coding processes, the coders collaboratively reviewed the developed codes, reached a consensus, and finalized the codes. A total of 51 codes were identified as pertinent to the scope of the study. Later, to generate themes and sub-themes, researchers combined similar codes or those that appeared to belong under a generic umbrella theme. Each theme was then titled based on what the codes collectively represented. After the theme generation process, the themes were reviewed and finalized by assessing the significance of each theme. Finally, nine major themes and six sub-themes were finalized when the codes were combined.

2.5. Ethical consideration

All participants provided informed consent and clarified that their participation was voluntary. Before the interview, participants read and agreed to an informed consent form. They were made aware that they could leave the interview at any moment. No personally identifiable information was gathered. Confidentiality and anonymity were given the utmost consideration. Participants were also assured that the data would be accessible only to the researchers and utilized exclusively for research purposes.

3. Results

The present study aims to explore and compare different changes in Indian family relationships, marriage, and career choices from the perspectives of three different generations. Thematic analysis was conducted, and the results were organized into themes, sub-themes, and codes (Appendix A2). Each theme is explained with its operational definition and illustrative quotations from the data in the result section. Verbatim responses from participants are labeled with unique IDs, age, and gender, where "M" represents male and "F" represents female. In addition, a comparative analysis of the perspectives of the three generations is provided (Table 2).

3.1. Shift from joint to nuclear family

This theme captures the transition of families from big joint family units to nuclear ones. All three generations agree that fewer children have been raised in families over the last few decades. Participants reported that reasons for this change could include better family planning, attractive white-collar jobs that offer more financial stability compared to farming, and the perceived lack of resources in joint family living conditions. The evaluations of the three different generations on the decrease in the number of children vary: the Cont-G and the Trans-G attribute this change to improved family planning, whereas the Pre-G views it negatively, believing that new parents are "busy" and too lazy to care for more children. Some illustrative verbatims are as follows:

> *"In earlier times, there were many children in households. Nowadays, most of them do thorough family planning. People decide the number of children based on their financial and social situation. Earlier, there was no such planning."* (ID_15/46/M)

> *"Lifestyle changes have led to more nuclear families. In earlier times, family members lived together and did farming together. For that, a joint family was better. However, since those times are past us, nuclear families seem like a better option nowadays, although there is nothing wrong with staying joint either."* (ID_13/48/M)

3.2. Filial piety

Filial piety is the cultural value and responsibility to treat one's parents with respect. This theme illustrates how the practice of filial piety has changed across multiple generations. The interviews captured different aspects of filial piety.

The older generations repeatedly claim that children of Cont-G have lost respect for elders in general. Even some members of Cont-G agree that they are less obedient to their parents. Both Pre-G and Trans-G expressed concerns that elderly parents were not receiving sufficient attention or care from other family members. These changes were attributed by the older generation to a general lack of respect and decreasing family values among the younger generation. However, Cont-G defended that they still respect and love their elders. They argued that, in contrast to earlier times, their way of expressing their respect has changed. Trans-G also acknowledges the change in how their children are showing respect to them. Some of the verbatims from the three generations are:

> *"The new generation generally lacks respect. In the past, children were not allowed to sit in front of their parents. Nowadays, it is not like that".* (ID_05/66/M).

> *"Compared to the past generations, the obedience of today's children has decreased."* (ID_25/23/M)

> *"After parents reach the age of 85-90, they are mostly viewed as a burden by rest of the family."* (ID_06/64/M)

> *"Many changes have happened in the way children show their respect to parents. In past generations, there was more fear in the respect. Now, things are in a peaceful state. Maybe the children have no fear whatsoever."* (ID_14/52/M)

3.3. Sense of individuality

This theme highlights how individuals are becoming more comfortable fulfilling their needs and preferences. It also shows that individuals are less resistant to breaking away from traditional ways of life when they develop a different view of things. All three generations concur that unlike in the past when people would repress or sacrifice their desires for the family, people now gradually value their own preferences and choices. They also reported that people are becoming more independent and developing a sense of autonomy, even within families, leading to more separation and divorces. Even though Cont-G wholeheartedly embraced these changes, both Pre-G and Trans-G view these changes in a negative light. Cont-G reported that they understand the importance of having independent identities and more autonomy in one's life. They also addressed how the younger generation is growing less religious and does not see the necessity to uphold the religious beliefs and practices of their parents. Some verbatims are:

> "*In most families, members are becoming more independent. Everyone has their own opinions."* (ID_10/67/F)

> *"Earlier, our families used to be more collectivistic in nature. In decision-making, multiple patriarchs*

Table 2. Comparison in perspectives of different generations

Themes		Pre-G (61 years and above)	Trans-G (40 – 60 years)	Cont-G (18 – 30 years)
Filial piety		Considers that young generations are not as fearful of their parents as they were before because the new approach of friendly parenting and the traditional displays of respect have changed.	Considers that the young generation is very disrespectful and does not care about others.	Considers that respect is not to be earned forcefully and is not bound to age or position. Furthermore, consider that the previous generation's respect for their elders/parents is more out of fear.
Sense of individuality		The younger generation is more exposed to the world and is trying to live the way it prefers according to its choices. They are independent but detached from the family.	The younger generations prefer their decisions more and are not thinking about how they affect family. They are more self-oriented.	Today, people have started giving importance to their choices and likes, unlike when everything was done for the family or parents. Now, people are forming a new sense of autonomy and giving equal preference for themselves and their identity.
Changes in the nature/ quality of relationships	Change in grandparent-grandchild relationship	More attachment and fondness toward grandchildren.		They are attached to grandparents but often have a conflict due to differences in beliefs.
	Shift toward positive parenting.	Earlier, the parents were strict. Even though they were involved in major decisions in life, the care toward children was less due to the greater number of children.	Earlier, parents were stricter, and they made all their decisions and choices. There was no scope for refusal. The distastefulness toward parents being friendly and the decreased hesitance of children to oppose parents are visible.	Earlier, parenting was strict and unhealthy. But today, parents are trying to adopt a healthy parenting style that focuses on the growth of their children.
Changes in matrimonial arrangements and partner selection		Today, more importance is placed on physical features, and not much emphasis is given to the family and background of partners.	Select partners mostly based on education and very superficially. Not very bothered about how their personality is, which is problematic in the long run.	Partners are chosen based on compatibility. People choose who they think will understand and respect them.
Increased divorces		Divorces were considered to be taboo earlier, but now people do not find it a need to be in bad marriages. Even parents are ready to accept children after divorce, unlike in the past.	The divorce rate is increasing as the partners are not ready for even slight adjustments, and all are more self-centered.	Divorces are normalized. It is very normal to get out of an unhealthy marriage. Parents today are very supportive of children's choice of divorce from unhealthy marriages.
More emphasis on individual choices in education and career decision-making		Parents' influence on children's careers has decreased. The tendency to carry on a job that has been passed down through generations has diminished.	Parents' influence decreases in children's careers. The parent's knowledge is less regarding careers, so children are more efficient in choosing a career.	Parent's control increased at some level. There is an increase in the trend of sending children to coaching at an early age.

> *from extended families had a say. Nowadays, the collectivistic element has decreased. We have become more individualistic and have created more autonomy for ourselves."* (ID_21/22/M)

3.4. Increased number of working women

All three generations agree that the participation of women in the workplace has increased rapidly over the last three decades. They opined that women desire financial independence for themselves, which will help them face any adversity in their lives and secure a better position within their families. Women entering the workforce change a family from a single-income to a dual-income household, thereby providing improved financial stability for the family. Some verbatim responses are:

> *"Women want to be self-sufficient, and they do not want to face a situation where they must completely*

depend on their family or husband for money. As a result, their participation in the workforce has increased. Women who have a job feel more secure regarding the future." (ID_06/64/M)

"The overall increase in the education level of people has been a big contributor in allowing women to have more access to education and jobs. Moreover, the current society is actively promoting to increase women's presence in said areas further." (ID_22/23/M)

"As both husband and wife in a family are working members, it increases the income of the family. This leads to having a better standard of living." (ID_28/22/F)

3.5. Families becoming egalitarian

An egalitarian family is one in which both partners hold equal power. This theme illustrates how Indian families are evolving to become more democratic and egalitarian. Given the strong patriarchal foundation of Indian society, such a drastic shift does not occur overnight. Two sub-themes emerged from this theme – flexible gender roles at home and pluralistic communication patterns.

3.5.1. Flexible gender roles at home

Previously, household labor was distinctly divided by gender. However, the rise of nuclear families and the increased participation of women in the workforce have compelled men to share household responsibilities. In dual-income households, it is now impractical to operate without men contributing a fair share of household work, which was unimaginable a few generations ago. Gender roles that were once rigidly assigned to women are becoming more fluid, and men are no longer shamed by society for doing household chores.

"The traditional gender roles are being rewritten these days. The concept of women staying in the kitchen and men staying in the living room is changing. Now men are expected to do whatever chore that is needed." (ID_15/46/M)

"Even though gender roles have not undergone a sea change, there have been some positive changes in expected gender roles in Kerala. The husband has started to participate more in household work. In the past, this was viewed as a great shame. Now, people do not shame others for doing chores." (ID_29/27/F)

3.5.2. Pluralistic communication pattern

Families with pluralistic communication patterns engage in open conversations where every member has equal opportunities for input when making collective decisions. Participants reported that in the past, significant family decisions were taken solely by the patriarch or older men, with no input from other members, such as women or children, even if the decisions directly impacted them. However, this authoritarian decision-making process is gradually losing traction, clearing the way for collective decision-making. All three generations observed that children now have more expressive freedom compared to the past when they were not allowed to raise their own opinions to their parents.

"In olden times, the patriarch of the family made all the decisions on his own. No one could protest against that decision. The rest of the members were expected to obey it. However, the oldest person in the family now discusses issues with the rest of the members and only decides based on the majority view." (ID_04/77/M)

"In today's families, children can freely express their opinions." (ID_07/77/M)

"The children have become more eager to share their experiences and thoughts. They openly express their opinions." (ID_15/46/M)

3.6. Changes in the nature/quality of relationships

Globalization has significantly impacted the Indian cultural system, leading to changes in the nature of family relationships. These changes reflect more individualistic thinking, conflicts in interactions, and less hierarchical structures within families. The sub-themes that emerged include changes in grandparent-grandchild relationships, decreased quality of family relationships, and a shift toward positive parenting.

3.6.1. Changes in grandparent-grandchild relationship

Two opposing points of view are evident in this subtheme. Grandparents claim to be closer to their grandchildren than to their children in terms of love and concern. However, the younger generation highlighted that despite their wish to have a good relationship with their grandparents, they face difficulties due to differences in beliefs and viewpoints on how they see the world. These discrepancies are most noticeable in their perspectives on many traditional ceremonies.

"I am very close to my grandchildren and love them very much. It's such that more fondness is toward grandchildren than my own children." (ID_15/77/M)

"The relationship with grandparents is such that I love them, but often there are conflicts due to the differences in opinion resulting in differences." (ID_27/24/F)

3.6.2. Decreased quality of family relationships

Participants felt that the quality of interaction between family members is declining, marked by decreased family cohesion, reduced intimacy, and unstable relationships. They also reflected that families are becoming increasingly materialistic and that there is a decrease in communication between parents and children due to social media use.

> *"Earlier, people were very connected with families, were close to them, and had consistent contact with all. The emotional bonding that family members have with each other is decreasing. Everybody is restricting themselves to self and is having an individualistic attitude."* (ID_22/23/M)

3.6.3. Shift toward positive parenting

Parenting has changed considerably in a positive direction over the past decades. Previously, parents were rigid, focusing on discipline and obedience, which often instilled fear in children. However, the transformation is now evident. Cont-G feels that today's parents lean toward an authoritative parenting style and provide space for discussion.

> *"Parenting has changed from the earlier ways. Nowadays, parents try to communicate openly with their children. Now, it has evolved from obedience to a friendly way of parenting. Before the parents, even though they loved their children, they were not ready to express themselves. However, today, parents openly express their emotions to their children. They appreciate standing by their children."* (ID_21/22/M)

3.7. Changes in matrimonial arrangements and partner selection

The matrimonial process and how Indian young adults choose their partners have been a matter of curiosity for researchers, evidenced by the growing body of research on this topic. Our results clearly show that marital agency and arrangements have varied over time. Participants reported that the age difference between partners has shrunk significantly, and individuals can now decide when and whom to marry. They also reported that it is no longer common for parents to force their daughters to marry early. Individuals are also allowed to marry later in life, typically after they have completed their education and achieved financial stability. Compared to earlier times, the number of love marriages, inter-caste, and even inter-religious marriages are becoming more common.

> *"Earlier in grandparents' generation, the age gap between partners was 10 to 12 years; in our parents' generations, it was 4 to 8 years. However, in our generation, this has decreased even more; some people marry partners of the same age."* (ID_21/22/M)

> *"The number of love marriages increased, and it has become more acceptable than the previous generations. Furthermore, the intercaste, interstate marriage is increasing more than before."* (ID_28/22/F)

The apprehension toward engaging in a committed romantic relationship is clearly visible in Cont-G. They find it difficult to trust their partner for fear of being exploited. Furthermore, the younger generation fears losing their independence and free will once they are in a relationship.

> *"It seems that the younger generation has a fear of starting a romantic relationship. Especially in the case of girls, they fear that they will be financially or sexually exploited, which prevents them from entering a relationship."* (ID_25/23/M)

The use of technology in partner selection is another important aspect where generational variations can be observed. Participants reported that online matrimonial platforms and dating apps are increasingly used to seek potential matches. This technology interface allows people to meet compatible people without geographical limitations. Participants from both Pre-G and Trans-G also reported that live-in relationships are gaining popularity and are used as a precursor to marriage to get to know each other. They also opined that homosexual/same-sex relationships are gaining more acceptance in India despite strict social sanctions and discrimination.

> *"The trend of dating apps and matrimonial sites are increasing. People choose their partners from these online platforms. Many romantic relationships and marriages started from these applications."* (ID_26/25/F)

> *"Young people prefer living together in relationships nowadays over marriage. This might be the future aspect of marriage where the number of marriages will be less."* (ID_10/67/F)

> *"Homosexual relationships are increasing, and they are opening to society more. Even though homosexual marriages are not legal in India, it will become in the near future."* (ID_15/46/M)

3.8. Increased divorces

All three generations concur that the number of divorces has significantly increased recently, and they shared that the value of the marriage institution has decreased. Even though some educated and progressive people in Pre-G have begun to normalize divorce, both the Pre-G and Trans-G are not happy about the increased divorce rate. They view divorce as evil and still consider it taboo. They blame those who seek divorce for not having the ability to make compromises or adjustments to maintain the family in the long run. However, the Cont-G has shown a very positive attitude toward divorce. They have even stepped forward and wish to normalize divorce. Participants also opined that supportive parents who concur with their children's decision to dissolve an unhealthy marriage are one of the significant factors in the rise in divorces.

> *"People have started to view divorce as a very normal phenomenon. They have realized that it is better to split up than waste your time and effort in a relationship when one is incompatible with their partner."* (ID_30/25/F)

> *"Nowadays, the two people in a marriage no longer have the patience or mentality to sacrifice for one another. This has caused more divorces lately. We can also expect this tendency to go up in the future."* (ID_06/64/M)

> *"Compared to the past, their parents have become more supportive. If any issues arise and cannot get past it, they encourage their children to leave the marriage."* (ID_11/57/M)

3.9. Changes in education and career decision-making

Education and employment choices are major life decisions. In comparison to the past, the importance of education and knowledge in several disciplines has boosted professional options. Even though there has been a significant change in job decisions, with parents' dominating influence on children's professional choices decreasing, younger generations believe that parents still have an impact on career choices. The Cont-G participants stated that parents lacked resources to guide their children in earlier times, but now most of them are educated and have access to resources by which they can guide the children. They also opined that most parents want their children to pursue professional courses and take up white-collar jobs. The new practice of sending children for tuition and coaching classes for national-level entrance examinations is common and has become a trend.

> *"Parents in today's generation do not interfere much in their children's career choices. They encourage children to take a career of their own choice."* (ID_22/23/M)

> *"Compared to previous generations, the parental control on children's career choices only increased. However, the tactics they use to convince children are not as harsh as before. They reason with the child both logically and emotionally. People want white collar jobs for their children."* (ID_29/27/F)

> *"Sending children to tuition and coaching from a very early age is highly seen today. Parents want their children to be in professions such as doctors, engineers, IAS, IPS, etc., and for this, they send their children for extra coaching."* (ID_26/25/F)

The Cont-G participants have also shared the migrating practice of the younger generation to foreign countries. They stated that the majority of young people try to go abroad for jobs and even start to settle there. Education overseas was formerly only available to a select few, primarily the wealthy, due to its high cost. However, the economy has changed, and there are now resources to assist students in completing their education in foreign nations.

> *"Today, a greater number of young people go abroad for education as well as for jobs. This was not very common before. They even started settling there."* (ID_26/25/F)

Our result shows that participants of all three generations reported different perspectives on the changes that have occurred in family relationships, marital systems, and career choices. However, they also had similar viewpoints on some aspects, such as the participation of women in the workplace and communication patterns among family members. Thus, Table 2 briefly overviews the themes where profound differences were found across generations.

4. Discussion

The present study aims to examine the transitions in Indian family relationships, marital systems, and career choices and to compare the perspectives of three generations on these changes, as they confront the effects of these changes at different points in their lives. The results show that all three generations have experienced changes to different extents.

One of the significant changes expressed unanimously by all three generations is the transition from joint family to nuclear family households in India. Participants mentioned several reasons for this shift, including increased family planning and an emphasis on small families. Studies have shown that industrialization, urbanization, and educational expansion lead to a decline in extended families and a corresponding rise in nuclear families (Allendorf, 2012). It can be inferred that increased family planning is also a result of globalization and urbanization (La Croix *et al*., 2002; Randall, 2006). The rise of attractive white-collar jobs, which resulted from globalization (Liu & Trefler, 2019), offers higher earnings than traditional jobs such as farming, providing further motivation to move out of a joint family setting.

Filial piety is a prominent issue in the study, with varying interpretations across generations. The results show that Pre-G feels that young generation no longer fears their elders. At the same time, Trans-G perceives the younger generation as disrespectful toward elders.

However, Cont-G has a different view on respect, believing that it should be earned rather than given out of fear. These results indicate that younger generations practice filial piety differently, leading older generations to ponder whether youngsters generally lack respect for their elders.

Another theme from the study is the development of a greater sense of autonomy among the young generation in various aspects such as education, career choices, lifestyle, relationships, and decision-making. They are empowered to pursue their interests, passions, and goals, which may not necessarily align with traditional societal expectations or norms. The influence of globalization and exposure to different cultures and ideas has likely contributed to this development of autonomy among the young generation in India. Many young Indians now choose to live independently, away from their families. On the other hand, some researchers argue that despite the rising individualism, Indian society uniquely allows both individualism and collectivism to co-exist (Sinha *et al*., 2001)

Participants of all three generations reported that women's participation in the workforce is increasing in the nation. The Periodic Labour Force Survey (PLFS, carried out during July 2021 – June 2022) reported an increase of 6.5% in women's labor force participation (from 22.9% in the financial year 2017 – 2018 to 29.4% in 2021 – 2022 [Dhamija & Chawla, 2023]). Participants also noted that women's desire for financial independence may have contributed to this increased participation. Many women desire to contribute to the family income, pursue their career aspirations, and gain financial autonomy. This desire for financial independence is often fueled by the need to break free from traditional gender roles and expectations, enhance self-esteem, and improve social status. Women's financial contributions enable families to invest in education, healthcare, and other essential needs, thereby improving the overall well-being of the family, including children, elderly parents, and other dependents.

As previous studies (e.g., Hondagneu-Sotelo [2003]) have shown, Indian families are becoming more egalitarian toward gender roles due to globalization. Several factors have contributed to this shift, including increased women's workforce participation, changing family dynamics, exposure to global ideas and values, and education and empowerment. Men are increasingly involved in household chores, child-rearing, and caregiving. At the same time, women are taking on more active roles in decision-making, financial management, and career pursuits, leading to more egalitarian gender roles within families. Access to higher education and exposure to foreign cultures have likely facilitated this change.

Globalization, with its rapid spread of information and cultural influences, has brought about significant changes in the communication patterns of Indian families. Pluralistic communication, characterized by open discussions, diverse opinions, and democratic decision-making, has become more common in Indian families compared to previous times. This shift is indicated by an increased freedom of expression for children's opinions and ideas. Conventionally, communication patterns in Indian families were often hierarchical and authoritarian, with parents or elders making most of the decisions without seeking input from children (Mishra & Satish, 2018).

Globalization has also impacted the relationship between grandparents and grandchildren. Interestingly, grandparents in the present study indicated that they feel closer to their grandchildren than to their own children. Although the younger generation loves their grandparents, they have difficulties in being close to their grandparents due to differences in beliefs and viewpoints on how they see the world.

With the advent of modernization, urbanization, and changing societal norms, there are concerns about the decreasing quality of family relationships in India. One of the factors implicated in this decline is the changing communication patterns within families. Traditional forms of family communication, often characterized by face-to-face interactions, extended conversations, and frequent gatherings, have been shifting to more modern forms of communication, such as text messages, social media, and virtual interactions (Mahmoud & Shafik, 2020). In traditional Indian families, close physical proximity, frequent touch, and expressions of affection among family members were standard. The increased physical distance among family members may have resulted in reduced opportunities for physical intimacy and expressions of affection, impacting the emotional bond among family members.

There has been a noticeable shift from strict parenting to authoritative parenting in India in recent years. Strict parenting, which often emphasizes conformity, obedience, and adherence to cultural norms and traditions, has been practiced in India (Sondhi, 2017). However, with increasing exposure to global influences and Westernization, parents in India are now more accepting of their children's individuality, self-expression, and autonomy. Reflecting authoritative parenting, they encourage children to express their opinions, make independent choices, and pursue their interests and passions.

The concept of marriage and mate selection has undergone major changes. All generations converge in their opinion that the number of love marriages has increased, and the influence of parents in their children's marriage has decreased considerably compared to the past. Globalization has also led to immense changes in the process of mate selection. The age at which people get married has increased, the age gap between partners has decreased, and the acceptance of love marriages has risen. Additionally, there has been an increased use of matrimonial sites and dating apps, along with an increase in dating culture in India. Over the years, the age at which people get married has increased. For women, the number of marriages under the age of 18 has declined significantly, from 65.9% in 1992 – 1993 to 23.2% in 2019 – 2021 (Singh *et al*., 2023). In traditional Indian society, the age difference between spouses was generally higher, with men being older than women. However, with globalization, the age difference in Indian marriages has decreased from seven to under five over the past 60 years (Banerjee, 2022).

Research shows that arranged marriage—a practice found largely in Asia and Africa in which parents and other family members select their children's spouses—was expected to be replaced by Western-style marriage, in which young people choose their own spouses (Allendorf & Pandian, 2016). Love marriages are gaining more acceptance and momentum in Indian society. The increase in love marriages can be attributed to changing attitudes toward relationships, greater autonomy, heightened exposure to Western ideals, increased social mobility, evolving gender roles, advances in technology and social media, and urbanization.

All the generations univocally agree that the divorce rate is increasing, but their outlook on this issue differs. Pre-G believes that divorces are no longer taboo as they were in the past. They also feel that staying in abusive relationships is unnecessary, which they see as a positive change. However, they still lament the decreasing value of marital relationships. Trans-G strongly believes that the lack of mutual adjustments between partners contributes to the rising divorce rates. They also cite increased individual autonomy as a reason for the increase in divorces. On the other hand, Cont-G feels that divorce is being normalized. They acknowledge the importance of leaving unhealthy relationships, which need not always be abusive, for one's mental health. Globalization might have also played a crucial role in this sudden increase in divorce rates. Changing social norms and values due to globalization have resulted in greater individualism and self-expression, leading to increased agency and autonomy among individuals, including women. Pursuing personal aspirations, independence, and self-fulfillment has led to a shift in attitudes toward marriage and family relationships, with less tolerance for marital discord or unhappiness.

The use of technology in the partner selection process has increased significantly, whether through matrimonial sites or dating apps (Agrawal, 2015). Matrimonial sites, which provide online platforms for individuals and families to search for prospective partners based on various criteria, such as caste, religion, education, and occupation, have gained popularity recently. Similarly, dating apps, which allow individuals to meet and interact with potential partners based on mutual interests and compatibility, have gained prominence among urban Indian youth. In 2022, India emerged as the fifth fastest-growing market in year-over-year growth in dating app spending. Compared to 2021, Indians spent $31 million more on dating apps in 2022 (Dazeinfo, 2023). Dating culture, once considered taboo in Indian society, is now becoming more accepted, especially among the younger generation.

Globalization has also helped to open up the world for Indians, leading to various career opportunities available for today's children compared to the past. Most participants agree that parents now give their children more freedom of choice regarding their careers. However, some parents still envision specific career paths for their children (mainly professional courses in medical, engineering, and technology fields) and force their children to achieve their parent's dreams. These parents push their children to tuition centers and coaching academies to "get ahead" of the competition. In India, 26% of students participated in private coaching, of which 1.5% underwent coaching to prepare for examinations (Ministry of Statistics and Program Implementation, 2016), and 71 million students are enrolled in private tuition according to a survey conducted by the National Sample Survey Organization (Varma, 2016).

Another phenomenon that has increased recently is the trend of Indians going abroad for education and careers. According to the "International Migration 2020 Highlights" by the Population Division of the United Nations Department of Economic and Social Affairs, in 2020, 18 million Indians were residing abroad, making India the country with the greatest diaspora population (Economic Times, 2023). Globalization can be attributed to the increasing number of Indians pursuing careers abroad due to economic factors, education and skill enhancement, cultural exposure, and the impact on the Indian workforce.

In summation, our study chronicles the transitions in attitudes and behavior concerning family relationships, marital systems, and career choices among Indians. It also highlights how participants from different generations perceive these changes differently. The differences in the opinions across the multigenerational participants can be attributed to many social, economic, political, and cultural changes that have occurred in India over the past 30 years. However, one common thread runs through all of these forces – the progressive implementation of globalization. Given that many past theories have endorsed the role of globalization in bringing out changes in the cultural environment (e.g., Appadurai [1996]), the role of globalization is vital in the dynamics of change in family relationships in India.

4.1. Limitations and future directions

Our study has certain limitations. The study was qualitative, with a limited sample of 30 participants from the state of Kerala. Kerala's relatively higher developmental index may have caused the state to be impacted by globalization differently than other states with lower sociodemographic indicators. As a result, the findings need to be interpreted considering this particular sociodemographic setting. Future research may, therefore, focus on multiple regions that correspond to different Indian states. In addition, future research can consider mixed methods for data collection. Increasing the number of participants to ensure representation from various levels of society (e.g., rural/urban) could provide more varied opinions and experiences. Our study probed only three domains of change, namely family relationships, marriage, and career choices. Future studies might focus on the intergenerational transfer of wealth, the impact of family structure on mental health outcomes, and the influence of family structure on social inequality. Furthermore, the way in which these changes affect different generations can also be explored.

4.2. Implications

The present study is one of the few studies that examine the influence of globalization on changes in Indian family dynamics, marriage, and career choice from a multigenerational perspective. Since the family is the basic structural unit of society, investigating changes within the family can enrich our understanding of both family and societal transformations. The insights from this study can be used to construct tools like questionnaires or scales for more extensive quantitative research in this field. By incorporating the perspectives of multiple generations, the research provides a comprehensive understanding of each generation, which can be particularly useful in counseling settings, especially during family therapies. In addition, the study sheds light on the nature of intergenerational relationships in India. The findings can also inform policies and practices aimed at supporting families in India.

5. Conclusions

The study uncovered several changes in Indian family relationships, marriage, and career choices from the perspectives of three different generations. Significant changes include the shift from joint families to nuclear families, changes in filial piety, an increased sense of individual autonomy, a more egalitarian nature within families, a rise in the number of working women, a decrease in the quality of family relationships, more authoritative parenting, positive in-law relationships, changes in marriage dynamics, changes in the process of partner selection, and changes in decision-making about education and careers. The study also highlighted how the opinions of the three generations were similarly aligned on various issues. The youngest generation was very appreciative of all the changes, while the older generations were somewhat resistant to some of the changes. The study is one of the first to examine the changes in Indian families from a broad perspective.

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Conflict of interest

The authors declare no conflicts of interest.

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Appendices

Appendix A1. Interview guide

Introduction

This study is conducted to understand different changes that have occurred in Indian families over the course of the past 30 years. We would like to know what changes you have perceived in family dynamics, parent-child relationships, marriage, and career choices compared to other generations. We assure you that the information you share will be treated with high confidentiality and will be used only for academic purposes.

Changes in the parent-child relationship

1. Can you describe the relationship you have with your children and grandchildren?
2. Do you think there have been major changes in the relationships of parents, children, and grandchildren in the past 30 years or so in society as a whole?
3. If yes, what are the changes?

Changes in marriage

1. Do you think there are changes that you can see in the process of marriage of your children or grandchildren compared to your time?
2. If yes, what are the changes?
3. How do you think it will be in the coming years?

Changes in career choices

1. What do you have to say about the choice of career of your children and grandchildren?
2. Do you think there is a change in the process of choosing a career among young generations in society in general?
3. If yes, what are the changes?

Changes in family dynamics

1. Do you think there have been any changes you experienced within the families in the past years?
2. If yes, what are the changes?

Conclusion

Other than the factors we have already discussed, do you think there are any major changes in family relationships?

Similar questions were asked to participants of all generations with small variations. For example, the first question asked about the parent-child relationship was, "Can you describe the relationship you have with your parents and children?" to the Trans-G group and "Can you describe the relationship you have with your parents and grandparents?" to the Cont-G group.

Appendix A2. Changes in Indian family dynamics, marriage, and career choices

Themes	Sub-themes	Codes
1. Shift from joint family to nuclear family		Decreased number of children
		Perception of having fewer resources in a joint family
		Change from agriculture as a profession
2. Filial piety		Respect toward parents
		Decreased attention to elderly parents
		Obedience
		Change in the traditional display of respect by youngsters
3. Sense of individuality		More importance to one's own preference
		Increased sense of autonomy
		Religious rituals have become a choice

(Cont'd...)

Appendix A2. ***(Continued)***

Themes	Sub-themes	Codes
4. More working woman		Desire for financial independence of women
		Opportunity for women
		Awareness of women's empowerment
		Financial security for family
5. Families are becoming egalitarian	Flexible gender roles at home	Division of labor at home
		Men are also being domesticated
	Pluralistic communication pattern	Democratic decision making
		Free expression of opinions
6. Changes in the nature/quality of relationships	Change in grandparent-grandchild relationship	Decreased relatedness to grandparents
		More fondness toward grandchildren
	Decreased quality of family relationships	Decreased family cohesion
		Unstable relationship
		Reduced intimacy in family relationships
		More materialistic nature of people
		Decrease in communication between children and parents due to social media use
	Shift toward positive parenting	Authoritative parenting
		Friendly parenting
		Earlier strict parenting
		Emotional expression of parents increased
7. Changes in matrimonial arrangements and partner selection		Reduced age gap in marriage
		Increased dating/non-committed relationships
		Increased live-in together relationships
		Homosexual relationships
		Autonomy in choosing marital partners
		More love marriage
		Apprehension in entering romantic relationships in fear of downside
		Use of dating apps and matrimonial sites.
		Increase in age of marriage
		Decreased dowry
		Pompous nature of marriage
8. Increased divorce		Normalization of divorce
		Lack of mutual adjustments
		Support of parents increased
		Diminishing value of marriage
9. Changes in education and career decision-making		Decreased influence of family on career choice
		Greater parental involvement in education and career
		Migration to foreign countries for education and career
		More resources to get information regarding various careers and courses
		Increased emphasis on coaching

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RESEARCH ARTICLE

Do female-headed households have poorer financial health compared to male-headed households? Evidence from China

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Abstract

The global trend of financialization has introduced significant risks and uncertainties, exacerbated by the outbreak of the COVID-19 pandemic, which has affected the economic and financial conditions of various groups. While existing research indicates that women generally exhibit lower levels of financial literacy and tend to have less access to financial resources compared to men, empirical research on gender disparity in financial health is still limited. This study aims to bridge this gap by analyzing gender differences in household financial health, using nationally representative household data from China and propensity score matching analyses. Contrary to prevalent beliefs, the findings reveal better financial health among female-headed households. For example, using the nearest neighbor matching, we found that female-headed households have a better balance of income and expenditure than male-headed households (β = 0.173, p < 0.001). Moreover, female-headed households are more likely to possess commercial insurance (β = 0.433, p < 0.001) and investment products than male-headed households (β = 0.082, p < 0.05). In addition, considering that women manage the day-to-day household consumption and are financial outperforming men, the implementation of household finance-related policies and programs, such as asset-building policies and Children's Development Accounts, would be more effective if targeted toward women in households.

Keywords: China; Financial health; Gender differences; Household finance; Propensity score matching

1. Introduction

The global trend of financialization has introduced significant risks and uncertainties, exacerbated by the outbreak of the COVID-19 pandemic, which has affected the economic and financial conditions of various groups (International Monetary Fund, 2021; Zhao *et al.*, 2023). This scenario underscores the criticality of financial health, which is defined as a state of being wherein a person can fully meet current and ongoing financial obligations, can feel secure in their financial future, and is able to make choices that allow them to enjoy life. It is intertwined with both physical and mental well-being (Arber *et al*., 2014; Bethune, 2015; Braveman *et al*., 2018; Chou *et al*., 2016; Cutts *et al*., 2011), constituting a measurable social determinant of health. The stress caused by financial difficulties can profoundly impact human health and overall quality of life (Bethune, 2015; Center for Financial Services Innovation, 2015; Kawachi & Kennedy, 1999; Weida *et al*., 2020).

In both practical and academic contexts, it is widely recognized that women often experience poorer financial health compared to men (Albanesi & Olivetti, 2009; American Bankers Association *et al*., 2022; Blau & Kahn, 2017; Chang, 2010). Research suggests that although women generally have longer life expectancies, they tend to accumulate less work experience and earn lower incomes (Gubbay & McKay, 2024; Johnson *et al*., 2023), which diminish their retirement or survivor benefits. These factors collectively heighten the financial risks faced by women (Blau & Kahn, 2017; Diane *et al*., 2016; Dickler, 2023).

Moreover, women generally display lower levels of financial literacy compared to men. For instance, the 2015 U.S. National Financial Capability Study showed men scoring 7.8 – 8% higher than women in objective financial literacy tests (Al-Bahrani *et al*., 2019). Similarly, studies in the U.S. highlight significant gender disparities in financial literacy among older adults, with women showing a substantial gap in financial sophistication (Bucher-Koenen *et al*., 2017; Fonseca *et al*., 2012). Empirical research across developed and developing nations has consistently shown that women have less knowledge about complex financial and investment concepts such as numeracy, compound interest, inflation, asset pricing, and risk diversification (Bottazzi & Lusardi, 2016; Hasler & Lusardi, 2017).

In addition, evidence suggests that women face more barriers to accessing financial resources and services compared to men (American Bankers Association *et al*., 2022; Govindapuram *et al*., 2022; Kairiza *et al*., 2017; Muravyev *et al*., 2009; Staveren, 2001). Utilizing data from the Global Findex database across multiple survey rounds, Morsy (2020) revealed significant gender gaps in banking service utilization across various countries and income brackets. Moreover, existing literature highlights gender-based financial constraints and inequalities at both micro and macro levels, including disparities in household savings and investment (Almenberg & Dreber, 2012; Itzkowitz *et al*., 2023; Were *et al*., 2021), and the reluctance of financial institutions to address women's financial needs (Morsy, 2020).

Financial literacy and access are crucial determinants of financial health (Lusardi & Mitchell, 2014; Sahay *et al*., 2021). Compared to men, women typically face disadvantages in financial literacy, access, and opportunities, which could imply poorer financial health. However, is this really the case? The "Lehman Sisters Hypothesis" suggests that increasing the number of women in executive positions in financial institutions might promote more prudent decision-making and risk management, potentially mitigating the impact of financial crises and enhancing institution's financial health (Staveren, 2014). In addition, several studies have found that women generally outperform men in the financial sector (Hollingdale, 2020). Other research indicates that while women may face fewer financing opportunities than men (Marques, 2015), gender-diverse board can foster sustainable corporate practices (Valls Martínez *et al*., 2020).

Moreover, studies have revealed that while women generally score lower on financial literacy assessments compared to men, it is not always clear whether this is due to a genuine lack of knowledge or a lack of confidence. For instance, studies show that women are more likely to select the "do not know" option in financial knowledge tests, but when this option is removed, their correct responses increase. In addition, evidence suggests that gender differences in risk aversion are often minimal or non-existent when financial decision scenarios are carefully controlled. These findings imply that perceived gender differences in risk attitudes may be more attributable to decision framing and societal stereotypes rather than inherent differences between men and women (Charness & Gneezy, 2012; Frydman & Camerer, 2023; Niederle & Vesterlund, 2007; Schubert *et al*., 1999; Yusof, 2015).

Existing research has examined gender differences in income, investment behavior, and risk attitudes, but studies on gender disparities in household financial health remain relatively scarce. Financial health not only extends beyond income and investments, but it also includes aspects such as financial management, levels of debt, savings, and the availability of emergency funds (Consumer Financial Protection Bureau, 2017; Center for Financial Services Innovation, 2015). Due to more conservative financial behaviors, women may perform better in certain aspects such as savings and debt management (Durmaz *et al*., 2023; Hira & Loibl, 2008; Lusardi & Mitchell, 2014). However, many studies fail to comprehensively analyze how these differences impact the overall financial health between genders. To address this gap, this study uses nationwide data from China to delve deeper into the gender disparities in household financial health. China's rapid economic development, complex gender norms, and evolving financial landscape make it a representative and scientifically valuable case for analysis. Moreover, China's comprehensive data on financial health provide an opportunity for a systematic examination of the relationship between gender and financial health.

1.1. Financial health and research questions

The concept of financial health was first introduced by the Center for Financial Services Innovation (CFSI) in 2015. However, there is still no consensus among researchers and organizations on its precise definition and measurement. Terms such as "financial health," "financial well-being," "financial wellness," and "financial fitness" are often used interchangeably.

The measurement of financial health varies significantly, often focusing on specific aspects of a household's financial situation. CFSI developed a framework that includes four main components: spending, saving, borrowing, and planning. This framework delineates eight indicators to evaluate these components: spending less than income, paying bills on time and in full, having sufficient living expenses in liquid savings, having sufficient long-term savings or assets, having a sustainable debt load, having a prime credit score, having appropriate insurance, and planning ahead for expense (Parker *et al*., 2016).

Furthermore, the Consumer Financial Protection Bureau (CFPB) offers a consumer-driven definition of financial health (or financial well-being), portraying it as a state of being wherein a person can fully meet current and ongoing financial obligations, can feel secure in their financial future, and is able to make choices that allow them to enjoy life (CFPB, 2017). CFPB proposed four elements of financial health: having control over day-to-day and month-to-month finances; having the capacity to absorb a financial shock; being on track to meet your financial goals; and having the financial freedom to make the choices that allow you to enjoy life (CFPB, 2017). In 2020, Innovations for Poverty Action (IPA) described financial health in terms of the ability to access funds quickly and affordably, which we refer to as Access-to-Funds. They proposed three primary concepts that encompass financial health: Access-to-Funds, which is a final outcome construct, and Access-to-Finance and Financial Behavior, which are intermediate constructs that each incorporates several components (Brune *et al*., 2020).

Given the variety of indicators proposed by different researchers and institutions, this study developed four specific indicators to assess financial health. These indicators were chosen based on the previously discussed indicators and the variables available in the data used for this study. These indicators include (i) income-expenditure balance, (ii) the ability to control debt and risk, such as having emergency insurance in case of sudden loss of income, (iii) wealth planning and managing future financial income and expenses, such as having a regular savings account, and (iv) the ability to invest in the future, such as household financial management. The study compares the financial health status of female-headed and male-headed households utilizing four variables: income-expenditure balance, possession of commercial insurance, regular savings accounts, and financial investment products.

Therefore, based on the question of whether female-headed households have poorer financial health than male-headed households, the study proposes the following four hypotheses:

- H1: Female-headed households have a statistically different balance of income and expenditure compared to male-headed households.
- H2: Female-headed households have a statistically different likelihood of having commercial insurance compared to male-headed households.
- H3: Female-headed households have a statistically different likelihood to save compared to male-headed households.
- H4: Female-headed households have a statistically different probability of owning investment products compared to male-headed households.

2. Data and methods

2.1. Data and sample

The research employs cross-sectional data from the China Household Finance Survey Project (CHFS2019), a comprehensive national survey carried out in 2017 by the China Household Finance Survey and Research Center at Southwest University of Finance and Economics. This survey covers 29 provinces (regions), 343 counties, and 1360 village (residential) committees across China, providing detailed micro-level information on demographic characteristics, household assets and liabilities, insurance coverage, as well as income and expenditure status. The dataset includes 34,643 participants from 34,643 households, representing a total of 107,001 residents. The CHFS baseline survey, known for its face-to-face household interviews, ensures both national and provincial representativeness.

For this study, the household and individual datasets were merged using the household and member IDs. Subsequently, a sample of respondents who were household heads aged between 16 and 80 at the time of the interview was selected. This age range was chosen because individuals aged 16 and above, whose primary livelihood source is their labor income, are considered to have full civil capacity, whereas individuals over 80 are considered to have limited civil capacity. The final sample size of household heads within this age range is 33,463.

2.2. Measurement

Table 1 presents the study variables and their corresponding operational definitions.

2.2.1. Independent variable

The independent variable in this study is the gender of the household head, with female household heads assigned a value of 1 and male household heads assigned a value of 0.

2.2.2. Dependent variables

Household financial health is measured through the following variables: (i) whether the household's income and expenditures are balanced, (ii) whether the household has commercial insurance, (iii) whether the household has savings accounts, and (iv) the number of financial investment products owned by the household.

Table 1. Study variables and their operationalization

Variable	Description	Coding
Independent variable	Gender of household head	1=Female 0=Male
Dependent variables	Whether the household's income and expenditures are balanced	1=Income higher than or equal to expenditures 0=Income lower than expenditures
	Whether the household has commercial insurance	1=Yes 0=No
	Whether the household has a savings account	1=Yes 0=No
	Number of financial investment products owned by the household	Ranging from 0 to 4
Control variables	Age of the household head	1=16 – 35 years 2=36 – 55 years 3=56 – 80 years
	Education attainment	1=Below high school 2=High school 3=Above high school
	Occupational type	0=Unemployed 1=Temporary job or farming 2=Stable job 3=Employer
	Residence in a first-tier city	1=Yes (first-tier city) 0=No (non-first-tier city)
	Residence in rural areas	1=Rural 0=Urban
	Total income of the family last year	Logged value
	Financial literacy score (from 3 questions)	Ranging from 0 to 3

Whether the household's income and expenditures are balanced is assessed through the question, "Overall, was your family's total income balanced with total expenditures last year?" Responses indicating "income higher than or equal to expenditures" are assigned a value of 1, while those indicating "income lower than expenditures" are assigned a value of 0.

The determination of whether the family has purchased commercial insurance is estimated by the question, "What type of commercial insurance did family members purchase?" Responses such as "commercial life insurance," "commercial health insurance," and "other commercial insurance" are assigned a value of 1, while the response "none" is assigned a value of 0. The determination of whether the family has a savings account is estimated by the question, "currently, does your family have an undisbursed RMB regular savings account?" Responses indicating "yes" are assigned a value of 1, while those indicating "no" are assigned a value of 0. The number of financial investment products owned by the household is calculated as the sum of internet finance, stocks, funds, and bonds. If a household possesses one financial product, it is assigned a value of 1, otherwise it is assigned a value of 0. The total score ranges from 0 to 4.

2.2.3. Control variables (matching variables)

The study selects the following seven variables as control variables: (i) age of the household head: categorized as 16 – 35 years (assigned a value of 1), 36 – 55 years (assigned a value of 2), and 56 – 80 years (assigned a value of 3); (ii) Education attainment: categorized as below high school (assigned a value of 1), high school (assigned a value of 2), and above high school (assigned a value of 3); (iii) Occupational type: categorized as employer (assigned a value of 3), stable job (assigned a value of 2), temporary job or farming (assigned a value of 1), and unemployed (assigned a value of 0); (iv) Residence in a first-tier city: assigned a value of 1 for residing in a first-tier city and 0 for a non-dweller in a first-tier city; (v) Residence in rural areas: assigned a value of 1 for residing in rural area and 0 for living in urban area; (vi) Total income of the family last year (logged); and (vii) Financial literacy, which is assessed through the following three questions: question 1: "how much attention do you pay to the economy and finance?" The response of "paying attention" is assigned a value of 1, while "no attention" is assigned a value of 0. Question 2: "assuming the bank's annual interest rate is 4%, how much principal and interest can you earn after depositing 100 yuan in a fixed deposit for 1 year?" The correct response is assigned a value of 1, and the incorrect response is assigned a value of 0. Question 3: "assuming the bank's annual interest rate is 5% and the annual inflation rate is 8%, what can you purchase with 100 yuan in the bank after 1 year?" The correct response is assigned a value of 1, and the incorrect response is assigned a value of 0. Financial literacy is then determined by measuring the total score, ranging from 0 to 3.

2.3. Methods of analysis

Descriptive and bivariate analyses (t and χ^2 tests) were used to describe and compare sample characteristics. The missing completely at random (MCAR) test ($\chi^2 = 1106.72$, $p = 0.053$) suggested that the data were MCAR. Therefore, listwise deletion was applied in the analysis. We employed a combination of propensity score matching and logistic regression to mitigate selection bias. Initially, male-headed and female-headed households were matched based on comparable propensity scores. Subsequently, logistic regression was utilized to examine the influence of the gender of the household head on the financial health of the household and obtain the coefficient of influence.

2.3.1. Matching method

The study utilized three propensity score matching approaches: nearest neighbor one-to-two matching (cal = 0.03), kernel matching (normal kernel matching, bandwidth = 0.3), and radius matching (cal = 0.03). To minimize sample loss, all three matching methods were conducted with replacement. Ultimately, nearest neighbor matching yielded 16,464 samples, kernel matching yielded 11,782 samples, and radius matching yielded 31,339 samples.

3. Results

3.1. Descriptive statistics

The study used four methods, including standardized residuals, studentized residuals, Cook's distance, and Welch distance, to identify outliers. Samples flagged as outliers by any of these methods were excluded. After excluding samples with missing values and outliers, the study retained a total of 31,361 samples.

Table 2 presents the overall sample characteristics and gender differences. Approximately 73% of households reported having a balanced income and expenditure, with female-headed households (74.46%) having a significantly higher percentage compared to male-headed households (72.16%). Nearly 17% of households had a savings account, with female-headed households (18.75%) having a significantly higher percentage compared to male-headed households (16.85%). Only 10% of households have commercial insurance, with female-headed households (12.45%) having a significantly higher percentage compared to male-headed households (8.86%). On average, households own 0.61 financial investment products (ranging from 0 to 4), with female-headed households (0.65) owning more compared to male-headed households (0.60).

Among the participants, 50% of the household heads were between 56 and 80 years of age, and 53.42% of female household heads and 49.39% of male household heads were in this age range. The educational attainment of female household heads was generally higher than that of male household heads. Female-headed households had significantly higher income (10.43) and more urban residency (78.27%) and were more likely to reside in first-tier cities (36.27%) compared to male-headed households (10.30, 59.75%, and 24.82%, respectively). Female household heads also had significantly higher financial literacy (0.83) compared to male household heads (0.79).

3.2. Propensity score matching

3.2.1. Propensity score matching estimation

A logit regression was conducted to predict financial health, which included covariates such as the household head's age, education level, occupation type, financial literacy, urban or rural residence status, and the logarithm of the household's total income in the last year. Propensity scores were then calculated for each household, and three matching methods – nearest neighbor one-to-two matching, radius matching, and kernel matching – were employed to pair samples of households with male and female heads. Finally, the balance of covariates in the matched samples was evaluated to ensure comparability.

3.2.2. Balance test

The results of the balance test presented in Table 3 demonstrate that upon utilizing these three methods for matching, the explanatory power of the matching variables concerning differences in the dependent variable converges toward zero. This suggests a substantial reduction in distributional disparities in the matching variables between the groups of female-headed and male-headed groups, thereby mitigating the confounding effect introduced by these variables. Specifically, the overall mean standard deviation (MeanBias) between the matched groups falls within 10%. Furthermore, the R^2 of the logit model, re-estimated using the matched sample (Ps R^2), approaches zero, indicating a weak explanatory capability of the model in determining household financial health. This implies that the gender of the household head tends toward conditional randomness. The outcomes from all

Table 2. Descriptive statistics (*N*=31361)

Variables	Full sample	Female	Male	Diff.
	M (SD) or *n* (%)	M (SD) or *n* (%)	M (SD) or *n* (%)	t/χ^2
Balance of income and expenditure				χ^2=15.41**
No	27.29	25.54	27.84	
Yes	72.71	74.46	72.16	
Savings account				χ^2=14.53***
No	82.69	81.25	83.15	
Yes	17.31	18.75	16.85	
Commercial insurance				χ^2=84.75***
No	90.27	87.55	91.14	
Yes	9.73	12.45	8.86	
Financial investment	0.61 (0.63)	0.65 (0.67)	0.60 (0.62)	t=-5.72***
Age				χ^2=101.02***
16 – 35	8.07	9.64	7.56	
36 – 55	41.56	36.94	43.04	
56 – 80	50.37	53.42	49.39	
Education				χ^2=85.00***
Middle school or below	65.90	61.71	67.24	
High school	26.83	29.52	25.97	
Bachelor's degree	7.27	8.77		6.79	
Occupation				χ^2=2000***
Unemployment	32.70	53.03	26.18	
Temporary employment	39.93	24.54	44.87	
Formal employment	26.22	21.86	27.62	
Employer	1.15	0.56	1.34	
City of residence				χ^2=378.56***
First-tier cities	27.60	36.27	24.82	
Non-first-tier cities	72.40	63.73	75.18	
Rural				χ^2=860.37***
No	64.36	78.27	59.75	
Yes	35.64	21.73	40.25	
Log of total annual household income	10.34 (2.22)	10.43 (2.06)	10.30 (2.26)	t=-2.7**
Financial literacy	0.80 (0.94)	0.83 (0.96)	0.79 (0.93)	t=-4.31***

Note: **p*<0.05; ***p*<0.01; ****p*<0.001.

Table 3. Balance test results

	Ps R^2	LR chi^2	p>chi^2	MeanBias	MedBias	B	R	%Var
Unmatched	0.069	2397.43	0.000	19.7	11.9	66.3*	1.06	100
Nearest neighbor with caliper matching	0.000	4.05	0.774	1.5	1.6	3.3	0.99	33
Kernel matching	0.000	4.61	0.707	1.4	1.2	3.5	0.97	33
Radius matching	0.000	3.56	0.828	0.8	1.0	3.1	0.89	33

three matching methods corroborate that propensity score matching achieves a good balancing effect.

To provide a comprehensive understanding of the matching process and the characteristics of the matching variables, we present the descriptive characteristics of these variables following propensity score matching, using one-to-two nearest neighbor caliper matching as an example. Table 4 illustrates that after one-to-two nearest neighbor matching, the deviation of matching variables between the treatment and control groups witnessed a reduction by nearly 80% or more for all variables except "age" and "log of total annual household income." The mean deviation of covariates between the treatment and control groups remains within 5%. Furthermore, all matching variables initially exhibiting significant differences within a 95% confidence interval are transformed into variables, displaying no significant differences within the same confidence interval. In summary, propensity score matching demonstrates an effective balancing effect, thereby bridging the characteristics of the treatment and control groups and thus satisfying the requirements for randomness in evaluating household financial health.

3.2.3. Common support conditions

Figure 1 depicts kernel density plots demonstrating the common support region between the treatment and control groups before and after matching, utilizing the example of nearest neighbor caliper one-to-two matching. As illustrated in Figure 1, compared to the pre-matching scenario (Figure 1a), a substantial overlap in the distribution of propensity scores between 0 and 1 is observed post-matching (Figure 1b). This observation signifies that the propensity score matching effectively fulfills the common support conditions, thereby indicating that the matching outcomes in the study mitigate the influence of selection bias on the research results.

3.3. Logit regression

Following the propensity score matching, the study conducts three separate logit regressions with the balance of household income and expenditure, whether the household has commercial insurance, and whether the household has savings accounts as dependent variables, respectively. In addition, an ordered logit regression was performed with the number of financial investment accounts serving as the dependent variable. The models are specified as follows:

$$\text{Logit}\ (p) = \beta0+\beta1.\text{Gender}+\beta2.\text{Age}+\beta3.\text{Education}+\beta4.\text{Occupation}+\beta5.\text{Citystatus}+\beta6.\text{Rural}+\beta7.\text{Financial literacy}+\beta8.\text{Log Household income}+ \epsilon$$

As demonstrated in Table 5, subsequent to four logit regressions based on the results of the three matching methods, the logit regressions consistently reveal, within a 99% confidence interval, that female-headed households are more likely to balance income and expenditure compared to male-headed households. Furthermore, the logit regressions consistently indicate, within a 99% confidence interval, that female-headed households are more likely to possess commercial insurance, suggesting a greater inclination toward risk aversion. Moreover, the logit regressions, within a 95% confidence interval for two matching methods and within a 90% confidence interval for one matching method, suggest that female-headed households tend to own a higher number of financial investment products than their male-headed counterparts. However, the logit regressions consistently reveal, across all three matching methods, that there is no statistically

Table 4. Balancing test results for nearest neighbor caliper one-to-two matching

Variables	Sample	Mean		%Bias	%Reduced bias	t-test	
		Male	Female			t	*p*
Age	Unmatched	2.438	2.418	3.0		2.33	0.020
	Matched	2.438	2.449	−1.7	44.1	−1.02	0.308
Education	Unmatched	1.471	1.395	11.9		9.17	0.000
	Matched	1.470	1.460	1.6	86.7	0.96	0.339
Occupation	Unmatched	0.700	1.041	−42.8		−33.15	0.000
	Matched	0.700	0.686	1.7	96.1	1.01	0.312
City of residence	Unmatched	2.103	2.3639	−29.7		−22.91	0.000
	Matched	2.103	2.1114	−1.0	96.8	−0.57	0.567
Living in rural areas	Unmatched	0.217	0.402	−40.9		−29.74	0.000
	Matched	0.217	0.222	−0.9	97.7	−0.63	0.531
Financial literacy	Unmatched	0.825	0.792	3.5		2.71	0.007
	Matched	0.825	0.818	0.8	78.2	0.47	0.638
Log of total annual household income	Unmatched	10.431	10.305	5.8		4.31	0.000
	Matched	10.432	10.373	2.7	53.4	1.74	0.082

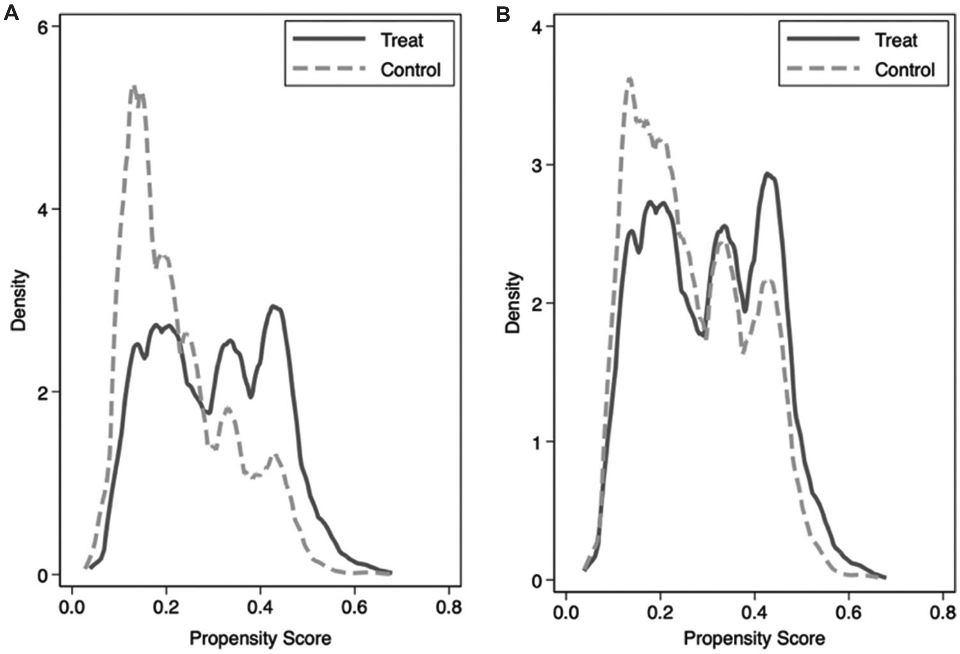

Figure 1. Kernel density plots before and after matching (nearest neighbor caliper one-to-two matching). (A) Sample before matching. (B) Sample after matching.

significant difference in the probability of savings between female-headed and male-headed households.

In summary, the results of the three matching methods consistently indicate that, among the four variables used to measure household financial health, female-headed households outperform male-headed households in three variables, except for the savings account variable. Therefore, all hypotheses except for hypothesis 3 (H3) are supported by the data, suggesting that female-headed households generally exhibit better financial health compared to male-headed households.

4. Discussion

Based on the results of the above data analysis, after controlling for variables such as age, occupation, education attainment, city of residence, rural residence, total annual household income, and financial literacy, female-headed households demonstrate healthier finances compared to male-headed households.

First, female-headed households display better financial balance, reflecting greater stability and sustainability in financial performance. This suggests that, after controlling for demographic and socioeconomic characteristics, women might have more effective financial management skills in handling daily expenses and savings compared to men. However, it is essential to consider that the self-reported nature of income and expenditure balance could introduce bias into the assessment results, potentially influenced by individual perceptions of financial balance.

Second, female household heads tend to purchase commercial insurance to manage household risks, reflecting a stronger inclination toward risk protection compared to men. Studies on gender differences in risk aversion yielded mixed results, with some research indicating significant differences (Arano *et al.*, 2010; Cupples *et al.*, 2013; Cornwall *et al.*, 2018; Croson & Gneezy, 2009), while others suggesting minimal or no differences, depending on factors such as income (Fisher & Yao, 2017; Owusu *et al.*, 2023), education (Cupples *et al.*, 2013; Owusu *et al.*, 2023; Yao *et al.*, 2011), age (Owusu *et al.*, 2023), racial and ethnic background (Yao *et al.*, 2005), and the specific types of risks being assessed (Weber & Millman, 1997; Harris *et al.*, 2006). Men and women have different attitudes toward certain types of risks. Research shows that women are more sensitive to risks with severe negative consequences and thus less willing to engage in risky behaviors (Weber & Millman, 1997). However, when there is a small chance of a large benefit for a fixed small cost, women are more likely to take the risk (Harris *et al.*, 2006). This aligns with our findings that female household heads are more likely to mitigate risks by purchasing commercial insurance, leading to significant positive outcomes at relatively low costs. This behavior suggests a cautious approach to risk management, where the focus is on avoiding potential losses rather than seeking gains. By prioritizing financial protection, these

Table 5. Logit regression results

	Nearest neighbor caliper one-to-two matching				Kernel matching				Radius matching			
	Balance of income and expenditure	Commercial insurance	Savings account	Financial investment	Balance of income and expenditure	Commercial insurance	Savings account	Financial investment	Balance of income and expenditure	Commercial insurance	Savings account	Financial investment
Gender	0.173***	0.433***	0.026	0.082*	0.185***	0.504***	0.060	0.061⁺	0.184***	0.423***	0.012	0.061*
	(0.037)	(0.054)	(0.043)	(0.034)	(0.044)	(0.065)	(0.051)	(0.040)	(0.032)	(0.045)	(0.036)	(0.030)
Age	−0.348***	−0.336***	0.480***	−0.867***	−0.352***	−0.306***	0.482***	−0.866***	−0.311***	−0.380***	0.459***	−0.992***
	(0.036)	(0.047)	(0.044)	(0.031)	(0.044)	(0.057)	(0.053)	(0.036)	(0.025)	(0.033)	(0.030)	(0.023)
Education	−0.311***	0.267***	0.162***	0.497***	−0.287***	0.311***	0.214***	0.503***	−0.270***	0.243***	0.116***	0.530***
	(0.033)	(0.045)	(0.039)	(0.032)	(0.040)	(0.054)	(0.046)	(0.038)	(0.024)	(0.033)	(0.028)	(0.024)
Occupation	−0.037	0.366***	−0.000	0.333***	−0.055+	0.362***	0.011	0.359***	−0.044*	0.360***	−0.001	0.392***
	(0.028)	(0.040)	(0.033)	(0.025)	(0.033)	(0.048)	(0.040)	(0.030)	(0.020)	(0.030)	(0.023)	(0.019)
City of residence	−0.200***	0.122*	0.328***	0.284***	−0.269***	0.125+	0.368***	0.352***	−0.176***	0.150***	0.348***	0.269***
	(0.040)	(0.058)	(0.046)	(0.037)	(0.047)	(0.069)	(0.054)	(0.044)	(0.030)	(0.044)	(0.034)	(0.029)
Living in rural areas	0.055	−0.443***	−0.305***	−0.827***	0.060	−0.500***	−0.303***	−0.846***	−0.041	−0.226***	−0.203***	−0.758***
	(0.050)	(0.087)	(0.061)	(0.041)	(0.059)	(0.103)	(0.074)	(0.049)	(0.032)	(0.053)	(0.038)	(0.027)
Financial literacy	−0.288***	0.374***	0.331***	0.616***	−0.317***	0.397***	0.353***	0.619***	−0.268***	0.364***	0.322***	0.574***
	(0.021)	(0.029)	(0.024)	(0.021)	(0.025)	(0.035)	(0.028)	(0.025)	(0.015)	(0.021)	(0.017)	(0.015)
Total annual household income	−0.202***	0.047**	0.179***	0.053***	−0.165***	0.026	0.154***	0.029**	−0.249***	0.063***	0.189***	0.097***
	(0.018)	(0.018)	(0.019)	(0.009)	(0.017)	(0.017)	(0.020)	(0.009)	(0.015)	(0.015)	(0.015)	(0.008)
_cons	4.730***	−3.241***	−5.256***		4.368***	−3.209***	−5.157***		5.078***	−3.281***	−5.224***	
	(0.224)	(0.231)	(0.240)		(0.229)	(0.248)	(0.257)		(0.183)	(0.184)	(0.183)	
cut1				−0.420**				−0.617***				−0.285**
				(0.131)				(0.145)				(0.107)
cut2				3.288***				3.080***				3.723***
				(0.134)				(0.149)				(0.111)
cut3				5.453***				5.280***				5.928***
				(0.152)				(0.172)				(0.124)
cut4				8.896***				8.546***				9.651***
				(0.428)				(0.469)				(0.392)
n	16464	16464	16464	16464	11782	11782	11782	11782	31339	31339	31339	31339

Note: ⁺p<0.10; *p<0.05; **p<0.01; ***p<0.001.

women are effectively securing their household's financial stability, which contributes significantly to their overall financial health.

Third, female-headed households possess more financial investment products. Since financial access is usually measured by the types of financial products a household possesses (Despard *et al.*, 2020; Chen & Sun, 2023), this indicates that their financial access is not inferior to that of male-headed households. While this finding includes a 90% confidence interval, it remains statistically robust across multiple propensity score matching. Financial investment products represent a crucial dimension of financial access. Female-headed households' broader range of financial investment products suggests that women may not face inferior financial access compared to men. This finding contrasts with existing literature that typically indicates women have less access to financial resources than men (Cavalluzzo *et al.*, 2002; Kairiza *et al.*, 2017; Muravyev *et al.*, 2009; Morsy, 2020; Were *et al.*, 2021). The study highlights the importance of considering whether women serve as the financial decision-makers in their households, which might account for these findings. This underscores the need for further research on the impact of household financial decision-making on gender differences in financial access.

Given the findings, we considered why female household heads exhibit better financial health than male household heads, even after controlling for financial literacy and educational attainment. This study proposes two potential explanations. First, the measurement of financial literacy in the data used for the study may not fully reflect actual financial literacy. The measurement combined self-ratings of financial attention with tests of objective financial knowledge. The tests of financial objective knowledge included understanding concepts such as compound interest and the effects of inflation. This composite approach, widely commonly accepted by economists as a scientific measure of financial literacy (Allgood & Walstad, 2012; Behrman *et al.*, 2012), may not fully capture the true essence of financial literacy. It primarily focuses on basic financial concepts, which may overlook more nuanced aspects such as practical application and adaptive financial decision-making in real-world contexts (Fernandes *et al.*, 2014; Kaiser & Menkhoff, 2017). Second, participation in financial decision-making could enhance women's actual financial literacy. Unlike studies focusing on the general female population, this research involves female household heads who actively engage in financial decisions within their families. This active involvement may explain their better financial performance. Household financial decision-making appears to improve individuals' financial literacy (Barber & Odean, 2001; Booysen & Guvuriro, 2021; Smith *et al.*, 2010; Wagner & Walstad, 2022; Zaimah *et al.*, 2015). Research indicates that men are generally more involved in household financial decision-making, which allows them to gain more financial knowledge and experience, subsequently enhancing their financial literacy. On the other hand, women tend to focus more on managing daily household consumption and other family-related responsibilities (Booysen & Guvuriro, 2021; Zaimah *et al.*, 2015). This division of labor may lead to women being less proficient in financial matters compared to men (Gudjonsson *et al.*, 2022).

The financial participation of female household heads, particularly in the household's financial decision-making process, enhances their overall financial literacy and consequently improves their financial performance. Policymakers should promote women's participation in financial activities and access to financial resources through targeted policies, such as anti-poverty initiatives and microcredit programs for female entrepreneurship. Moreover, since women often manage daily household finances and tend to outperform in this area, household finance-related policies and programs (such as asset-building policies, Children's Development Accounts) may be more effective when aimed at women. Empowering women in financial decision-making within the household through social activities will not only enhance women's status within the household and promote gender equality in broader society but also contribute to improving the financial health of households.

Several limitations of the study should be acknowledged. First, the cross-sectional nature of the data restricts the ability to infer causality between the gender of the household head and financial health outcomes. Longitudinal studies would be more effective in establishing causal relationships and understanding the dynamics over time. Second, the study focuses on female household heads as financial decision-makers, which might not be representative of the general female population. This could limit the generalizability of the findings to all women. In addition, cultural and regional differences within China may influence financial behaviors and access to resources, which were not fully accounted for in this study.

5. Conclusion

The findings of this study challenge the prevalent belief that women have poorer financial health compared to men. The analysis reveals that female-headed households in China exhibit better income-expenditure balance, are more likely to possess commercial insurance, and show a higher propensity to own financial investment products than male-headed households. These results indicate that female household heads may possess effective financial management skills and a heightened inclination toward risk aversion and financial planning.

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Conflict of interest

The authors declare no conflict of interest.

Author contributions

Conceptualization: Yingying Zhang
Formal analysis: Yingying Zhang
Methodology: Yingying Zhang
Writing–original draft: Yingying Zhang
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Ethics approval and consent to participate

Not applicable.

Consent for publication

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Availability of data

This study used publicly available datasets, which can be downloaded at https://chfser.swufe.edu.cn/datasso/Home/Login?5228714360447555497.

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RESEARCH ARTICLE

The gendered division of household labor and decision-making in Tehran, Iran

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Abstract

The division of labor and decision-making within households is highly influenced by gender norms and resource allocation. However, there has been a marked shift away from traditional gender roles in domestic tasks and decision-making in recent years. This study examines the division of domestic responsibilities, childcare, and decision-making within households, as well as the socioeconomic factors that influence these dimensions in Iran. Data come from the "Survey of Married Lifestyle," which included 1736 married people aged 18 years and over in Tehran, selected through a multi-stage random sampling process. The results reveal that while women are increasingly involved in decision-making, they still primarily shoulder the burden of household chores and childcare. Factors such as women's education and income, as well as men's education and dual-earner status, are key determinants of the division of labor in households. Social policies that focus on enhancing women's access to education and economic opportunities are crucial for promoting gender equality and empowering women in household decision-making.

Keywords: Domestic labor division; Childcare; Decision-making; Dual-earner status; Resource-based approach; Iran

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1. Introduction

The family structure and relationships have experienced notable transformations, mainly as a result of industrialization, urbanization, and globalization (Goode, 1963; Megha *et al*., 2024). These macro-social forces have led to increased awareness among women regarding their personal and social rights, as well as in questioning men's traditional views on women's roles within both the family and society. Therefore, there have been substantial changes in the distribution of power resources and the traditional division of domestic responsibilities.

Household-level decisions made by spouses, who often have different preferences and bargaining power, have significant implications for the well-being of all household members, including children (Alem *et al*., 2023). Intra-household bargaining power is also important for policymakers, as it is closely linked to women's empowerment (Dong, 2021). Therefore, it is crucial to examine the division of domestic labor and decision-making among family members from various perspectives. Arguments from the perspective of power resources suggest that the balance of power in the household between husbands and wives is negotiated through the exchange of resources such as income, educational attainment, and occupational prestige. Research suggests that wives with higher incomes should have more power in these negotiations, leading to a more equitable division of labor in the household (Fuwa, 2004; Shu *et al*., 2012). Bargaining theories suggest that women's relative contributions to the household determine their position in intra-household negotiations and decision-making power (Gómez-Valle & Holvoet, 2022; Bercea & Oreffice, 2006). Labor market opportunities are considered one of the most critical determinants of women's bargaining power within the household, according to bargaining theories (Dong, 2021).

The gender roles in both the family and society have undergone notable transformations in many regions worldwide. A key trend in modern societies in recent decades has been the increasing labor force participation of women, marking a significant shift from traditional norms (Drobnič *et al*., 2024). Increasing employment opportunities for women enhance their autonomy in decision-making. Previous research consistently demonstrates a strong relationship between decision-making authority and the distribution of household responsibilities, reflecting power dynamics in marital relationships (Gazso-Windle & McMullin, 2003). Women's participation in decision-making is influenced by changes in family structure and societal norms (Rashid, 2013). The level of involvement in decision-making and household chores can vary across different societies. This is influenced by factors such as women's age, employment status, income, property ownership, education level, male migration, and number of children (Agarwal, 1994; Kabeer, 1999; Quisumbing, 2004; Anderson & Eswaran, 2009; Ghobadi *et al*., 2011; Mohammadi, 2012; Gómez-Valle & Holvoet, 2022; Ram Mohan *et al*., 2022). Women in more advantageous positions compared to their partners, who challenge traditional gender roles, are more likely to make joint decisions rather than acting independently. Working women are less likely to shoulder the sole responsibility for childcare and daily cooking (Gómez-Valle & Holvoet, 2022). Women with higher incomes, greater education, longer working hours, and more egalitarian attitudes toward gender roles tend to do less household work. Conversely, men with shorter working hours, higher education, and more egalitarian attitudes toward gender roles tend to contribute more to household chores (Coltrane, 2000). Castells (2010) argues that women's economic participation enhances their bargaining power and allows them to challenge traditional family structures without fear of repercussions. Employment and income strengthen women's formal and informal authority. While the direct impact of women's income on their bargaining power is not entirely clear, research suggests that a smaller income gap between partners can enhance women's bargaining power. However, some studies indicate that women's employment, property ownership, income, or education does not always result in greater decision-making authority within the household; in some cases, it may even diminish it. This is particularly evident in South Asia, where women may take out loans for the family, which they repay independently, leading to a loss of control over their assets and income, potentially worsening their financial situation (Mabsout & Van Staveren, 2010).

In recent decades, the Iranian family has experienced significant changes both structurally and ideationally (Sadeghi & Agadjanian, 2019). Conventionally, power dynamics within families were often based on gender and age, with men and older individuals typically holding authority. However, there has been a noticeable improvement in the social status of women, leading to greater autonomy in decision-making. This change has been supported by women's increased access to resources and opportunities, challenging traditional family power structures in Iran (Bagheri *et al*., 2009; Askari-Nadoushan *et al*., 2012). Several studies have explored this transition in Iran (Jarollahi, 1996; Raisi & Moghadas, 2012; Amini *et al*., 2013; Nayebi & Golshani, 2013; Rezvani & Zanjanizadeh, 2015). However, most of these studies have focused on women's resources such as income and education, with less emphasis on the influence of men's socioeconomic status. Therefore, this study aims to investigate the division of domestic labor and decision-making authority within households in Tehran, while also examining the socioeconomic factors associated with these dynamics. The results of this study could have important implications for women's empowerment, their social and economic participation, and the promotion of gender equality.

1.1. Theoretical framework

Gender inequality in the division of domestic labor and decision-making power within households can be explained by two main sociological approaches: The resource-based approach and the gender-centered approach. The "*resource-based approach*" suggests that individuals' power and choices in the division of domestic labor and decision-making are influenced by their resources, such as education, employment, and income. Women's empowerment in education and employment has increased their bargaining power over men (An, 2008). The resource-based approach considers the domestic division of labor as the outcome of ongoing negotiation and bargaining between spouses. In contrast, the "*gender-centered approach*" argues that gender disparities in domestic labor and family decision-making are strongly influenced by gender roles (Chung and Lee, 2017; Campaña *et al*., 2023). Social norms and values determine which tasks should and should not be carried out by women and men (Campaña *et al*., 2018). The theoretical framework in this study is grounded in the resource-based approach. Therefore, we expect that an individual's division of domestic work is determined by their socioeconomic status in relation to their partners.

2. Data and methods

2.1. Data source and sampling

The research used data from the 2015 *Survey of Married Lifestyle in Tehran City*, conducted by the first author. With a 95% confidence level, a sampling error of 0.05, and a design effect of 2, the sample size was determined to be around 1730. The study targeted married individuals, with one spouse chosen randomly for inclusion. Sampling was done using the probability proportional to size method, with samples collected from 50 districts in Tehran.

2.2. Measures

The validity and reliability of the questionnaire were evaluated using expert qualifications, face and construct validity, and Cronbach's alpha. Our analysis focused on three dependent variables: division of domestic labor, childcare responsibilities, and family decision-making power.

The division of domestic labor was assessed based on tasks such as cooking, dishwashing, and house cleaning. The Cronbach's alpha coefficient of internal consistency was 0.75, which indicates acceptable reliability. A higher score on this scale indicates a greater burden of household duties on women.

Childcare responsibilities were measured by tasks such as overseeing children's homework, helping with dressing, managing sleep routines, caring for sick children, and engaging in play or conversation with children. The Cronbach's alpha was 0.82, which indicates strong reliability. A higher score on this scale signifies a large share of childcare duties being carried out by women.

Family decision-making power was assessed in areas such as family affairs, leisure activities, major purchases, parenting styles, visits to relatives and friends, and identifying the primary decision-maker in the family. The Cronbach's alpha was 0.84, which indicates strong reliability. A higher score on this scale suggests that women play a more significant role in family decision-making.

The study considered various independent variables, including education, income, length of marriage, having a child, income earner status, parent's socioeconomic status, and the couple's relative income and education levels.

The respondents' education levels were classified as below a diploma, a diploma, or tertiary education. The *family income* was categorized as <600 USD, 600 – 1000 USD, or more than 1000 USD per month. The *length of marriage* was divided into either <5 years, 5 – 10 years, 10 – 19 years, or 20 years and above. Having *a child* was also considered as an independent variable.

Income earner status refers to the position of income earners within a family, either as a single earner or as a dual earner. *Parents' socioeconomic status* was defined as their perceived social and economic standing of parents, classified as low, medium, or high. The *couple's relative education level* was calculated by comparing the educational levels of the man and woman, which can be categorized as men's higher education, equal education, or women's higher education. The c*ouple's relative income level* was determined by the difference between the man's and woman's income, classified as either men's higher income, equal income, or women's higher income.

2.3. Statistical analysis

Data analysis was carried out using descriptive statistical analysis methods and regression in Statistical Package for the Social Sciences software v26. Different specification and diagnostic tests were performed to assess ordinary least square assumptions, as well as the accuracy and validity of statistical analyses. Multivariate linear regression models were used to investigate the impact of socioeconomic factors on family decision-making power, division of domestic labor, and childcare responsibilities.

3. Results

3.1. Descriptive analyses

The socioeconomic variables are described in Table 1. The average age of the respondents was 44.1 years (Standard deviation = 12.7). Around a third of the respondents had tertiary education, 82% had children, and 45% had been married for over 20 years. Women were the financial contributors in 21% of households. There was a significant income gap between men and women. Around 54% of couples had equal levels of education, while 10% had equal income levels.

Table 2 displays how domestic labor division, childcare responsibilities, and decision-making are distributed within households. According to the findings, there is significant gender inequality, with approximately 90% of women handling household tasks and 71% taking care of

Table 1. The description of socioeconomic and demographic variables

Variable	Sample size	Percentage
Age		
18 – 34 years old	427	24.6
35 – 49 years old	762	43.9
50 – 64 years old	403	23.2
≥65 years old	144	8.3
Mean (SD)	44.1 (12.7)	
Gender		
Men	844	48.6
Women	892	51.4
Man's education		
Under diploma	618	35.6
Diploma	540	31.1
Tertiary	578	33.3
Woman's education		
Under diploma	587	33.8
Diploma	566	32.6
Tertiary	583	33.6
Man's income per month		
<600 USD	1,000	58.2
600 – 1000 USD	469	27.3
>1000 USD	250	14.5
Woman's income per month		
<600 USD	1,671	96.4
600 – 1000 USD	52	3.0
>1000 USD	10	0.6
Income earner status		
Single earner	1,370	79.1
Dual earner	361	20.9
Couple' relative level of education		
Men's higher education	408	23.5
Equal education	945	54.4
Women's higher education	383	22.1
Couple' relative level of income		
Men's higher income	1,519	88.4
Equal income	171	10.0
Women's higher income	28	1.6
Parent's socioeconomic status		
Low	455	26.4
Middle	885	51.3
High	386	22.4

(Cont'd...)

Table 1. *(Continued)*

Variable	Sample size	Percentage
Length of marriage		
<5 years	245	14.3
5 – 10 years	278	16.2
10 – 19 years	424	24.7
≥20 years	771	44.9
Having children		
Not having children	308	17.8
Having a child (ren)	1,423	82.2
Total	1,736	100.0

Abbreviation: SD: Standard deviation.

children. However, there has been a shift in the decision-making process, with 81% of participants sharing this responsibility together.

3.2. Multivariate regression analysis

The results of multivariate analyses are displayed in Table 3. Multivariate linear regression models were utilized to examine the influence of predictors on the proportion of women involved in household labor division, childcare, and family decision-making. The models in Table 3 were assessed for normality, multicollinearity, and heteroscedasticity, and various tests confirmed that these assumptions were satisfactory. The tests for skewness and kurtosis tests showed that the data distribution was normal. The variance inflation factor (VIF) was employed to identify multicollinearity, and all VIF values were <5, indicating that there was no multicollinearity problem with any of the predictors. The Breusch–Pagan test was carried out to test heteroscedasticity, and the results showed no evidence of variance in the residuals.

According to the beta coefficients derived from multivariate regression models, men's education, women's education and income, and dual-earner status are negatively associated with the share of women in domestic labor, whereas men's income, and having children positively influences the share of women in domestic labor.

According to Table 3, as men's education, women's income, and dual-earner status increase, their involvement in childcare decreases. On the other hand, an increase in men's income and women's equal or higher education are positively associated linked to an increased proportion of women engaged involved in childcare. In addition, the findings suggest that women's participation in household decisions is positively influenced by their education, dual-earner status, and the length of their marriage.

Table 2. The distribution of domestic labor division, child care responsibilities, and family decision-making within the household (%)

Items	Always the woman	More the woman	Equal	More the man	Always the man	Total
Cooking and preparing daily meals	82.2	10.6	7.1	0.1	0	100.0
Dishwashing	71.8	15.9	11.5	0.7	0.1	100.0
House cleaning	71.5	18	8.6	1	0.9	100.0
Domestic labor division (*n*=1,736)	75.2	14.8	9.1	0.6	0.3	100.0
	90		9.1	0.9		100.0
Overseeing children's homework	54.1	19.7	22.9	2	1.3	100.0
Helping with dressing	61.8	24.4	13.3	0.4	0.1	100.0
Managing children's sleep routines	60.4	23.9	14.9	0.3	0.5	100.0
Caring for sick children	46.1	26.4	27.1	0.3	0.1	100.0
Play with children or talking to them	17.9	19	61	1.6	0.5	100.0
Childcare responsibilities (*n*=1,428)	48.1	22.7	27.8	0.9	0.5	100.0
	70.8		27.8	1.4		100.0
Making decisions about family affairs	2.3	5.5	81	8.6	2.6	100.0
Making decisions about leisure activities	2.1	9.7	82.3	4.4	1.5	100.0
Making decisions about major purchases	2	5.9	80.1	8.9	3.1	100.0
Making decisions about parenting styles	2.8	8.7	86	1.5	1	100.0
Making decisions about visiting relatives and friends	2	7.7	85.7	3.3	1.3	100.0
Who is the main decision-maker in your family?	1.3	2.9	68.2	20.1	7.5	100.0
Family decision-making power (*n*=1,736)	2.1	6.7	80.6	7.8	2.8	100.0
	8.8		80.6	10.6		100.0
Domestic labor division scale	Mean=10.92		SD=1.65	Range=4 – 12		
Child care scale	Mean=13.34		SD=1.98	Range=0 – 20		
Family decision-making scale	Mean=11.85		SD=2.48	Range=0 – 24		

Abbreviation: SD: Standard deviation

In summary, the multivariate modeling findings of the present study partially conform to the power resource theory. Women with educational and financial resources tend to have lower levels of domestic labor and childcare responsibilities and are more engaged in making family decisions. Nevertheless, a considerable portion of gender disparities in household division of labor and decision-making cannot be accounted for resource-related factors, highlighting the influence of traditional gender norms and beliefs.

4. Discussion

In recent decades, there has been a shift in traditional gender roles in many developing countries toward a more equal sharing of domestic labor and decision-making power. This study aimed to explore the gendered division of household tasks and decision-making authority in Iranian households and factors influencing these dynamics. The findings revealed that a majority of Iranian women actively participate in household decision-making, indicating a move toward more equal decision-making processes within households. Factors such as women's education, dual-income status, and length of marriage were found to positively impact women's participation in household decision-making. Consistent with previous studies (*e.g.*, Albert & Escardíbul, 2016; Khare, 2021; Cannonier & Burke, 2022), women with higher levels of education are more likely to be involved in household decision-making. Moreover, the study found that in dual-earner households, both partners are typically involved in household decision-making. As noted by Bernasek and Bajtelsmit (2002), women's contribution to household decisions is influenced by their share of the total household income. The study also found that the longer the duration of marriage, the greater the level of women's involvement in decision-making, in line with existing literature (*e.g.*, Mostafiz & Jamil 2022; Gómez-Valle & Holvoet 2022).

Furthermore, the study results revealed that factors such as the level of education for both men and women, women's income, and having dual-earner status were

Table 3. Predictors of greater share of women in domestic labor division, child care, and family decision-making (beta from multivariate regression models)

Predictors	Domestic labor division scale	Childcare scale	Family decision-making power scale
Man's education	−0.080*	−0.054*	−0.017
Woman's education	−0.076*	−0.004	0.083**
Man's income	0.096*	0.101*	0.001
Woman's income	−0.110*	−0.054*	0.016
Income earner status (dual earner)	−0.235***	−0.150***	0.065*
Couple's relative level of education (Women's equal or higher education)	0.063	0.105*	0.019
Couple's relative level of income (Women's equal or higher income)	0.002	0.046	0.041
Parent's SES	−0.038	0.003	−0.032
Length of marriage	0.031	−0.005	0.101**
Having children	0.110**	-	0.015
F (sig.)	34.82 (0.001)	6.23 (0.001)	2.85 (0.001)
Adjusted R-square (%)	43.1	20.8	14.8
Breusch–Pagan test	Insignificant	Insignificant	Insignificant
Skewness (kurtosis) tests	−1.298 (1.857)	−0.901 (1.298)	0.453 (1.650)
Durbin–Watson statistic	1.87	1.76	1.74

Notes: A higher score indicates a larger share of women in domestic labor division, child care, and family decision-making. The values of VIF of all variables in the table are under 5. *p<0.05; **p<0.01; ***p<0.001.

associated with a decrease in women's engagement in domestic chores. Higher education can result in higher income, allowing individuals to outsource or delegate household chores (Gupta, 2007). Education also enhances negotiation and bargaining skills, as well as promotes gender egalitarianism (Román, 2021; Magda *et al*., 2024). However, our findings align with previous research (*e.g.*, Sayer *et al*., 2004) showing that the relationship between education and housework is not consistent for childcare, which is often viewed as a more fulfilling activity. Women's income was found to be inversely associated with housework and childcare, while men's income tended to have a positive association with these responsibilities. Magda *et al.* (2024) also noted that women's participation in housework decreases as their share of total household income increases. However, women do not significantly benefit from their male partners' income in terms of housework (Gupta, 2006). In addition, shifting from a single-earner to a dual-earner family status was associated with a decrease in women's involvement in household tasks and childcare. Winkler and Ireland (2009) observed that dual-earner wives typically spend less time on household management compared to single-earner wives. Overall, women's access to financial resources appears to empower them, leading to a reduction in their domestic labor and an increase in their participation in family decision-making. In this regard, the relative resources perspective suggests that differences in individual resources such as income and education can explain the gender differentials in power and decision-making in the family and division of labor household chores (An, 2008; Shu *et al*., 2012). Therefore, according to the relative resource bargaining perspective, the partner with more economic resources and power (usually determined by income and educational level) has the ability to dictate their role within the household, while the partner with fewer economic resources takes a larger share of unpaid domestic work (Garcia & Tomlinson, 2021).

In addition, our findings indicate that despite the increase in women's involvement in household decision-making and having access to bargaining power, they are still primarily responsible for household and childcare duties.

Housework and childcare remain largely perceived as femininity (Sekeráková Búriková, 2023), a pattern observed in various regions including Asia and Southern Europe (Fisher & Robinson, 2011; Kim, 2018). Studies consistently found that women perform a disproportionately high share of household tasks, even in the most egalitarian contexts (Moreno-Colom, 2017). Gender disparities in household labor persist, even when accounting for resource-based factors, largely due to the "stickiness" of gender role expectations (Altman & Humberd, 2023). From a gender-centered approach, cultural norms and social expectations often dictate that wives are tasked with cooking and caring for children, while husbands are expected to work outside the home to support the family (Alem *et al*., 2023). Thus, cultural models governing the division of labor by gender and societal attitudes and norms regarding gender roles profoundly impact the opportunities and barriers to equitable participation for both genders (Drobnič *et al.*, 2024). Consequently, gender norms have the potential to reinforce the gendered division of labor within both micro- and macro-level structures.

5. Conclusion

The study found that women's participation in household decision-making was generally high; however, they continue to shoulder the majority of household and childcare responsibilities. Access to relative resource factors, such as education and income, plays a crucial role in decreasing the burden on women in terms of housework. Consequently, an individual's role in household division and decision-making is influenced by their socioeconomic status relative to their partner's. Higher levels of education for both men and women, along with women's access to financial resources, are linked to greater gender equality in household responsibilities and women's decision-making authority. However, even when considering factors related to the relative resource bargaining perspective, gender disparities in household labor and childcare, while diminished, still persist. This implies that gender roles can actually override relative resources, and the distribution of resources alone cannot fully explain persistent gender inequalities. Thus, both resource-based and gender-ideology factors are likely to influence the gendered division of household labor and decision-making. Therefore, it is recommended that social policies focus on educating men, empowering women, changing traditional gender attitudes, and promoting equal partnerships.

Our study was conducted with a limited sample in the city of Tehran and the findings may not be applicable to the entire country of Iran. Future research should include larger samples encompassing both rural and urban areas. The data used in this study are from 2015, and there may have been significant changes in the gender division of labor and decision-making within households since then. Therefore, updated data are needed to monitor these changes. Furthermore, a longitudinal study examining the causal relationships between the gender division of labor within the household, decision-making authority, and other relevant factors would be highly valuable.

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Conflict of interest

The authors declare that they have no competing interests in conducting this research.

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Conceptualization: Rasoul Sadeghi
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Ethics approval and consent to participate

This study was approved by the NIPR (#1393-145). A cover page was included in the survey questionnaire to inform all participants that participation in the survey is voluntary and anonymous and that the survey data would be used for research purposes only.

Consent for publication

Not applicable.

Availability of data

The data are not publicly available.

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ACCSCIENCE PUBLISHING

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RESEARCH ARTICLE

Choice of a country for migrant entrepreneurship

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Abstract

In today's society, entrepreneurial activities are important, as they can create social values and wealth. This study explores entrepreneurial activities across various European countries and proposes a novel approach for its effective measurement. To this end, this study utilizes established indices by the World Bank – the 2020 European Chamber (EuCham) index, and the migrant integration policy index (MIPEX), which focuses on migrant integration. In addition, it introduces a novel index, called the Migrant Entrepreneurship (IMIGRENT) index, to accurately quantify a country's attractiveness for entrepreneurial activities. These are part of the respective indexes for entrepreneurial activities, such as company registration processes, personal affairs, accommodation, and environmental conditions. A country's attractiveness for entrepreneurial activities is evaluated based on entrepreneurs' preferences and diverse needs, as well as immigrants' citizenship. After comparing the three indices mentioned above, more similar results are obtained for the 2020 EuCham and the IMIGRENT index than MIPEX, attributable to the greater importance given to financial factors in the IMIGRENT and EuCham indexes compared with MIPEX, which prioritizes social and integration-related factors. Notably, the IMIGRENT index reports some important additional values in a comparative analysis of European countries, such as the role of immigrant citizenship, and the country's legislation, as well as other aspects related to personal affairs, accommodation, social services, or the host country's weather.

Keywords: Migration; Entrepreneurship; Immigrant integration; Business attractiveness; 2020 European chamber index; Migrant integration policy index

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1. Introduction

According to the 2022 World Migration Report (World Migration Report, 2022), Europe is the leading destination for migration with 87 million migrants, representing 30.9% of the global international immigrant population. It is followed by Asia (86 million; 30.5%), North America (59 million; 20.9%), and Africa (25 million; 9%). In the past 15 years, South America and the Caribbean have experienced significant growth, with their international immigrant population more than doubling, from 7 million in 2007 to 15 million in 2022. At present, these regions have the highest growth rate and host 5.3% of all international immigrants. Finally, Oceania hosts approximately 9 million international immigrants (3.3%).

Based on these figures, the education and training provided to the workforce should align with each country's job requirements, and the success of this alignment significantly influences labor market outcomes, productivity, and economic growth. However, when workers are overeducated or undereducated for their roles, a skill mismatch occurs, which incurs costs for individuals, businesses, and society. Specifically, overqualified workers tend to experience wage reductions, lower job satisfaction, and higher turnover rates compared with workers in jobs that match their qualifications. Moreover, persistent qualification mismatches can result in long-term career damage. According to the International Labor Office (ILO, 2013), immigrants, especially first- and second-generation immigrants, are highly susceptible to skills mismatches.

Although skills and qualifications play an important role in an immigrant's economic and social integration, they do not guarantee successful integration or labor market success. Rather, they represent an immigrant's potential to integrate and succeed in the host country's job market by significantly influencing immigrants' career paths and the types of jobs they can obtain (Organisation for Economic Co-operation and Development [OECD], 2018).

The evaluation and validation of skills and qualifications affect migrants as well as refugees. Migrants can prepare for the qualification process in their destination country; however, refugees often leave their home country without knowing their final destination. Moreover, they may be unable to bring their academic credentials and struggle to access relevant institutions in their host country for document verification. Due to these challenges in verifying their qualifications, skills, and work experience, many refugees and migrants face unemployment or jobs that do not fully utilize their abilities, with many highly skilled immigrants forced into low-skilled, temporary, or poorly paid positions. According to the European Commission, this situation is a loss not only for these migrants and refugees but also for the receiving societies and their economies.

Interestingly, immigrants are often seen as highly entrepreneurial, with higher rates of business ownership compared with local-born individuals in developed countries such as the United States, the United Kingdom, Canada, and Australia. Immigrant entrepreneurs have made significant contributions to the technology and engineering sectors, especially in regions such as Silicon Valley (Fairlie & Krashinsky, 2006; Karren, 2024; Kushida, 2024). Immigrant workers play a key role in determining the adoption of technology. Highly skilled immigrants, such as scientists and engineers, drive innovation by developing new products and securing patents. Meanwhile, lower-skilled immigrants fill specific market gaps, allowing the former to focus on challenges requiring more than just additional labor. The expertise provided by highly skilled immigrants drives the innovation process in the high-skilled tech industry, contributing significantly and positively to technological advancement. As for the lower-skilled workers, they can complement the advancement of technology and help accelerate the adoption of new technologies (Karren, 2024).

1.1. Literature review

The topic of IMIGRENT has gained increasing recognition among policymakers, stakeholders, and researchers (Ram *et al*., 2017; Solano *et al*., 2019; 2023). This growing interest is driven by several factors, including the notable growth of the small business sector, highlighting the contributions of immigrants and their natural entrepreneurial inclinations.

In OECD countries and the European Union (EU), approximately 12% of foreign-born migrants are self-employed, with the percentage varying by country (OECD, 2018; Desiderio, 2014; Rath & Schutjens, 2016; Solano *et al*., 2019; Taddei & Solano, 2020). However, data from Eurostat and the OECD indicate that migrant-run businesses frequently underperform compared with those run by locals in several metrics due to limited access to essential infrastructure, networks, and credit opportunities. These disparities restrict immigrants' ability to fully engage in the entrepreneurial environment. For instance, foreign-born entrepreneurs are more likely to manage microbusinesses and generate fewer jobs, especially in the formal economy. Furthermore, compared with local-owned businesses, businesses owned by immigrants are 27% less likely to survive in the first 5 years (OECD & European Union 2015; OECD, 2018; Taddei & Solano, 2020; UNCTAD, 2018; Eurostat, 2023).

The reasons for which such a high number of immigrants choose to start businesses remain unclear. However, previous studies have revealed that various factors in the host country, including labor market discrimination, selective immigration policies, and limited opportunities in areas with high immigration, contribute to this trend. Recently, less obvious factors driving immigrant entrepreneurship, such as personality-based self-selection, have been discussed. Specifically, immigrants are more inclined to become entrepreneurs than local residents because those who decide to leave their home country to start a new life elsewhere tend to have a greater willingness to take risks. Entrepreneurs generally face the risk of failure: slightly over 60% of startups in various OECD countries survive past their 3rd year, with only 40% lasting beyond 7 years (Vandor, 2021). Moreover, immigrants frequently deal with issues such as unemployment, underemployment, xenophobia, and psychological trauma. This hypothesis has been tested by a longitudinal study involving engineering and business students from two Austrian universities (Vandor, 2021). This study's findings indicated that individuals with high achievement motivation are significantly more likely to emigrate and become entrepreneurs at some point in their lives.

A recent analysis based on data from the Global Entrepreneurship Monitor and a cross-sectional dataset of 630,139 observations from 69 nations covering the period from 2012 to 2015 indicated that the proportion of immigrants in a country is statistically associated with the likelihood of various types of businesses, including opportunity-driven, necessity-driven, export-oriented, and growth-oriented ventures (Wellalage *et al.* 2023). The findings also indicated that the cultural and geographical differences moderate the relationship between immigration and entrepreneurship, with cultural dimensions having a more pronounced impact on entrepreneurial activities in middle-income countries compared with high-income ones (Wellalage *et al.*, 2023).

It is worth mentioning the difference in entrepreneurial activities and access to them by immigrants and refugees in terms of the legal status of access to the labor market (Newman *et al.*, 2024). In this regard, there is growing empirical research on IMIGRENT, including a recent systematic review by Dabić *et al.* (2020), who found that refugee entrepreneurs tend to have less social capital, fewer economic resources, and greater uncertainty due to their visa status. Related research has found that refugees often endure more traumatic experiences than voluntary migrants, who generally have more choices regarding where to move, more time to prepare for addressing legal issues such as visas, and better access to financial resources (Campion, 2018; Hynes, 2011). When analyzing the differences between refugees and voluntary migrants, it is important to recognize that involuntary migrants have diverse experiences and specific individual needs, which can vary according to their arrival mode, visa category, and social status in their home country (Hynes, 2011). For example, refugees on temporary visas without permanent protection, such as asylum seekers, often have limited access to formal employment opportunities and few financial resources to establish and expand their businesses.

1.2. Objectives and indexes of the present study

Based on the above discussion, the objectives of this study are as follows:

1. To review two of the most representative indexes in the literature (European Chamber [EuCham] 2020 and the Migrant Integration Policy Index [MIPEX]) for immigrant entrepreneurship and the influence of host counties and their respective legislation
2. To introduce a more extensive index for quantifying the attractiveness of a country for migrant entrepreneurial activities, the IMIGRENT index, based on a broad list of additional factors (social, economic, personal, climatic, and security) that are influencing the decision for starting a business in a new country.

Subsequently, we briefly summarize the three approaches mentioned above. The first approach uses an index developed by the World Bank and Transparency International, which has gained international recognition (EUCHAM, 2020). This approach has been used by EuCham, which ranks European countries based on economic indicators mainly related to starting a business, paying taxes, trading across borders, and registering property.

The second approach involves a recent analysis of migrant integration using MIPEX, developed by Solano & Huddleston (2020). This approach quantifies the policies implemented for integrating migrants in 56 countries (from six continents) and considers related factors such as labor market mobility, family reunification, education, health, permanent residence, access to citizenship, anti-discrimination, and political participation. In their comparative study, the legal and policy frameworks for migrant entrepreneurs in the EU and OECD countries are thoroughly examined. On the one hand, by analyzing various regulations, policies, and practices, they revealed that the legal framework can hinder access to self-employment for certain migrants, depending on their legal status. On the other hand, they found that the policy framework offers various measures that support migrant entrepreneurs. However, these measures often consider migrant entrepreneurs as a relatively uniform group, overlooking their diverse and unique needs.

The third is the novel IMIGRENT index, which can be applied to all countries worldwide and is based on a comprehensive set of criteria covering nearly all aspects of establishing entrepreneurial activities. The criteria are summarized as follows:

- Immigration procedures
- Company registration and ownership
- Personal affairs and accommodations
- Social services
- Specific issues
- Climatic and natural conditions

The novelty of this index is its in-depth analysis of all aspects related to migrant entrepreneurial activities. Specifically, it quantifies the attractiveness of a country for the entrepreneur and determines what aspects are considered more important than others. In addition, it is universal, that is, it can be applied to any citizenship and is based on the policies of the potential host country.

Based on the aforementioned criteria, the IMIGRENT index incorporates aspects from the 2020 EuCham index (World Bank Ease of Doing Business score and Transparency International Corruption Perception Index), regarding starting a business and paying taxes and from the MIPEX index, regarding immigrant integration in terms of family reunification, education, health, permanent residence, and citizenship access Apart from these aspects, the IMIGRENT index incorporates the most important results from the literature (Desiderio, 2014; OECD & European Union 2015; OECD, 2018; Ram *et al*., 2017; Solano *et al*., 2019, 2023; Dabić *et al*., 2020; Wellalage *et al*., 2023; Karren, 2024; Kushida, 2024; Newman *et al*., 2024). Moreover, it fills gaps regarding the role of additional reasons for the decision to start and own a business, which has not been considered so far: these include social, economic, personal, climatic, and security factors. The IMIGRENT index also considers migrants' personal preference to engage in entrepreneurial activity in a given country, filling a gap regarding individual attitudes. These factors refer to personal affairs and accommodation and play a crucial role when starting a business; they reflect the attitude of the local people toward immigrants, the country's crime index, and the risk of war or natural disasters, as well as weather (see Appendix for further details).

The rest of this study is organized as follows. Section 2 describes the methodology. Section 3 discusses the main results. Section 4 compares the results of the three indexes, whereas Section 5 presents the main conclusions.

2. Data and methods

2.1. Method 1

This study combines quantitative and qualitative approaches, incorporating statistical data from various sources such as the World Bank, Transparency International (EUCHAM, 2020), the Policies for Migrant Integration by Solano & Huddleston (2020), the OECD, and Eurostat. To select and review the relevant research, we conduct an online search of the Web of Science and Scopus databases using keywords such as "immigrant," "refugee," "entrepreneur," and "small business."

2.2. Method 2

This study conducts a comprehensive analysis to measure a country's attractiveness for immigrant entrepreneurship using the IMIGRENT index. Each of the six categories in this new index contributes to the objective score and corresponding weight, based on a maximum normalized value of 100 (Section 3.2).

Regarding the first category of the IMIGRENT index, immigration procedures, information is obtained from host countries' Ministry of Internal Affairs and various police departments that deal with immigration procedures. As for the second category, company registration, and ownership, information is obtained from host countries' Ministry of Economy and official information published by experts in the field. Regarding the third category, personal affairs, and accommodations, information is obtained from specific sites concerning real estate. For the fourth category, social services, such information is obtained from the host countries' Ministries of Social Security. In the fifth category, information regarding local friendliness scores is obtained from the Internations.org webpage (Expat Insider, 2022). Finally, for the sixth category, climatic and natural conditions, information is obtained from numerous webpages of the host countries, especially those dedicated to weather-related issues such as the World Meteorological Organization (WMO, 2024). Meanwhile, the statistical analysis partly relies on information used for the MIPEX complemented by other indicators such as immigrant procedure and company registration statistics, country weather conditions, crime, and positive or negative attitudes toward foreigners. Finally, a data wrapper is used to enhance the visualization of the results. This program was chosen because it is an open and user-friendly software that is suitable for generating simple, yet comprehensive visual presentations for academic reports.

3. Results

3.1. Non-European immigrants in Europe

When analyzing immigration in Europe, it is important to focus on the non-European immigrants who moved to Europe in the last decades. According to 2011 data from Statista (2018), the top five major EU foreign-born communities are Morocco (2.29 million), Turkey (2.08 million), Russia (1.81 million), Algeria (1.51 million), and Ukraine (1.09 million). Due to the current armed conflict between Russia and Ukraine (as of July 15, 2024), a total of 6,021,400 Ukrainian refugees have resettled in the EU under the temporary protection scheme for individuals fleeing the war in Ukraine (EU Protection, 2022; UNHCR EU-UA, 2023). The countries that have attracted a majority of non-European immigrants are Germany, France, Italy, the Netherlands, Sweden, and, before Brexit, the United Kingdom. Figure 1 depicts the number of immigrants from non-European countries who settled in Europe in 2022. Based on the findings,

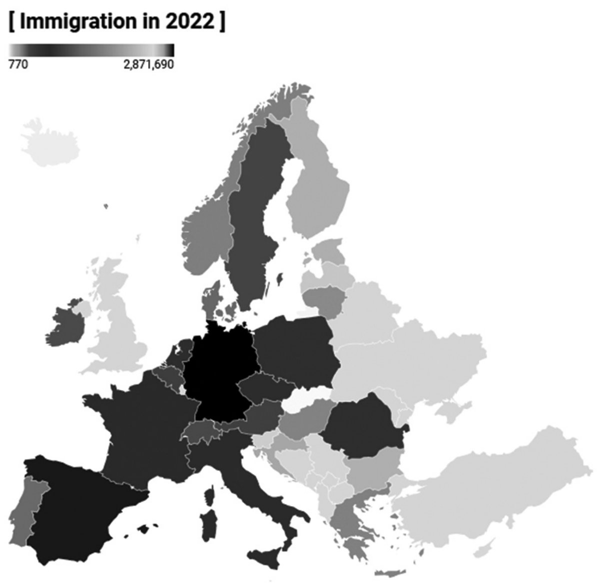

Figure 1. Immigration from non-EU countries to the EU, Switzerland, and Norway in 2022
Note: The numbers refer to the number of people in thousands.
Source: Eurostat (2023). Author's interactive map published at: https://datawrapper.dwcdn.net/WcEbc/2

Germany, Spain, France, Italy, and the Netherlands were the primary destinations for such immigrants during that year (Eurostat, 2023).

3.2. The 2020 EuCham and MIPEX scores

3.2.1. The 2020 EuCham index

Since the mid-1990s, the European business landscape has experienced significant and rapid changes with the establishment of a single market. The introduction of a common currency in 1999, the expansion of the Single European Act to new domains (e.g., e-commerce), and the ongoing move toward supranational business taxation regulations have all played major roles in developing a more unified business environment. These developments have prompted the diversification of firm structures. For instance, many multinational corporations have transitioned into European transnational entities, competing globally with the advantage of a robust, extensive domestic market. Meanwhile, small- and medium-sized enterprises operating at the European level have become micro-multinationals, facing competition at the local, national, and international levels and adhering to market harmonization regulations formulated for all parties within the single market (Suder, 2007).

At present, entrepreneurs must navigate an exceedingly competitive market. Europe teems with top-tier brands, long-established companies, and some of the world's most cutting-edge technological and industrial enterprises (Calviño, 2022). Becoming an entrepreneur in Europe requires meeting two crucial prerequisites: first, strict compliance with existing legislation enabling the commencement of commercial operations in any EU country where the business is established; and second, possessing unwavering determination and resilience to wholeheartedly embrace and cultivate the following:

- Legal compliance: Adhering to the legal requirements to start a business in the EU
- Adaptability and resilience: Possessing such qualities to navigate the challenges of entrepreneurship
- Focus and commitment: Demonstrating such attributes in the business endeavor
- Value of learning: Recognizing this value and remaining committed to acquiring new skills.

Therefore, embarking on an entrepreneurial journey in Europe, especially as a foreigner, is a significant endeavor. The Support Adventure classification of the easiest countries in Europe for foreigners to start a business in 2022 lists countries such as Denmark, Estonia, and Norway, which offer unique advantages for aspiring entrepreneurs (Kristina, 2022).

In a recent in-depth analysis conducted by EuCham, 46 European countries were ranked based on their economic environments. The ranking, which ranged from 0 to 100, was determined by a comprehensive analysis that utilized internationally recognized indexes from the World Bank Ease of Doing Business score and Transparency International Corruption Perception Index. First, the Ease of Doing Business score assesses disparities between a country's economic policies and regulations and the best practices observed across all economies. This score encompasses various indicators such as starting a business, paying taxes, trading across borders, and registering a property.

Second, Transparency International's Corruption Perception Index evaluates the perceived level of corruption within a country's public sector. A low score indicates prevalent bribery, a lack of consequences for corruption, or a government that fails to adequately address societal needs (EUCHAM, 2020). The results of the 2020 EuCham index are presented in Figure 2.

The Nordic countries, along with some central European countries (Germany, Austria, and Switzerland) and the United Kingdom, Ireland, and Iceland, are at the top of this list. These nations have succeeded in establishing attractive business climates, highlighting their respective progress and economic potential. Compared with previous results from the same index, the Nordic countries have maintained their leading positions. However, among the notable movements in the list, Spain and Montenegro have made significant advancements, with Estonia, Lithuania, and Georgia standing out among the post-Soviet countries. Conversely, North Macedonia has experienced the most significant decline (EUCHAM, 2020).

3.2.2. MIPEX

In 2020, Solano and Huddleston used the MIPEX to extensively analyze the policies for migrant integration, based on a large investigation conducted by numerous research groups in 56 countries (across six continents), including: all EU member states and the United Kingdom; other European countries, such as Albania, Iceland, North Macedonia, Moldova, Norway, Serbia, Switzerland, Russia, Turkey and Ukraine; Asian countries including China, India, Indonesia, Japan, Jordan, Saudi Arabia, South Korea, and the United Arab Emirates; North American countries such as Canada, Mexico, and the United States; South American countries such as Argentina, Brazil, and Chile, as well as South Africa, Australia, and New Zealand.

The indicators have served to identify connections between integration policies, the outcomes for immigrants resulting from these policies, and public opinion. The indicators include the following three main directions:

- Basic rights: Do immigrants have the same rights as nationals? For example, do they enjoy equal rights to work, training, healthcare, and protection against discrimination?
- Equal opportunities: Are immigrants provided with the same opportunities as nationals?
- Secure future: Are immigrants allowed to establish long-term settlements and feel secure about their future in the country?

Based on the categorization into different groups, such as comprehensive integration, equality (on paper), and temporary integration, Solano & Huddleston (2020) revealed various degrees of immigrant integration across countries. Specifically, in countries characterized by comprehensive integration, immigrants have access to the same rights and opportunities as nationals, with provisions for long-term settlement and a secure future. These countries are likely to provide robust support systems and policies that facilitate immigrant integration into various aspects of society, including entrepreneurship. Conversely, although countries under the category of equality (on paper) may have formal legal frameworks to ensure immigrant rights and opportunities, in reality, they may not be fully realized. Such discrepancies can hinder immigrants' abilities to fully pursue entrepreneurial activities on an equal footing with nationals. Finally, countries classified under temporary integration may provide limited rights and opportunities for immigrants, with little to no emphasis on long-term settlement or security. In this regard, immigrants may face barriers to entrepreneurship and be less inclined to establish their roots or invest in long-term endeavors due to the uncertainty regarding their future in the host country. The results of Solano & Huddleston (2020) are presented in Figure 3.

The Nordic countries, Belgium, Portugal, and Ireland have higher scores for migrant integration. Although

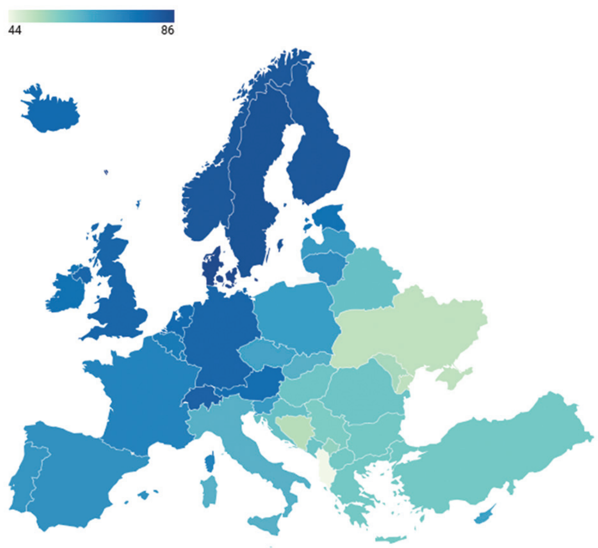

Figure 2. Ranking of European countries for doing business in 2020
Source: 2020 EuCham. Author's interactive map published at: https://datawrapper.dwcdn.net/LW8Rv/1/

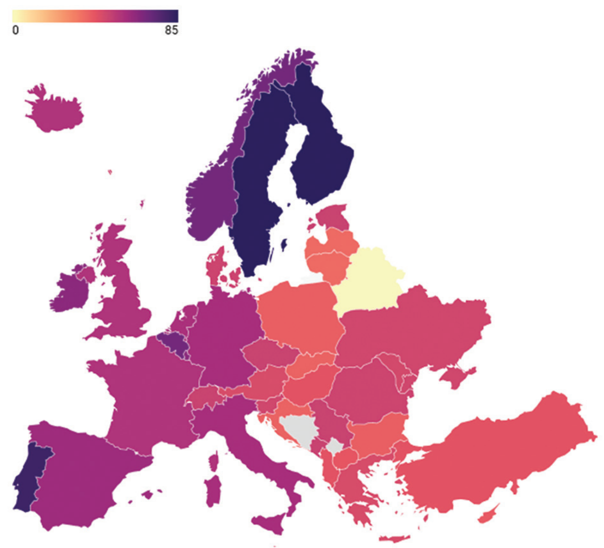

Figure 3. European migrant integration 2020
Source: Solano & Huddleston, 2020). Author's interactive map published at: https://datawrapper.dwcdn.net/YbFri/2/

the majority of the Eastern European countries do not follow this trend, the scores for Ukraine, Moldova, and Romania are higher (i.e., at least 50 out of 100). Finally, when comparing the scores of the IMIGRENT index, there are some deviations (Table 1). The reason for this might be that some aspects related to migrant integration in the MIPEX are underestimated in the IMIGRENT index.

3.3. The IMIGRENT index

3.3.1. Main ideas of the IMIGRENT index

This section introduces a new method for quantifying the appeal of a given country for entrepreneurial activities, known as the IMIGRENT index. To the best of the author's knowledge, this is the first instance of an index that incorporates in-depth analyses and personal insights from various criteria for quantifying a country's attractiveness for entrepreneurship. This index is based on a comprehensive set of criteria comprising six categories:

- Immigration procedures: This category encompasses various aspects such as stay permits, processing timeframes, work permits, recognition of foreign diplomas or qualifications, and citizenship procedures
- Company registration and ownership: This category covers various factors such as the freedom to conduct business, tax procedures, ownership and direction of one's company, and registration as an individual entrepreneur
- Personal affairs and accommodations: This category considers various aspects such as purchasing real estate by foreigners, proficiency in the local language, bringing one's vehicle, and using a foreign driver's license
- Social services: This category includes health care and pensions for foreigners and educational opportunities
- Specific issues: The factors in this category include anti-discrimination measures, crime indexes, the risk of armed conflict, terrorism, and kidnapping
- Climatic and other natural conditions: This category considers various factors such as environmental quality, geological and climatic hazard risks, risks of disease (e.g., malaria), and air pollution levels.

The country score is determined by the following formula:

$$Score\ (country) = \Sigma_i\, Q_i \times W_i,$$

where the sum of i refers to all the questions under investigation, totaling 77 (or 25 in the reduced version). Meanwhile, Q_i represents the discrete values introduced by these questions (e.g., 0, 10, or different values) and W_i refers to the corresponding weights assigned for each question, ranging from 0 to 1. Based on these aspects, the maximum score for a country is normalized to 100.

Table 1. Comparison between the used three indexes EuCham, MIPEX, and IMIGRENT

Countries	2020 EuCham	MIPEX	IMIGRENT
Denmark	86	49	79
Sweden	84	85	79
Estonia	77	50	78
Finland	83	85	78
Norway	83	69	77
Germany	80	58	75
Portugal	69	81	75
Iceland	79	56	74
Luxembourg	75	64	74
Netherlands	79	57	74
United Kingdom	80	56	74
Belgium	75	69	73
Austria	78	46	72
Ireland	77	64	71
Lithuania	71	37	71
France	73	56	70
Slovenia	68	48	70
Croatia	60	39	68
Czech Republic	66	50	68
Greece	58	46	68
Italy	63	58	68
Latvia	68	37	68
Poland	67	40	68
Switzerland	79	56	68
Bulgaria	58	40	66
Cyprus	66	41	66
Romania	59	49	66
Slovakia	63	39	66
Spain	70	60	66
Hungary	59	43	62
Ukraine	50	48	57

Note: The third column shows the position of the countries according to the author's calculations of the IMIGRENT scores.
Abbreviations: IMIGRENT: Migrant Entrepreneurship;
MIPEX: Migrant integration policy index; EuCham: European chamber.

3.3.2. Results of the IMIGRENT index: The case of Europe

For more clarity, the 25 main questions in the reduced version of this analysis are presented in the Appendix. An illustration of the application of these questions to various European countries, based on each country's legislation and the author's criteria of a hypothetical EU citizen entrepreneur, is presented in Figure 4.

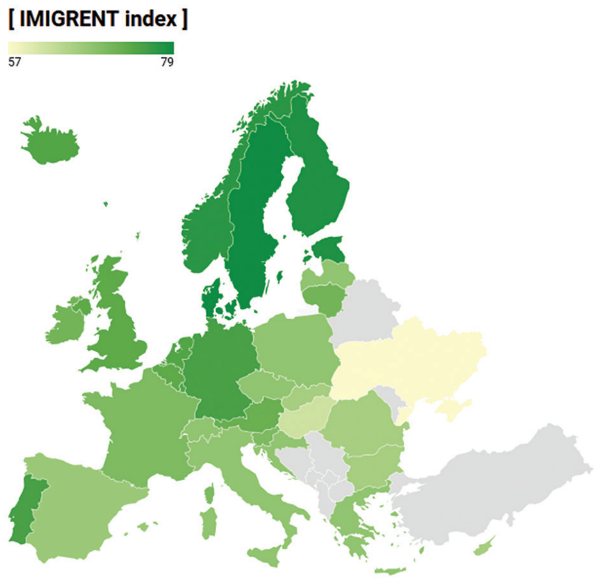

Figure 4. Migrant entrepreneurship index for the European scenario
Author's interactive map published at: https://datawrapper.dwcdn.net/7mlv1/3/

As shown in Figure 4, the Nordic countries, along with Estonia, have higher scores, followed by Portugal, Germany, Ireland, and the United Kingdom, even after Brexit. Meanwhile, the Netherlands, Belgium, and Austria have relatively high scores, whereas Southern Europe and the majority of Eastern Europe have similar but lower scores. As an illustration of how this map is constructed, we use Spain as an example and demonstrate how the quantification was performed.

For Questions 1 – 6 from the first category, that is, immigration procedures, the official website of the Spanish Ministry of Internal Affairs (Min_Interior_ES, 2024; Sede Policía, 2024) is used. These questions are quantified as follows: Q1 – 10, Q2 –5, Q3 – 0, Q4 – 5, Q5 – 9, and Q6 – 0. It should be noted that the author's preferences are such that the corresponding weights W_i are fixed to unity. For instance, the maximal score for Q1 is because this simulation was performed for an individual holding EU citizenship. If it was someone from a visa-exempt non-EU country, such as the United States or Serbia, the weight would also be the same. However, if it was someone coming from a non-EU country requiring a visa, such as the People's Republic of China, the question would be weighted as 0.

For Questions 7 – 14 from the second category, company registration and ownership, they were quantified using information from the Spanish Ministry of Economy, Commerce, and Enterprises (Min_Economia_ES, 2024) and specific official information published by experts (Giambronelaw, 2024). The questions are quantified as follows: Q7 – 5, Q8 – 5, Q9 – 10, Q10 – 10, Q11 – 10, Q12 – 10, Q13 – 5, and Q14 – 0.

Next, for Questions 15 – 18 from the third category, personal affairs and accommodations, the questions are quantified using specific information from real estate sources (Idealista, 2024). These questions are quantified as follows: Q15 – 10, Q16 – 5, Q17 – 0, and Q18 – 0. For Questions 19 and 20 from the fourth category, social services, the questions were quantified using information from the Spanish Ministry of Inclusion, Social Security and Migrations (Min_Seg_Social_ES, 2024). These questions are quantified as follows: Q19 – 10 and Q20 – 8.

For the questions from the last two categories, that is, specific issues (Questions 21 – 23) and climatic and other natural conditions (Questions 24 and 25), the quantification is based on the information cited in Section 2.2., (Expat Insider, 2022; WMO, 2024). The corresponding scores are as follows: Q21 – 8, Q22 – 8, Q23 – 10, Q24 – 6, and Q25 – 10.

Finally, the application of the formula used in this analysis provides a total normalized score of 66 points (with 100 being the maximum). This value for the IMIGRENT index is reflected in the interactive map published at https://datawrapper.dwcdn.net/7mlv1/3/and cited in Figure 4. A similar method can be used to calculate the IMIGRENT index for the rest of the European countries, as demonstrated in Figure 4.

3.3.3. Comparison of the three indexes

An estimation of the IMIGRENT index for the majority of the European countries is provided in the third column of Table 1. In this column, the index value is depicted and calculated based on the assigned criteria regarding different important aspects of starting a business.

Although the comparison of the three indexes yields similar results, the IMIGRENT index introduces additional aspects (e.g., company registration, online access, personal affairs and accommodations, and natural conditions) that can improve quantification and provide further important details. This is evident in cases such as Finland, where climate conditions are highlighted, and Spain, where faulty institutions and ambiguous rules contribute to a lower total index score. Meanwhile, in Germany, the results are generally positive, except for instances where indirect barriers are created for economic reasons. Other notable comparisons are as follows. First, Portugal scores well due to its flexible banking and business regulations, friendly population, favorable weather, and efficient administration, whereas Hungary scores low due to its restrictions on property purchases, the use of foreign driver's licenses, and access to social care, despite having flexible banking and business regulations. Second, Poland benefits from banking and business flexibility but scores higher than Hungary because of its better social system. Third, Italy's low score is attributable to its cumbersome administration and additional procedures for recognizing foreign diplomas, whereas France (although not highly developed in e-services) offers better flexibility in many aspects. Fourth, Denmark and Sweden exhibit flexibility in various areas, but their scores are slightly reduced due to property ownership restrictions and weather conditions (even though they remain among the top-ranked countries). Meanwhile, Ukraine has a relatively low score, due to its restrictions on foreigners without permanent residence, the negative impact of the climate, and the ongoing armed conflict with Russia.

Based on the findings, the top-ranked countries in each category are as follows:

- Immigration procedures: Denmark, Sweden, and Finland
- Company registration and ownership: Denmark, Estonia, and Finland
- Personal affairs and accommodations: Estonia, Denmark, and Ireland
- Social services: Germany, Belgium, and the Netherlands
- Specific issues: Portugal, Spain, and Estonia
- Climatic and other natural conditions: Croatia, Greece, and Italy

4. Discussion

The IMIGRENT index is a novel measure that considers all the key aspects related to starting an entrepreneurial activity in a new country. Although this analysis mainly focuses on the European context, this index is universal and can be applied to any country in the world and any origin (citizenship) of the entrepreneur.

Moreover, the incorporation of several aspects regarding immigrant integration in the host country allows us to draw some comparisons between the three indexes. As shown in Table 1, there is a good correlation between the 2020 EuCham and the IMIGRENT indexes. However, the similarity between the IMIGRENT index and MIPEX is not as obvious, although both have a common basis in focusing on migrant integration. It is possible that the weights of the issues related to the financial aspects of the IMIGRENT index are higher. In other words, these issues are considered more important than those related to social (and integration) aspects, at least in the reduced version of the index (Appendix). As described earlier, the 2020 EuCham index is mainly based on issues such as starting a business, paying taxes, or trading across borders. Meanwhile, the IMIGRENT index depends on the applicant's perspective and the weight of importance regarding various issues such as financial aspects, although the legislation of the different countries is well established, at least on paper.

Upon further comparing the IMIGRENT index with MIPEX, some northern or central European countries, such as Denmark, Estonia, Iceland, Germany, Austria, and the Netherlands (which have high 2020 EuCham and IMIGRENT scores), do not have high MIPEX scores. This is mainly because the integration in these host countries can be classified (according to the MIPEX) as "favorable" (Iceland), "temporary integration and halfway favorable" (Germany), or "comprehensive integration and halfway favorable" (Estonia). Meanwhile, countries such as Sweden, Finland, and Norway have high scores in these indexes. An interesting example is Portugal, which has a higher MIPEX score compared with the other indexes. According to the MIPEX framework, such countries are classified as "comprehensive integration," which fully guarantees equal rights, opportunities, and security for both immigrants and citizens (Solano & Huddleston, 2020).

Meanwhile, regarding the affinity of foreign-born entrepreneurs to manage microbusinesses and generate jobs, particularly in the formal economy (Taddei & Solano, 2020; UNCTAD, 2018; Eurostat, 2023), it should be noted that the IMIGRENT index considers these aspects mainly within its second (i.e., company registration and ownership). This category also considers the fact that migrant-run businesses often underperform (compared with those run by locals) in several metrics, due to limited access to essential infrastructure, networks, and credit opportunities (Desiderio, 2014; Rath & Schutjens, 2016; Solano *et al*., 2019; Taddei & Solano, 2020).

It is also worth noting the distributions of the IMIGRENT scores across Europe. As discussed in the previous section, the Nordic countries and northern/central European countries, such as Germany, the Netherlands, Belgium, and Ireland, have higher IMIGRENT scores. This is mainly due to their entrepreneurial specifications and "user-friendly" legislations for establishing a business compared with the cumbersome rules and regulations of southern European countries such as Spain, Italy, and Greece. In addition, Eastern European countries have lower scores than Western European ones due to the lack of entrepreneurial activities during several decades of socialist regimes. For instance, when comparing Bulgaria and Germany regarding social services or conducting business activities without being hindered, there is a significant difference between the two countries, resulting in higher scores for Germany.

Regarding the geographical differences in the scores, they reflect the importance of immigrant participation in entrepreneurial activities at a higher rate than local-born individuals (Wellalage *et al*., 2023). Moreover, immigrant and local-born entrepreneurs contribute differently according to local legislation and the ease of doing business. For example, in 2019, immigrant entrepreneurs accounted for 21.7% of all business owners in the United States, and more than 44% of Fortune 500 companies in 2020 had at least one founder who was either an immigrant or a child of immigrants (Wellalage *et al*., 2023).

It is also interesting to discuss the fact that immigrants are more willing to become entrepreneurs than local persons because those who decide to leave their home country to start their life anew tend to have a risk-taking mindset, which is an important characteristic for entrepreneurs, who face the risk of business failures (Vandor, 2021). According to this author's observations, this attitude is seen in countries such as Spain and Italy, where the majority of small businesses are sustained by immigrant entrepreneurs. In this regard, the IMIGRENT index highlights immigrants' contribution to the local economy by emphasizing the importance of immigrant citizenship and the country's legislation within its first category (i.e., immigration procedures) and in other categories such as personal affairs and accommodations and social services (Appendix). This also indicates that European citizenship makes all the procedures related to establishing a business in a new country relatively easier. Furthermore, by comparing a European immigrant in a European country with a refugee from a third-world country, it is obvious that their experiences greatly differ, from the immigration procedures to the social security procedures. Only the last two categories, that is, specific issues and climatic and other natural conditions, are independent of the origins of the immigrants/refugees.

These findings are in line with those of previous studies, confirming the effectiveness of the IMIGRENT index (Dabić *et al*., 2020; Solano *et al*., 2019; Karren, 2024). It is also important to emphasize that this index not only introduces new features, such as accurately incorporating key issues and adapting to entrepreneurs' perspectives. In future studies, its practical usefulness will be demonstrated further.

5. Conclusion

This study compares two internationally recognized indexes to quantify a country's attractiveness for entrepreneurial activities by immigrants: the World Bank and Transparency International's 2020 EuCham (EUCHAM, 2020), and MIPEX. Further, it introduces a novel index called IMIGRENT. This new measure offers a comprehensive assessment of a country's entrepreneurial attractiveness by incorporating additional factors that have not yet been considered, such as personal affairs and accommodations, specific issues, and climatic and natural conditions. Specific inquiries into the national legislation of each country allow for a precise evaluation of the country's attractiveness. This index is also universally applicable, adapting to the needs/perspectives of entrepreneurs aiming to start businesses in a new country based on their citizenship and personal attitudes toward certain issues. This last aspect is especially important because different personalities based on varied personal needs can produce different results.

The analysis in this study covers various issues and parameters, which can be helpful for decision-making when considering entrepreneurial activities in a new country. In addition, the findings reveal that local user-friendly and transparent legislation for starting a personal business is vital. However, additional factors, such as social politics, climatic conditions, and security also play a significant role in such decision-making processes.

Moreover, this study presents a simulation for a hypothetical immigrant entrepreneur from the EU who would like to settle in another EU country (in this study, Spain). However, this approach is broadly applicable and can cover various contexts.

It is worth noting that the IMIGRENT index goes beyond traditional metrics by considering key areas such as immigrant citizenship, the host country's legislation, personal affairs, social services, and weather conditions. All these areas not only contribute to a broader understanding of the immigrant experience in various countries but also serve as useful data for a comparative analysis. By highlighting differences in these areas, the IMIGRENT index effectively guides policymakers and immigrants in making more realistic decisions about entrepreneurial strategies.

It is worth mentioning that this study's analysis is limited to the European context and a reduced form of the IMIGRENT index, as described in the Appendix. An extended study must include the analysis of the full set of 75 questions for comprehensively describing immigrant entrepreneurs' decisions. This analysis will be presented in a future publication.

Future research will also explore the factors driving the differences between the MIPEX and IMIGRENT indexes, the dynamic evolution of a country's attractiveness for entrepreneurial activities within the IMIGRENT framework, and the impact of economic or political changes worldwide. Finally, from a quantitative perspective, suitable graphs will be developed, accounting for interdependence between different countries in terms of the six categories of the IMIGRENT index. The resulting graph for each country will provide important information regarding the country's attractiveness for immigrant entrepreneurial activities, with any similarities providing a measure of the common policies between different European countries.

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Author contributions

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Consent for publication

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Availability of data

All data have been described in the main text.

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Appendix

This Appendix presents the reduced version of the IMIGRENT index used in this study, which includes the following 25 questions from the six categories explained in the text:

1) Immigration procedures

Q [1] 1_1 Weight: Your preference X Points according to legislation
Is immigration possible?

Is a visa or similar pre-arranged permit necessary for entry as a visitor for a short period of stay (<30 days)?

If no visa, pre-arranged visa, or permit is necessary for entry, then = 10 points.

If a visa on arrival is necessary, with no supporting documents or pre-arranged procedures, then = 7 points.

If a pre-arranged travel permit (U.S. ESTA, Australian ETA, European Union ETIAS, etc.) is necessary, then = 5 points.

If an e-visa before arrival is necessary, then = 3 points.

If a sticker visa in a passport obtained through a consulate or visa agency is required in advance, then = 0 points.

Q [2] 1_2 Weight: Your preference X Points according to legislation
Are the immigration procedures clear?

A clear website of the immigration authorities in which the user does not need more than 20 min to understand the entire process and all the procedures are written in a major international language.

If yes, then = 10 points. If no, then change the value to 1 h and give 3 points (this also applies if there is no information in any major foreign language). Otherwise = 0 points.

Q [3] 1_3 Weight: Your preference X Points according to legislation
Does the applicant have to pay to access the immigration authorities or receive a positive outcome? (e.g., being unable to receive an appointment when attempting to make one for the first time and/or a different outcome if performing the procedure through an intermediary).

If no, then = 10 points; If yes, then = 0 points.

Q [4] 1_4 Weight: Your preference X Points according to legislation
Does a foreign citizen need a permit to stay in the country indefinitely?

If border runs are allowed to renew the stay, then it should be considered that no permit is necessary.

If no, then = 10 points; If yes, then = 0 points.

Q [5] 1_5 Weight: Your preference X Points according to legislation
Is a foreign citizen allowed to work?

If a foreign citizen is allowed to work, both as an employee or as self-employed, then = 10 points; If a foreign citizen is only allowed to work as an employee or as self-employed, then = 5 points.

If a foreign citizen is not allowed to work, then = 0 points.

Q [6] 1_6 Weight: Your preference X Points according to legislation
Is recognition of foreign-issued diplomas or qualifications necessary?

If no, then = 10 points; If yes, then = 0 points.

2) Company registration and ownership

Q [7] 2_1 Weight: Your preference X Points according to statistics
Is it possible to freely conduct business activities and not be hindered, racketeered, or blackmailed (either through official or unofficial means) by the government or competitors with more power?

If yes, then = 10 points; If no, then = 0 points (Values in between are also possible).

Q [8] 2_2 Weight: Your preference X Points according to legislation
Is it possible to complete the vast majority of paperwork online?

If yes, then = 10 points; If no, then = 0 points.

Q [9] 2_3 Weight: Your preference X Points according to legislation
Can a foreign citizen obtain a digital signature that can be used to perform all the necessary transactions for professional or personal issues in the same or similar manner as local citizens, and with the same or similar functions?

If yes, then = 10 points; If no, then = 0 points.

Q [10] 2_4 Weight: Your preference X Points according to legislation
Can a non-resident, foreign citizen open a bank account and perform transactions based on the same conditions as local citizens?

If yes, then = 10 points; If no, then = 0 points.

Q [11] 2_5 Weight: Your preference X Points according to legislation
Can a foreign citizen be a director of his/her own company?

If yes, then = 10 points; If no, then = 0 points.

Q [12] 2_6 Weight: Your preference X Points according to legislation
Does a foreign citizen need to have a work permit or residence permit to be a director of his/her own company?

If no, then = 10 points; If yes, then = 0 points (values in between are also possible if there are restrictions).

Q [13] 2_7 Weight: Your preference X Points according to legislation
Is a foreign citizen allowed to work as an individual entrepreneur and reside in the country on this ground?

If yes, then = 10 points; If no, then = 0 points.

Q [14] 2_8 Weight: Your preference X Points according to legislation
If yes, then is a work permit necessary?

If no, then = 10 points; If yes, then = 0 points (also if it is not possible).

3) Personal affairs and accommodation

Q [15] 3_1 Weight: Your preference X Points according to legislation
Can a foreign citizen buy real estate?

If yes, then = 10 points; If no, then = 0 points (values in between are also possible in case there are some restrictions).

Q [16] 3_2 Weight: Your preference X Points according to legislation
Are foreigners residing in the country allowed to drive indefinitely using their driver's license?

If yes, then = 10 points; If no, then = 0 points.

Q [17]3_3 Weight: Your preference X Points according to legislation
Is it possible to drive your vehicle registered abroad if residing in the country?

If yes, then = 10 points; If no, then = 0 points.

Q [18] 3_4 Weight: Your preference X Points according to statistics

Do at least 50% of local people have a conversational level of English?

If yes, then = 10 points; If no, then = 0 points.

4) Social services

Q [19] 4_1 Weight: Your preference X Points according to legislation
Are resident foreigners allowed access to healthcare under the same conditions as the citizens of the country?

If yes, then = 10 points; If no, then = 0 points.

Q [20] 4_2 Weight: Your preference X Points according to legislation
Are foreigners allowed to have a pension in the country under the same conditions as local citizens?

If yes, then = 10 points; If no, then = 0 points.

5) Specific issues

Q [21] 5_1 Weight: Your preference X Points according to statistics
Are foreigners welcome?

If yes, then = 10 points; If no, then = 0 points.

Q [22] 5_2 Weight: Your preference X Points according to statistics
Crime index

Min = 0, Max = 10.

Q [23] 5_3 Weight: Your preference X Points according to statistics
Is the country at war or at risk of war or are there important terrorist groups?

If no, then = 10 points; If yes, then = 0 points (values in between are also possible).

6) Climatic and other natural conditions

Q [24] 6_1 Weight: Your preference X Points according to statistics
Climatic comfort

Is the average temperature in any given month below 15 or above 30 degrees C?

If yes, then = 0 points; If no, then = 4 points.

Is the average number of sunshine hours in any given month below 120 or above 360?

If yes, then = 0 points; If no, then = 3 points.

Is the average relative humidity of the air in any given month below 45% or above 65%?

If yes, then = 0 points; If no, then = 3 points

Q [25] 6_2 Weight: Your preference X Points according to statistics
Endemic illnesses (e.g., malaria, dengue, or other serious or fatal endemic illnesses)

If yes, then = 10 points; If no, then = 0 points.

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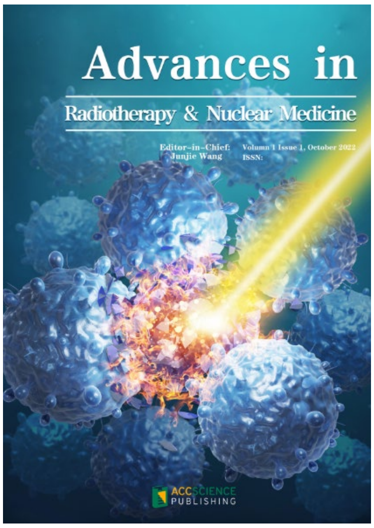

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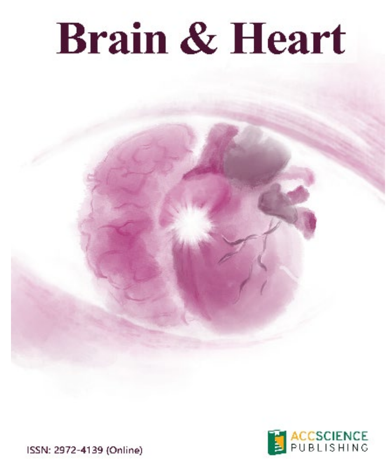

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