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EuroQol EQ-5D-5L assessment of health-related quality of life and comorbidity burden among long-term care facility residents in Kuala Kubu Bharu, Selangor, Malaysia

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Abstract

Malaysia is experiencing rapid population aging alongside an increasing burden of non-communicable diseases, raising concerns about the health-related quality of life (HRQoL) of adults residing in long-term care facilities. Given the absence of published evidence on HRQoL among long-term care facility residents with comorbidity in Malaysia, this study assessed the HRQoL of 100 adults aged 40 years and above residing in a government-funded long-term care facility in Kuala Kubu Bharu, Selangor, Malaysia, using the EQ-5D-5L instrument and EQ Visual Analogue Scale (EQ VAS). A cross-sectional census study was conducted, with utility index scores derived using the Malaysian population-based value set. The mean EQ-5D-5L utility index was 0.730 (standard deviation [SD] = 0.136), ranging from 0.024 to 1.000, while the mean EQ VAS score was 57.95 (SD = 17.54). Mobility was the most affected dimension, with 96% of residents reporting some degree of limitation. Pain/discomfort and anxiety/depression were the least affected dimensions, with 86% and 95% of residents reporting no problems, respectively. An inverse trend was observed between comorbidity burden and HRQoL, with mean utility index scores declining from 0.779 among residents with no chronic illness to 0.680 among those with two or more chronic conditions; however, the differences were not statistically significant. Age and male gender were identified as significant independent predictors of EQ-5D-5L utility index scores ($R^2 = 0.315$), whereas no sociodemographic variables significantly predicted EQ VAS scores ($R^2 = 0.022$). As a cross-sectional study conducted in a single facility, causal relationships cannot be established, and the findings should be interpreted cautiously because they may not be generalizable to other long-term care facilities. The health utility estimates generated in this study may provide preliminary evidence for future actuarial and health-financing applications in Malaysia.

Keywords: EQ-5D-5L; EQ Visual Analogue Scale; Health-related quality of life; Health utility index; Comorbidity

1. Introduction

Malaysia is undergoing a demographic transition marked by a significant rise in its older adult population, which is projected to make it an aging nation by 2050, when 15% of the population will be categorized as senior citizens (Abdullah *et al.*, 2024). Additionally, the mortality burden has been a significant concern among them, particularly due to the high prevalence of non-communicable diseases (NCDs) as the leading cause of death in Malaysia. This raises concerns about maintaining health-related quality of life (HRQoL), especially among older adults, as their proportion is expected to climb to 14.5% by 2040 (Lim *et al.*, 2023). Even though Malaysian life expectancy is increasing due to improvements in healthcare, this gain is often accompanied by greater exposure to morbidity (Din *et al.*, 2024). Data from the National Health and Morbidity Survey 2023 highlight the substantial burden of NCDs in Malaysia. Among Malaysian adults, 15.6% had diabetes, many of whom were unaware of their condition; 29.2% had hypertension; and 33.3% had hypercholesterolemia, with a considerable proportion of cases remaining undiagnosed. Additionally, abdominal obesity affected 54.5% of adults (Institute for Public Health, 2024). Taken together, these findings underscore the importance of assessing HRQoL, particularly among older adults living in institutional care settings, where individuals may be admitted before the age of 60 years and may have poorer health status and greater care needs (Onunkwor *et al.*, 2016).

According to the World Health Organisation, quality of life is how people perceive their wellbeing, based on their lifestyle, health status, and cultural and personal goals (The WHOQOL Group, 1995). This definition is quantified as HRQoL, which measures how health status impacts people's daily lives. Among available measurement tools, the 5-level EQ-5D (EQ-5D-5L) instrument, developed by the EuroQol Group, is widely used due to its simplicity and ability to generate health utility values across five key dimensions of health (Wong *et al.*, 2022). Compared with its predecessor, the 3-level EQ-5D (EQ-5D-3L), the EQ-5D-5L introduces five response levels for each component, enabling a more nuanced understanding of health states and improving the instrument's reliability and sensitivity, especially in distinguishing between different levels of health status. The EQ-5D-5L was launched in 2009 and designed to overcome the limitations of the EQ-5D-3L, particularly the ceiling effect, which arose when a significant proportion of respondents reported their health as "perfect" across all dimensions, limiting the instrument's ability to detect shifts in health status over time. The ceiling effect was notably higher in East and South Asia than in Europe (Cheng *et al.*, 2024). The EQ-5D-5L reduces clustering in fewer health states, improves discrimination between subgroups, requires a smaller sample size, and measures mobility-related problems more accurately (Devlin *et al.*, 2018).

The EQ-5D-5L instrument consists of two components: the EQ-5D descriptive system for HRQoL and the EQ Visual Analogue Scale (EQ VAS) for overall health state. Every health state has a five-digit code. The descriptive system has categorized health into five specific components: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Respondents are required to rate their health in each aspect using a five-level Likert scale, where 1 indicates no problem, 2 a slight problem, 3 a moderate problem, 4 a severe problem, and 5 an extreme problem (Shafie *et al.*, 2019). For instance, 11111 indicates no issues in each dimension. In contrast, 12345 indicates no issue in mobility, slight difficulties with self-care, moderate challenges with usual activities, severe pain/discomfort, and extreme anxiety/depression. Nevertheless, the EQ VAS ranges from 0 to 100, with 100 representing the best health imaginable and 0 representing the worst health imaginable.

Utility values derived from the EQ-5D-5L facilitate meaningful comparisons of health states across different disease conditions and are widely used in economic evaluation, particularly in estimating quality-adjusted life years. This approach provides a practical way to examine how sociodemographic factors such as age, income, and educational level are associated with variations in health outcomes. In Malaysia, EQ-5D-5L has been applied in several disease-specific populations, including cancer (Dzulkipli *et al.*, 2025; Raman *et al.*, 2022; Wan Puteh *et al.*, 2024), stroke (Wong *et al.*, 2021) and heart failure (Kuan *et al.*, 2024; Tan *et al.*, 2024), providing foundational evidence on the HRQoL of the Malaysian population. However, these studies typically focus on a single disease condition, covering only a limited range of health states, and do not account for the association between comorbidity and health status.

The growing older adult population in Malaysia presents a critical challenge, as those in institutional care often deal with more chronic illnesses and functional limitations compared to those living in the community (Onunkwor *et al.*, 2016). However, aging is conventionally defined using chronological thresholds such as 60 or 65 years. Institutional care often includes individuals below these age groups due to the early onset of chronic illness, disability, and multimorbidity. In Malaysia, conditions such as diabetes, stroke, and related complications contribute to earlier functional decline, leading to admission into long-term care facilities at relatively younger ages. Therefore, this study adopts a broader age threshold of 40 years and above

to capture the full spectrum of individuals with reduced functional capacity and increased care dependency residing in long-term care facilities.

As noted by Cheng *et al.* (2024), who confirmed through a systematic review that EQ-5D evidence in Asian residential care settings remains scarce, and Durán-Gómez *et al.* (2026), who demonstrated that multimorbidity is associated with significantly reduced HRQoL among institutionalized older adults in international settings, studies specifically examining HRQoL among long-term care facility residents using the EQ-5D-5L in Malaysia remain limited to date, with no published evidence examining the association between comorbidity burden and health states in this population. This scenario reflects a research gap worth exploring, as population-specific health utility estimates for this vulnerable group can provide essential evidence for care planning, health resource allocation, and health economic applications. Addressing this gap is therefore important for understanding how comorbidity burden shapes HRQoL across multiple health dimensions in long-term care populations, particularly in the context of Malaysia's rapidly aging society and escalating NCD burden.

The significance of this study lies in the pressing need for population-specific HRQoL evidence among long-term care facility residents in Malaysia. As demand for formal institutional care is projected to rise alongside demographic aging (Abdullah *et al.*, 2024), health policy decisions regarding resource allocation, rehabilitation planning, and care standards remain insufficiently informed by empirical HRQoL data from this population. This study follows the health utility framework, which conceptualizes HRQoL as a preference-weighted measure of health states derived from population-based valuation studies such as the Malaysian EQ-5D-5L value set derived by Shafie *et al.* (2019). Within this framework, each health dimension contributes a specific disutility weight to the overall utility index score, such that the simultaneous presence of impairments across multiple dimensions results in progressively lower utility values. This framework is particularly well-suited to multimorbid populations whose complex health profiles span several dimensions concurrently. While the EQ-5D-5L has been widely applied across various disease-specific populations in Malaysia, its application among long-term care facility residents with comorbidity remains limited in the published literature, and this study addresses that gap by generating preference-weighted health utility values for a population whose HRQoL profile cannot be adequately captured by studies confined to single disease-specific outpatient settings.

This study therefore has two objectives: (i) to evaluate the HRQoL of adults residing in a long-term care facility in Kuala Kubu Bharu, Selangor, using the EQ-5D-5L instrument; and (ii) to generate health utility estimates that may provide preliminary data for future health economic and actuarial research in Malaysia.

2. Data and methods

2.1. Study design

This study employed a cross-sectional design and was conducted at Rumah Ehsan Kuala Kubu Bharu, a government-funded long-term care facility in Hulu Selangor District, Selangor, Malaysia. Rumah Ehsan is operated by the Malaysian Department of Social Welfare (*Jabatan Kebajikan Masyarakat* [JKM]) and provides care, treatment, and protection for adults who are frail, chronically ill, without family support, or unable to care for themselves independently. As a fully government-subsidized facility, residents do not pay for accommodation or care, making the facility accessible to individuals from lower socioeconomic backgrounds who lack family support. The facility accommodates approximately 100 residents, both male and female, across four dormitories, with daily care provided by registered nurses and caregivers. The resident population is characterized by a high prevalence of chronic illnesses, physical comorbidities, and functional dependency. Eligibility for admission requires applicants to be Malaysian citizens, certified by a government medical officer as chronically ill, and free from infectious diseases or psychiatric disorders (JKM, 2024).

2.2. Data collection

Prior to data collection, all eligible residents were verbally briefed on the purpose and nature of the study, including the voluntary nature of participation and their right to withdraw at any time without affecting the care they received at the facility. Verbal informed consent was obtained from all residents before data collection commenced. For residents who were unable to provide consent or complete the questionnaire independently because of physical limitations or communication difficulties, the assigned nursing staff who served as proxy respondents were informed of the study purpose and data collection procedures and provided verbal agreement to participate on behalf of the residents. No written consent forms were administered, consistent with the non-invasive observational nature of the study and in accordance with the approval granted by the Malaysian Department of Social Welfare.

Data collection was conducted from October 17 to October 19, 2024, at Rumah Ehsan Kuala Kubu Bharu. Residents were recruited using a census sampling approach,

whereby all residents present at the facility during the data collection period were invited to participate. The inclusion criteria were: (i) adults aged 40 years and above; (ii) residents of the facility at the time of data collection; and (iii) able to participate either through self-report or through a proxy nurse respondent. Residents who were absent during the data collection period were excluded from the study.

A total of 100 residents met the eligibility criteria and agreed to participate. Each survey session took approximately five minutes to complete. Most questionnaires were completed through self-report. However, for residents who were unable to self-report due to physical limitations or communication difficulties, responses were provided by primary nurses assigned to their care. These proxy respondents had direct and regular contact with the residents and were therefore familiar with their daily health status and functional abilities. The exact number of proxy-completed questionnaires was not systematically recorded during data collection and is therefore unavailable. This represents a methodological limitation because proxy assessments may differ from self-reported assessments, particularly for subjective dimensions such as pain/discomfort and anxiety/depression, where symptoms are less directly observable by caregivers.

The questionnaire consisted of two sections. Section A captured residents' demographic characteristics, including age, gender, and ethnicity. Section B collected health-related information, including diagnosed diseases and perceived health status. Information on chronic illnesses was obtained from residents and verified by nursing staff using medical records maintained by the facility. Residents also completed the EQ-5D-5L descriptive system and the EQ VAS to assess HRQoL. The EQ-5D-5L instrument was administered in either English or Malay according to the resident's language preference.

2.3. Ethical approval

This study is part of a larger study, with ethical approval obtained from the Universiti Teknologi MARA Research Ethics Committee (Ref: REC/10/2024 [PG/EX/66]). Prior to the commencement of data collection at the facility, formal permission was obtained from the Malaysian Department of Social Welfare and from EuroQol for the use of the EQ-5D-5L instruments. The study adhered to the Malaysian Department of Social Welfare's guidelines throughout data collection.

2.4. Sample size

This study employed a census sampling approach at a single long-term care facility. Therefore, the sample size was determined by the number of eligible residents present at Rumah Ehsan Kuala Kubu Bharu during the data collection period rather than by an a priori sample size calculation. All 100 eligible residents were included, representing the complete study population within the facility at the time of data collection. Although the census approach minimized selection bias within the facility, the findings should be interpreted cautiously because the study was conducted at a single facility. Consequently, the results may not be generalizable to other long-term care facilities or to the broader Malaysian population. In addition, several subgroup analyses were based on small numbers of residents, particularly the 40–49 age group (n = 7), which may have limited statistical power and precision. Findings involving this subgroup should be interpreted with caution.

2.5. Health index value

The health index value represents a resident's EQ-5D-5L health state as a single utility score reflecting HRQoL, typically ranging from 0 (poorest health) to 1 (perfect health). Utility scores were derived using the Malaysian EQ-5D-5L value set developed by Shafie *et al.* (2019) through the MULT8_HYBRID model, based on a representative sample of 1,125 Malaysian adults. The model assigns disutility weights to severity levels across the five EQ-5D-5L dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. This study used the MULT8_HYBRID model to estimate health utility scores. The model is expressed as **Equation 1**:

$$y = \alpha + \sum_{d=1}^{5}\sum_{l=2}^{5}\beta_{dl}x_{dl} + \varepsilon \quad (1)$$

where y denotes the observed utility value, β_{dl} represents the coefficient for dimension d, x_{dl} is a dummy variable indicating the presence of severity level l in dimension d, α is the intercept term, and ε is the error term. The model incorporates dimension-specific coefficients for mobility (0.340), self-care (0.261), usual activities (0.202), pain/discomfort (0.338), and anxiety/depression (0.300), together with severity-level modifiers for Levels 2, 3, and 4 of 0.239, 0.316, and 0.766, respectively.

To estimate utility values, each resident's EQ-5D-5L health state was represented using a five-digit code corresponding to the severity level reported in each dimension. The utility value, $U(x)$, for a given health state x was calculated by aggregating the relevant disutility weights and subtracting the resulting value from 1, as shown in **Equation 2**:

$$U(x) = 1 - \sum_{i=1}^{5}\beta_{i,x_i} \quad (2)$$

where β_{i,x_i} represents the disutility associated with severity level l_i in dimension i. A health state of 11111 corresponds to full health (utility = 1.000), while lower utility values indicate poorer HRQoL.

2.6. Statistical analysis

All statistical analyses were conducted using R statistical software. Descriptive statistics, including percentages, means, and standard deviations, were used to summarize residents' sociodemographic characteristics, EQ-5D-5L utility index scores, and EQ VAS scores. Given the non-normal distribution of the outcome variables, non-parametric tests were employed for group comparisons. The Kruskal–Wallis test was used to examine differences across age groups, followed by Dunn's post hoc test with Bonferroni adjustment for pairwise comparisons. Gender differences were assessed using the Mann–Whitney *U* test. Spearman's rank correlation coefficient was used to examine associations between sociodemographic variables and HRQoL outcomes.

Although the outcome variables were non-normally distributed, multiple linear regression analyses were also conducted because linear regression does not require normally distributed outcome variables but instead assumes that model residuals are approximately normally distributed and that other model assumptions are reasonably satisfied. Regression diagnostic plots were examined to assess linearity, homoscedasticity, normality of residuals, and influential observations prior to interpretation of the regression models. Visual inspection of the diagnostic plots did not indicate severe violations of model assumptions.

Comorbidity group, age, and gender were included as independent variables, with comorbidity entered using two dummy variables (1 disease and ≥ 2 diseases), using no chronic illness as the reference category. Female was specified as the reference category for gender. The regression models therefore included four predictors: age, gender, and two dummy variables representing comorbidity status. Given the census sample of 100 residents, a parsimonious modeling approach was adopted to minimize the risk of overfitting and unstable coefficient estimates while retaining variables considered clinically relevant to HRQoL. Ethnicity was not included in the regression models because inclusion of additional predictors was considered inappropriate given the available sample size. Model fit was evaluated using the coefficient of determination (R^2) and the overall *F*-statistic. Statistical significance was assessed at $\alpha = 0.05$ for all analyses.

Comorbidity burden was classified into three categories: no chronic illness, one chronic illness, and two or more chronic illnesses. This count-based approach was selected to provide a straightforward measure of comorbidity burden among residents and to facilitate comparison of HRQoL across groups. Weighted comorbidity indices were not used because the study aimed to evaluate overall comorbidity burden rather than mortality risk or disease-specific prognosis. However, the classification was based on the number of chronic conditions and did not account for differences in disease type or severity.

3. Results

Table 1 presents the sociodemographic characteristics of the study population. A total of 100 residents were included in the study. The mean age was 67 years (standard deviation [SD] = 10), with ages ranging from 40 to 89 years. Most residents were male (61%) and of Malay ethnicity (71%). The largest age group was 60–69 years (34%), whereas the smallest was 40–49 years (7%). Overall, 81% of residents reported having at least one diagnosed chronic illness, with stroke, diabetes mellitus, hypertension, and cancer being the most frequently reported conditions.

Table 1. Participant characteristics

Sample	Total (*N* = 100)	Male (*n* = 61)	Female (*n* = 39)
Age, mean (standard deviation)	67 (10)	65.4 (8.7)	69.4 (11.4)
Range	40–89	40–84	43–89
Age group, *n* (%)			
40–49	7 (7)	4 (6.6)	3 (7.7)
50–59	16 (16)	13 (21.3)	3 (7.7)
60–69	34 (34)	21 (34.4)	13 (33.3)
70–79	33 (33)	21 (34.4)	12 (30.8)
80+	10 (10)	2 (3.3)	8 (20.5)
Ethnicity, *n* (%)			
Malay	71 (71)	42 (68.9)	29 (74.4)
Chinese	18 (18)	10 (16.4)	8 (20.5)
Indian	11 (11)	9 (14.8)	2 (5.1)
Diagnosed with chronic illness, *n* (%)			
Yes	81 (81)	52 (85.2)	29 (74.4)
No	19 (19)	9 (14.8)	10 (25.6)

Table 2 presents the distribution of reported problems across the five EQ-5D-5L dimensions by age group. Mobility was the most affected dimension, with 96% of

Table 2. Reported issues across EQ-5D-5L dimensions by age group

Parameters	Age group					
	40–49	50–59	60–69	70–79	80+	Total
Total	7	16	34	33	10	100
Mobility, *n* (%)						
None	0 (0)	0 (0)	2 (5.9)	1 (3)	1 (10)	4 (4)
Slight issues	0 (0)	0 (0)	3 (8.8)	4 (12.1)	1 (10)	8 (8)
Moderate issues	0 (0)	12 (75)	24 (70.6)	21 (63.6)	7 (70)	64 (64)
Severe issues	0 (0)	3 (18.8)	5 (14.7)	7 (21.2)	1 (10)	16 (16)
Unable to	7 (100)	1 (6.2)	0 (0)	0 (0)	0 (0)	8 (8)
Self-care, *n* (%)						
None	3 (42.9)	3 (18.8)	4 (11.8)	9 (27.3)	3 (30)	22 (22)
Slight issues	2 (28.6)	4 (25)	17 (50)	10 (30.3)	4 (40)	37 (37)
Moderate issues	2 (28.6)	9 (56.2)	13 (38.2)	14 (42.4)	3 (30)	41 (41)
Severe issues	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Unable to	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Usual activities, *n* (%)						
None	2 (28.6)	0 (0)	2 (5.9)	5 (15.2)	3 (30)	12 (12)
Slight issues	2 (28.6)	7 (43.8)	25 (73.5)	17 (51.5)	6 (60)	57 (57)
Moderate issues	2 (28.6)	8 (50)	7 (20.6)	11 (33.3)	1 (10)	29 (29)
Severe issues	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Unable to	1 (14.3)	1 (6.2)	0 (0)	0 (0)	0 (0)	2 (2)
Pain/discomfort, *n* (%)						
None	2 (28.6)	14 (87.5)	30 (88.2)	32 (97)	8 (80)	86 (86)
Slight issues	3 (42.9)	2 (12.5)	4 (11.8)	1 (3)	2 (20)	12 (12)
Moderate issues	1 (14.3)	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)
Severe issues	1 (14.3)	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)
Unable to	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Anxiety/depression, *n* (%)						
None	3 (42.9)	15 (93.8)	34 (100)	33 (100)	10 (100)	95 (95)
Slight issues	3 (42.9)	0 (0)	0 (0)	0 (0)	0 (0)	3 (3)
Moderate issues	0 (0)	1 (6.2)	0 (0)	0 (0)	0 (0)	1 (1)
Severe issues	1 (14.3)	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)
Unable to	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Note: Percentages were calculated using the number of residents in each age group as the denominator. Percentages in the Total column were calculated using the overall sample ($N = 100$).

residents reporting some degree of limitation, representing the highest prevalence among all EQ-5D-5L dimensions. Although most residents (64%) reported moderate mobility limitations rather than severe problems, this finding is consistent with the functional profile of long-term care facility residents, among whom physical impairment and dependency are common. Notably, all seven residents in the 40–49 age group reported complete inability to walk. Review of facility records indicated that all seven cases were associated with diabetes mellitus-related lower-limb amputations. This distinctive clinical profile was unique to the youngest age group and likely contributed substantially to the lower EQ-5D-5L utility index scores observed in this subgroup. Usual activities and self-care were also frequently

affected, with 88% and 78% of residents reporting some degree of limitation, respectively. In contrast, anxiety/depression and pain/discomfort were the least frequently reported problem dimensions, with 95% and 86% of residents reporting no problems, respectively.

A total of 33 distinct EQ-5D-5L health states were observed, indicating substantial heterogeneity in residents' health states. The most frequently reported health state was 32211, accounting for 25% of residents and corresponding to a utility score of 0.782. This health state reflects moderate limitations in mobility and slight limitations in self-care and usual activities, with no reported problems in pain/discomfort or anxiety/depression. Utility index scores ranged from 0.024 to 1.000. The lowest observed score (0.024) corresponded to health state 53344, indicating extreme mobility limitations, severe pain/discomfort and anxiety/depression, and moderate limitations in self-care and usual activities. In contrast, the highest score (1.000), representing full health (11111), was reported by one resident (1%).

Table 3 presents the EQ-5D-5L utility index and EQ VAS scores by age group and gender, together with the corresponding inferential test results. A statistically significant difference in EQ-5D-5L utility index scores was observed across age groups (H = 23.179, p < 0.001). Post-hoc Dunn tests with Bonferroni adjustment showed that residents aged 40–49 years (mean = 0.407, SD = 0.203) had significantly lower utility index scores than all other age groups (adjusted p < 0.05). This finding is consistent with the complete inability to walk reported by all seven residents in this age group, all of whom had diabetes-related lower-limb amputations. Given the small size of this subgroup (n = 7), the observed age-group differences should be interpreted cautiously.

Among residents aged 50 years and above, mean utility index scores ranged from 0.705 to 0.789, with no statistically significant pairwise differences observed. Although utility scores showed a gradual increase across older age groups, this trend was not statistically significant and should be interpreted cautiously because of the relatively small subgroup sizes. The influence of the 40–49 age group was substantial; excluding these seven residents increased the overall mean utility index from 0.730 to approximately 0.754. No significant differences in EQ VAS scores were observed across age groups (H = 4.347, p = 0.361).

Regarding gender, Mann–Whitney U tests indicated no statistically significant differences in either EQ-5D-5L utility index scores (U = 1085, p = 0.457) or EQ VAS scores (U = 999, p = 0.175). Although male residents reported slightly higher mean EQ-5D-5L utility index scores (0.741 vs. 0.713) and EQ VAS scores (59.59 vs. 55.38) than female residents, these differences were not statistically significant. The association between gender and HRQoL after adjustment for age and comorbidity is presented in Table 4.

Figure 1 presents the Spearman correlation matrix examining the relationships between sociodemographic variables and HRQoL outcomes. Four statistically

Table 3. EQ-5D-5L utility index and EQ VAS scores by age groups and gender

Variables	*n*	EQ-5D-5L index mean (SD)	EQ VAS mean (SD)
Age group			
40–49	7	0.407 (0.203)	64.29 (16.44)
50–59	16	0.705 (0.125)	59.38 (19.05)
60–69	34	0.758 (0.074)	53.38 (16.27)
70–79	33	0.764 (0.093)	60.91 (18.98)
80+	10	0.789 (0.08)	57 (14.18)
Kruskal–Wallis H (p-value)[a]	NA	H = 23.179, p < 0.001*	H = 4.347, p = 0.361
Post hoc (Dunn): 40–49 significantly lower than all other age groups	NA	Bonferroni-adjusted p < 0.05 vs. 50–59, 60–69, 70–79, 80+	All Bonferroni-adjusted p > 0.05
Gender			
Female	39	0.713 (0.135)	55.38 (15.1)
Male	61	0.741 (0.137)	59.59 (18.87)
Mann–Whitney U (p-value)[b]	NA	U = 1085, p = 0.457	U = 999, p = 0.175

Notes: [a]Kruskal–Wallis test for age group; [b]Mann–Whitney U test for gender. *Statistically significant (p < 0.05). A post hoc Dunn test with the Bonferroni correction was conducted for pairwise age-group comparisons.
Abbreviations: EQ VAS: EQ Visual Analogue Scale; NA: Not applicable; SD: Standard deviation.

significant correlations were identified. Age showed the strongest association, demonstrating a moderate positive correlation with EQ-5D-5L utility index scores ($r = 0.37$, $p < 0.001$). Although this finding appears counterintuitive, it was largely driven by the exceptionally low utility scores observed among residents aged 40–49 years, all of whom had diabetes-related lower-limb amputations and reported complete inability to walk. As shown in Table 3, this subgroup recorded substantially lower utility scores than all other age groups.

Chronic illness, coded as a binary variable (presence versus absence of chronic illness), was negatively correlated with EQ-5D-5L utility index scores ($r = -0.22$, $p < 0.05$), indicating lower HRQoL among residents with chronic illness. Age was also negatively correlated with chronic illness ($r = -0.23$, $p < 0.05$), suggesting that younger residents in this facility were more likely to have severe chronic conditions requiring long-term care facility admission. In addition, age was negatively correlated with gender ($r = -0.22$, $p < 0.05$), reflecting the higher mean age observed among female residents. No statistically significant correlations were observed between any sociodemographic variable and EQ VAS scores. As chronic illness was coded as a binary variable (presence versus absence of chronic illness), the corresponding Spearman correlation coefficient should be interpreted cautiously and primarily as an exploratory measure of association.

Table 4 presents the results of the multiple linear regression analyses for EQ-5D-5L utility index scores and EQ VAS scores. For the EQ-5D-5L utility index, the overall regression model was statistically significant ($R^2 = 0.315$, adjusted $R^2 = 0.286$, $F(4,95) = 10.923$, $p < 0.001$), explaining 31.5% of the variance in utility scores. Age ($B = 0.0072$, $p < 0.001$) and male gender ($B = 0.0552$, $p = 0.036$)

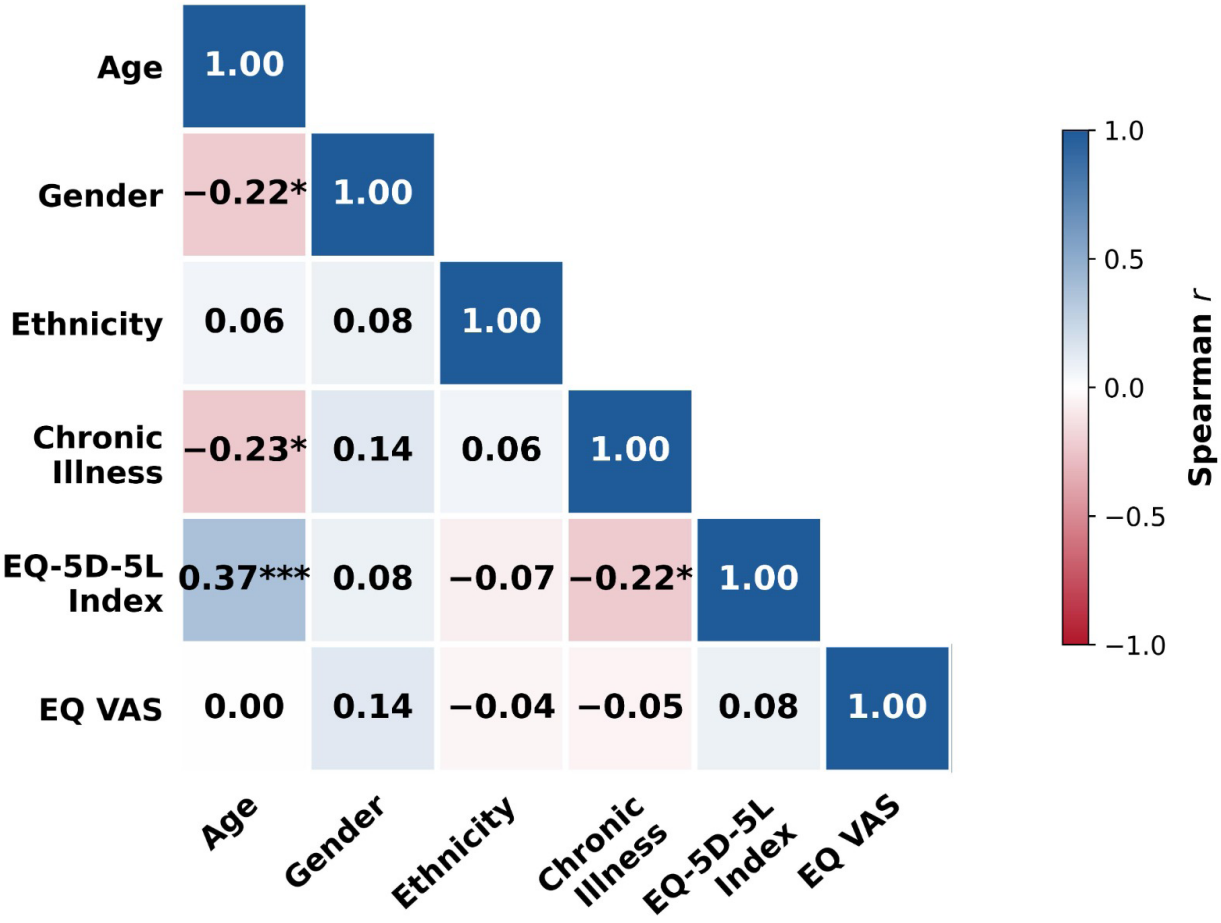


Figure 1. Spearman correlation matrix of EQ-5D-5L utility index scores, EQ VAS, and selected sociodemographic and clinical characteristics.
Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Gender: 0 = Female, 1 = Male; Chronic illness: 0 = No, 1 = Yes.
Abbreviation: EQ VAS: EQ Visual Analogue Scale.

Table 4. Multiple linear regression: Predictors of EQ-5D-5L index score and EQ VAS

Variable	EQ-5D-5L Index			EQ VAS		
	B	95% CI	*p*-value	*B*	95% CI	*p*-value
Intercept	0.2358	0.0484, 0.4232	0.014*	58.951	30.107, 87.795	<0.001*
Comorbidity: 1 disease (ref: None)	−0.0227	−0.0855, 0.0402	0.476	−3.583	−13.254, 6.088	0.464
Comorbidity: ≥ 2 diseases (ref: None)	−0.0405	−0.1139, 0.0329	0.276	−4.817	−16.119, 6.486	0.400
Gender: Male (ref: Female)	0.0552	0.0037, 0.1066	0.036*	4.258	−3.666, 12.183	0.289
Age (years)	0.0072	0.0048, 0.0096	<0.001*	−0.006	−0.378, 0.366	0.974

Notes: *B* = Unstandardized regression coefficient. Reference categories: No comorbidities and female gender. *Statistically significant ($p < 0.05$).
EQ-5D-5L index model: $R^2 = 0.315$, adjusted $R^2 = 0.286$, $F(4, 95) = 10.923$, $p < 0.001$. EQ VAS model: $R^2 = 0.022$, adjusted $R^2 = -0.019$, $F(4, 95) = 0.542$, $p = 0.705$.
Abbreviations: CI: Confidence interval; EQ VAS: EQ Visual Analogue Scale.

were identified as significant independent predictors after adjustment for comorbidity. In contrast, comorbidity status was not significantly associated with utility index scores after adjustment, although residents with one disease ($B = -0.0227$) and those with two or more diseases ($B = -0.0405$) showed lower scores than residents without chronic illness.

For EQ VAS scores, the overall regression model was not statistically significant ($R^2 = 0.022$, adjusted $R^2 = -0.019$, $F(4, 95) = 0.542$, $p = 0.705$), explaining only 2.2% of the variance. None of the variables examined, including age, gender, and comorbidity status, significantly predicted EQ VAS scores.

Table 5 presents the EQ-5D-5L utility index and EQ VAS scores stratified by comorbidity group. The overall mean EQ-5D-5L utility index was 0.730 (SD = 0.136), ranging from 0.024 to 1.000, while the overall mean EQ VAS score was 57.95 (SD = 17.54), ranging from 10 to 100. Among the 81 residents with at least one diagnosed chronic illness, stroke was the most frequently reported condition, either alone or in combination with other diseases, followed by diabetes mellitus and hypertension.

An inverse trend was observed between comorbidity burden and HRQoL. Mean EQ-5D-5L utility index scores declined from 0.779 (SD = 0.107) among residents without chronic illness to 0.733 (SD = 0.097) among those with one disease and 0.680 (SD = 0.201) among those with two or more chronic conditions. A similar pattern was observed for EQ VAS scores, which decreased from 60.53 (SD = 15.63) to 58.19 (SD = 19.53) and 55.22 (SD = 13.52), respectively.

However, Kruskal–Wallis tests indicated no statistically significant differences in EQ-5D-5L utility index scores ($H = 4.859$, $p = 0.088$) or EQ VAS scores ($H = 0.391$, $p = 0.823$) across comorbidity groups. The group with two or more chronic conditions exhibited the greatest variability in EQ-5D-5L utility index scores (SD = 0.201). Notably, one resident in this group reported full health (utility = 1.000) despite having multiple chronic conditions.

4. Discussion

This study provides empirical evidence on the HRQoL of adults residing in a long-term care facility in Kuala Kubu Bharu, Selangor, Malaysia. The mean utility index of 0.730 observed in this study reflects moderate reductions

Table 5. EQ-5D-5L and EQ VAS by comorbidity burden

Comorbidity	*n*	EQ-5D-5L				EQ VAS			
		Min	Max	Mean	SD	Min	Max	Mean	SD
None	19	0.608	0.919	0.779	0.107	35	90	60.526	15.625
1 disease	58	0.397	0.919	0.733	0.097	10	100	58.190	19.527
≥ 2 diseases	23	0.024	1.000[a]	0.680	0.201	20	80	55.217	13.524
Total	100	0.024	1.000	0.730	0.136	10	100	57.95	17.54
Kruskal–Wallis *H* (*p*-value)	NA		$H = 4.859$ (0.088)				$H = 0.391$ (0.823)		

Notes: [a]One resident out of 100 reported no problems across all five EQ-5D-5L dimensions, resulting in a maximum utility value of 1.000. No statistically significant differences were observed across comorbidity groups ($p > 0.05$).
Abbreviations: EQ VAS: EQ Visual Analogue Scale; SD: Standard deviation.

in HRQoL among long-term care facility residents and falls within the range of the Malaysian EQ-5D-5L value set developed by Shafie *et al.* (2019). Compared with residents of long-term care facilities in Australia (Lay *et al.*, 2023), residents in the present study demonstrated higher EQ-5D-5L utility index scores (0.730 vs. 0.453) but lower self-rated health as measured by EQ VAS (57.95 vs. 67.9). This divergence may reflect differences in institutional case-mix and admission criteria. Rumah Ehsan primarily admits individuals with chronic illness and limited family support, resulting in a resident population with substantial physical care needs. Cultural differences in the perception and reporting of health may also contribute to discrepancies between preference-based and self-rated health measures.

Among the five EQ-5D-5L dimensions, mobility was the most commonly affected, considerably more prevalent than pain/discomfort or anxiety/depression. This pattern is consistent with the disease profile of the facility, where stroke and diabetes-related complications, including lower-limb amputation, were common conditions associated with substantial physical impairment. In contrast, pain and anxiety may be more susceptible to adaptation among individuals living with longstanding chronic conditions. Residents who have adjusted to stable physical impairments may recalibrate their perception of health, resulting in relatively favorable ratings for pain/discomfort and anxiety/depression despite significant functional limitations. Similar findings have been reported among institutionalized populations, where psychological wellbeing may remain relatively preserved despite high levels of physical disability (Omar *et al.*, 2020; Onunkwor *et al.*, 2016). Additionally, the use of proxy respondents for some residents may have influenced reporting patterns, as caregivers can more readily observe mobility and self-care limitations than subjective experiences such as pain or anxiety. Consequently, the high proportion of residents reporting no problems in pain/discomfort (86%) and anxiety/depression (95%) should be interpreted cautiously, as these dimensions may have been underestimated among residents whose responses were provided by nursing staff.

The markedly lower utility scores observed among residents aged 40–49 years illustrate that HRQoL in this facility is not simply age-related but reflects disease-specific severity and early-onset disability. All seven residents in this age group had diabetes-related lower-limb amputations and reported complete inability to walk, which substantially reduced their EQ-5D-5L utility index scores because mobility carries the largest disutility weight in the Malaysian value set developed by Shafie *et al.* (2019). This finding likely reflects a selection artifact inherent to the admission profile of the facility, where younger residents are admitted only when severe disability or chronic disease complications result in significant care needs, rather than a generalizable age-related pattern among long-term care facility residents more broadly. A sensitivity analysis excluding these seven residents increased the mean EQ-5D-5L utility index from 0.730 to approximately 0.754, and the Kruskal–Wallis test for age-group differences was no longer statistically significant ($H = 2.143$, $p = 0.543$), confirming that the observed age-group effect was driven entirely by this clinically distinct subgroup. The age effect observed in this study should therefore be interpreted as reflecting disability severity rather than chronological age per se, and caution is warranted when generalizing this finding to long-term care populations with different admission profiles.

Two findings warrant further consideration. First, chronic illness showed a significant negative correlation with EQ-5D-5L utility index scores when coded as a binary variable, yet no significant association was observed when comorbidity was analyzed using a three-category classification or in the adjusted regression model. This discrepancy may reflect differences in the operationalization of disease burden across analyses. The binary classification may capture an overall effect of chronic illness, whereas subdividing residents by disease count may reduce statistical power, particularly within smaller subgroups, and obscure broader patterns. Furthermore, the non-significant adjusted findings suggest that age may partially confound the relationship between chronic illness and HRQoL. Second, although gender was not significantly associated with EQ-5D-5L utility index scores in the unadjusted analyses, male gender emerged as a significant predictor in the adjusted regression model. This finding may reflect confounding by age, as female residents in the facility were generally older than male residents. The emergence of gender as a significant predictor only after adjustment highlights the importance of considering multiple sociodemographic factors simultaneously when examining determinants of HRQoL.

No significant predictors of EQ VAS scores were identified in the regression analysis ($R^2 = 0.022$, $p = 0.705$). This null result may reflect several factors. First, the EQ VAS captures an individual's overall subjective assessment of health rather than preference-weighted dimension-specific ratings, and residents with similar health states may report different EQ VAS scores due to differences in personal expectations, adaptation to chronic illness, or cultural perceptions of wellbeing. Second, the EQ VAS is known to have weaker psychometric properties than the utility index in populations with cognitive or physical impairment, where the abstract nature of rating overall health on a visual

scale may introduce substantial measurement error. Third, proxy reporting for some residents may have introduced additional variability in EQ VAS responses, as caregivers may find it more difficult to estimate a resident's overall health perception than to report observable functional limitations. Taken together, these factors likely explain the absence of significant sociodemographic predictors of EQ VAS scores in this study.

The health utility estimates derived from this study contribute to the health utility literature by providing population-specific preference-weighted values for a multimorbid institutionalized population, a group that has been largely absent from the Malaysian health utility literature. Mean utility values declined progressively across comorbidity groups, from 0.779 among residents without chronic illness to 0.680 among those with two or more chronic conditions. Although these differences did not reach statistical significance, likely due to the small subgroup sizes, particularly within the no-chronic-illness group (n = 19) and the two-or-more-diseases group (n = 23), the observed inverse trend is consistent with the broader literature on multimorbidity and HRQoL in institutionalized populations (Aguilar-Ortiz *et al.*, 2025). The absence of statistical significance should therefore be interpreted as a power limitation rather than evidence of no effect. These utility estimates may serve as preliminary inputs for future health economic analyses and health financing research relevant to the Malaysian long-term care sector. As the present study is cross-sectional, causal relationships between comorbidity burden and HRQoL cannot be established, and future research using longitudinal designs will be required to examine how health states and utility values change over time in this population.

From a theoretical standpoint, the findings support the health utility framework premise that HRQoL is a multidimensional construct shaped by the interaction of physical functioning, disease burden, and sociodemographic factors. The finding that age and gender emerged as significant independent predictors of EQ-5D-5L utility index scores, while comorbidity count alone did not, suggests that the relationship between disease burden and HRQoL in institutionalized populations is more complex than a simple additive model would predict. This underscores the importance of examining HRQoL through a multivariate lens rather than relying on unadjusted group comparisons. From a policy perspective, the findings highlight the need for targeted interventions within long-term care facilities in Malaysia. The high prevalence of mobility limitations underscores the importance of physiotherapy, rehabilitation services, and mobility-support programs within institutional care settings. The observed inverse trend between HRQoL and increasing comorbidity burden further emphasizes the need for integrated disease management strategies, particularly for stroke, diabetes mellitus, and hypertension, which were the most commonly reported chronic conditions in this study.

This study has several limitations. First, the findings are based on residents from a single long-term care facility and may not be generalizable to other facilities or to the broader Malaysian long-term care population. Second, some subgroup analyses, particularly the 40–49 age group (n = 7), were based on small sample sizes and should be interpreted cautiously. Third, some questionnaires were completed by proxy respondents because certain residents were unable to self-report. The exact number of proxy-completed questionnaires was not recorded during data collection, preventing assessment of both the prevalence and magnitude of potential proxy-response bias. Previous research has reported higher levels of agreement between proxy and self-reported EQ-5D assessments for observable dimensions such as mobility, self-care, and usual activities than for more subjective dimensions, including pain/discomfort and anxiety/depression (Dao-Tran *et al.*, 2026; Kelly *et al.*, 2021). Consequently, the high proportion of residents reporting no problems in pain/discomfort (86%) and anxiety/depression (95%) should be interpreted cautiously, as these dimensions may have been underestimated among residents whose responses were provided by nursing staff. Future studies should systematically record proxy participation and, where feasible, compare self-reported and proxy-reported responses to quantify the extent of bias. Finally, the cross-sectional design precludes causal inference regarding the relationship between comorbidity burden and HRQoL, and future research using longitudinal data and larger multi-facility samples will be necessary to establish causal relationships and improve the generalizability of the findings.

5. Conclusion

This study provides evidence on the HRQoL of residents in a Malaysian long-term care facility using the EQ-5D-5L instrument. Mobility was the most affected EQ-5D-5L dimension, while an inverse trend was observed between comorbidity burden and both EQ-5D-5L utility index and EQ VAS scores. Residents aged 40-49 years demonstrated substantially poorer HRQoL due to severe diabetes-related disability, highlighting the importance of disease severity and functional impairment rather than chronological age alone. These findings underscore the need for targeted rehabilitation and chronic disease management programs

within long-term care facilities. The health utility estimates generated in this study may also provide preliminary inputs for future actuarial and health-financing applications in Malaysia. Future research should involve multiple facilities, larger and more diverse samples, and longitudinal designs to better understand changes in HRQoL over time and to enhance the generalizability of the findings.

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Conflict of interest

The authors declare they have no competing interests.

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Writing – review & editing: Nur Annisa Ezzaty Rusli, Nurin Haniah Asmuni, Syazreen Niza Shair

Ethics approval and consent to participate

Prior to the commencement of data collection, formal permission was obtained from the Malaysian Department of Social Welfare on July 26, 2024 (Reference No.: JKMM 100/12/5/2: 2024/075), as well as from EuroQol for the use of EQ-5D-5L instruments. This study received ethics approval from the Universiti Teknologi MARA Research Ethics Committee (Reference No.: REC/10/2024 [PG/EX/66]). The study adhered to the guidelines the Malaysian Department of Social Welfare set forth throughout the data collection process. A total of 100 participants voluntarily participated in this survey, with informed consent obtained from their legal caretakers due to their inability to write. They were briefed about the study's objectives, and those who agreed to participate were provided with validated EQ-5D-5L forms, available in English or Malay, depending on their preference.

Consent for publication

Verbal informed consent was obtained from all participants prior to data collection. For residents unable to provide consent, verbal agreement was obtained from the assigned nursing staff acting as proxies. No identifying information is included in this article.

Availability of data

The data used in this study were collected from Rumah Ehsan Kuala Kubu Bharu with permission from the Department of Social Welfare (JKM), Malaysia. Due to privacy and ethical restrictions, the data are not publicly available but may be obtained from the corresponding author upon reasonable request and with permission from the relevant authority.

AI tools statement

Claude AI was used to assist in developing R code for the statistical analysis and to improve grammar and readability. The authors reviewed all outputs generated from R software and edited all content and take full responsibility for the manuscript.

Further disclosure

Part of this study has been presented at the 5th International Conference on Applied & Industrial Mathematics and Statistics 2025 (ICoAIMS 2025), held at The Pearl Kuala Lumpur Hotel, Malaysia, on May 23–24, 2025. This manuscript represents an extended and revised version of the work presented at the conference.

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