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ORIGINAL RESEARCH

Assessment of Health-Related Quality of Life Among Patients with Chronic Diseases and Its Relationship with Multimorbidity: A Cross-Sectional Study from Saudi Arabia

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Objective: Chronic diseases hold the potential to worsen the overall health of patients by limiting their functional status, productivity, and capacity to live well, affecting their overall health-related quality of life (HRQoL). The purpose of the study was to assess the HRQoL of individuals with chronic diseases residing in the Al-Jouf region of Saudi Arabia. Furthermore, the current study also sought to ascertain the impact of multimorbidity and the duration of illness on HRQoL.

Material and Methods: A cross-sectional study was conducted among the residents of Al-Jouf region for a period of 6 months. A self-administered EuroQoL (EQ-5D-5L) study tool was used. Appropriate statistical analysis was conducted to ascertain the relationship between various variables and HRQoL.

Results: A total of 500 out of 562 participants completed the study, with a response rate of 88.97%. Participants had a mean age of 46.15 ± 16.79 years, and the majority were female (n = 299; 59.80%). A mean HRQoL score of 0.82 ± 0.20 was reported, poorest in patients with kidney failure (0.65 ± 0.26) and highest in hepatitis. However, nearly half of the participants had diabetes mellitus type II (n = 205, 39.20%). Patients aged <30 years (OR: 0.109; p = 0.002), male participants (OR: 0.053; p < 0.001), no disability (OR: 0.143; p = 0.002), and <2 comorbid diseases (0.84 ± 0.18; p < 0.001) reported better QoL. Additionally, comorbid conditions such as DM, prolong the duration of the overall illness (14.19 ± 7.67 years). Overall, imperfect health (n = 390, 78%) was reported by the study participants.

Conclusion: The present study provided preliminary data about the current HRQoL status of individuals with imperfect health and lower HRQoL. In the future, large-scale longitudinal studies are required to investigate the most prevalent chronic diseases, their associations, and change in HRQoL, as there is a dearth of information in the Saudi population.

Keywords: HRQoL, EQ-5D-5L, chronic diseases, diabetes mellitus, hypertension, Saudi Arabia, disease outcomes, quality of life

Introduction

Chronic diseases are considered the silent pandemic, being the leading cause of disability and mortality worldwide.[1] According to the World Health Organisation's (WHO) estimation, chronic diseases account for 63% per-year mortality rate, ie, 38 million.[2] For those aged above 70 years, the leading five causes of death worldwide in 2019 were diabetes mellitus (DM), ischemic heart disease (IHD), stroke, chronic obstructive pulmonary disease (COPD), Alzheimer's disease, lower respiratory tract diseases (LRTI), and chronic kidney disease (CKD).[3] The increasing incidence of diabetes mellitus (DM) in

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people indicates that by 2030, the number of DM cases in developed and developing nations will rise by 20% and 69%, respectively.[4] According to the country-specific report on the Global Burden of Disease 2010, chronic diseases per 100,000 people were the main cause of death in Saudi Arabia, ie, DM (56,000 cases), hypertension (HTN) (51,000 cases), obesity (45,000 cases), asthma (49,000 cases), and an increase in Body Mass Index (BMI).[5,6] The quality of life for patients and overall healthcare costs would suffer as a result of the marked rise in the prevalence of chronic diseases.[4]

Providing healthcare services not only involves optimising patient care and decreasing morbidity and mortality but also enhancing Health-related Quality of Life (HRQoL) for patients with chronic diseases.[7–9] Quality of life (QoL) was conceived as acrucial assessment of an individual's various aspects of life. The WHO defines QoL as an individual's perception of their position in life concerning their standards, goals, expectations, and concerns. Furthermore, the quality of life of those suffering from chronic illnesses is gravely affected. In this context, QoL assessment aids in ascertaining the impact of disease, its management, the factors influencing QoL, co-morbidities, and an individual's overall life satisfaction.[10,11] For this HRQoL evaluation, the previously validated EuroQOL-5 Dimensions-5 levels (EQ-5D-5L) tool was utilised in the present study.**The** EQ-5D-5L instrument is the most widely used tool in healthcare interventions, cost-utility analysis, and ascertaining the patient's perception regarding their health.[12], [14–16]

The present study aimed to ascertain the impact of chronic diseases, and multiple morbidities on QoL as the data are lacking in remote regions such as Al-Jouf, Saudi Arabia. The previously conducted studies were primarily from the metropolitan cities, ie, Riyadh and Makkah. Moreover, the current study utilises the EQ-5D-5L study instrument, which is regarded as the most reliable instrument. However, the use of EQ-5D-5L is scarce in the Kingdom of Saudi Arabia (KSA) as compared to studies conducted internationally and was only adopted in studies with only one chronic disease.[7,16–20] Furthermore, previous studies were focused on single diseases such as DM, breast cancer, COPD, urinary tract infections, etc.[19–22] Therefore, this study aimed to provide an overview of the impact of the major chronic diseases, multimorbidity, and factors decreasing the HRQoL of the residents of Al-Jouf Province, Saudi Arabia. Furthermore, this study will help policymakers implement interventions, prioritise funding and to improve the HRQoL.

Materials and Methods

Ethical Approval

Prior to the commencement of the study, approval was obtained from the Local Committee on Bioethics (LCBE) of Jouf University (Reference no.: 31–06-42) and it was also approved by the Research Ethics Committee at Saudi MOH (Reference no.: 124. 28/02/2022). A brief description of the study and its purpose was provided to the participants at the beginning of the survey, ensuring their anonymity. A written informed consent from the individual participant was obtained before administering the survey. This study complies with the Declaration of Helsinki.

Study Design and Study Population

A cross-sectional multi-center study was conducted among the participants with chronic diseases in the Al-Jouf region of Saudi Arabia. The survey was conducted over a period of seven months, ie, September 2022–March 2023. Al-Jouf is a province in the northern region of KSA with limited access to healthcare facilities and a population of approximately 0.5 million. The inclusion criteria for the present study were: (1) patients willing to participate; (2) adults of more than 18 years of age; (3) either male or female; (4) having been diagnosed with at least one chronic disease; and (5) being able to write and understand Arabic and/or English. Exclusion criteria for the study included (1) patients of age less than 18 years, (2) pregnant women, (3) planning to conceive, and (4) being unable to understand Arabic or English. Participants who failed to fulfil the inclusion criteria were excluded from the study. The flow diagram of the current study is shown in Figure 1.

Study Settings

The current study utilised a multi-centered approach and data was collected from the willing participants from various hospitals and pharmacies in Al-Jouf region.

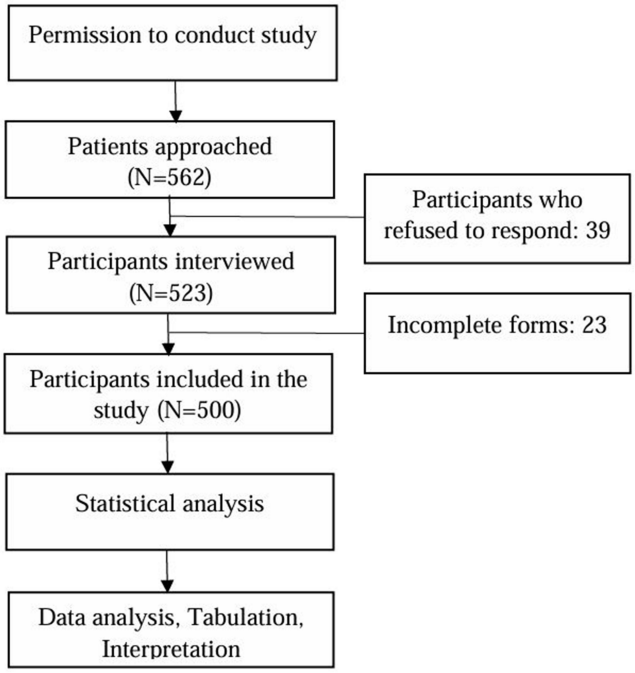

Figure 1 Study schematic diagram.

Sampling Technique

A convenient sampling technique was adopted in the present study to collect data from major cities of the Al-Jouf region, ie, Sakaka, Qurayat, and Dumat al-Jandal. For data collection, a list of all the accessible hospitals and pharmacies was compiled, and approval was taken from the concerned center prior to data collection. Different hospitals and pharmacies were assigned to the investigators, which they visited and collected data from the individuals who consented to participate in the study. Participants with at least one chronic disease and meeting the inclusion criteria were included in the study.

Study Tool for Assessing QoL

For the assessment of HRQoL, the Arabic and English versions of EuroQoL-5 dimensions-5 levels (EQ-5D-5L) were used, which was previously validated by the EuroQol research group and several previously conducted studies.[19,23,24] Instead of being disease-specific, it converts health states into a single index score that may also be useful for economic evaluation.[25–27] The panel of experts from relevant fields evaluated the questionnaire for its content validity. Recommended suggestions were included in the finalised form of questionnaire. For the validity of the study tool, a pilot study with a small sample size (n = 30) was conducted to evaluate the comprehensibility and understandability of the questionnaire. The participants in the pilot study group were not included in the final questionnaire. To quantify the internal consistency of the study tool, Cronbach's alpha (α) was used. A value of 0.69 indicated the adequacy of the study tool's . Test-retest was used to quantify the reliability of the EQ-5D-5L instrument. The Cohen's Kappa (κ) range of 0.54–1.00 suggested moderate to excellent reliability of the instrument in the population.

At the start of the self-administered questionnaire, a brief description of the study and objectives was provided, followed by written informed consent. The questionnaire broadly comprised two parts: (1) socio-demographic characteristics of the study participants and (2) evaluation of health status via EQ-5D-5L instrument. The first section of the questionnaire consisted of a series of questions about the socio-demographic characteristics of the study participants, including their gender, age, marital status, nationality, qualification, employment status, monthly income, height, weight, Body Mass Index (BMI), smoking status, and presence of any sort of disability. Moreover, BMI is measured as kg/m^2 and broadly categorised into four major classes according to WHO guidelines, ie, underweight (<18.5), normal (18.5–

24.9), overweight/pre-obese (25.0–29.9), and Obese (≥30).[28] Furthermore, the questionnaire inquired about clinical and health-related information, including type of chronic disease, duration of illness, and co-morbidities.

The second section of the study tool was the EQ-5D-5L instrument, which further consisted of two components: (1) a description of the health state and (2) a perception of the health state by the participant. The health state (EQ-5D-5L) of the patient with chronic disease was assessed in terms of five dimensions (5D): (1) mobility (MO), (2) self-care (SC), (3) usual activities (UA), (4) pain/discomfort (P/D), and (5) anxiety/depression (A/D). Each of the five dimensions had further five levels (5L), indicating (1) no problem, (2) slight problems, (3) moderate problems, (4) severe problems, and (5) unable to/extreme problems.[16] The scales are scored from 1 (no problem) to 5 (extreme problem) in each question. This score was used to obtain a five-digit code of HRQoL for each patient, which represented the EQ-5D-5L health profile (11111: full health/no problem in any dimension; 55,555: worst health/extreme problems in all dimensions). This 5-digit code was further analysed by using a set of weights and converting the health state (ie, 11111) to a single summary index value ($EQ\text{-}5D_{index}$). England's population reference valuation set (Devlin value set) was used in the present study, as well as in the previously conducted studies.[19,25] The reference value set was applied to the study data for further analysis to obtain the EQ-5D index score. The set of possible health values yields an HRQoL score between - 0.094 and 1, where 1 represents preferred health, 0 represents death and a score of less than 0 represents health states worse than death. For categorical reporting of health states, this $EQ\text{-}5D_{index}$ score was categorised into four states: 0 (death), less than 1 (imperfect health), equal to 1 (perfect/full health), and negative values (worse than death).[13–15] At the end of the EQ-5D-5L tool, a visual analogue scale (EQ-VAS) with 0 (worst health state) to 100 (Best health) endpoints was provided. This $EQ\text{-}5D_{VAS}$ represents the self-perception of the patient regarding their QoL.[19,25]

Data Collection

Data was collected from the participants using a paper-based, self-administered questionnaire . Informed consent was obtained before the survey from the institutes as well as participants. The data set included information on the socio-demographic characteristics of the participants as well as disease-related information such as the type of chronic disease, duration of each illness, and presence of co-morbidities. Data was obtained by the investigators themselves by visiting different hospitals and pharmacies. Data was translated into the English language by a linguist and subsequently scrutinised. Incomplete responses were excluded from the analysis.

Statistical Analysis

Data analysis was carried out using Statistical Package for the Social Sciences (SPSS) version 25. Kolmogorov-Smirnov (K-S) Test was used to assess the normality of the data. Descriptive analysis of the socio-demographic and disease characteristics of the study participants was conducted and for continuous variables, data was represented as Mean ± SD. For the representation of categorical variables, frequency and percentages (%) were used. For consistency and reliability of the study tool, Cronbach's alpha (α) and Kohen's kappa (κ) were used, respectively. Inferential statistics were applied to evaluate associations between study variables. Categorical data were compared using the chi-square test. Furthermore, the association between categorical variables such as socio-demographic variables, duration of illness, and comorbidities with the EQ-5D index and VAS score was evaluated using chi-square. Continous data were compared by independent sample *t*-test and one-way ANOVA, where appropriate. For continuous variables, bivariate Pearson correlation was used. A multiple linear regression model was run to determine the predicting variables for HRQoL. Regression coefficients with a 95% confidence interval (CI) were presented. For all statistical analysis, P-value of <0.05 was considered statistically significant.

Results

Characteristics of Study Participants

As shown in Figure 1, the response rate for the present study was 88.97% (n=500/562). A total of 500 patients were included in this study, with the majority having awareness that they are suffering from chronic diseases (n = 488, 97.60%). The socio-demographic data of the study participants is represented in Table 1. The mean age of the participants was 46.15 ± 16.79 years, belonging to the age group of 30–60 years (n = 292, 58.40%). Larger proportion

Table 1 Characteristics of the Study Participants

Variable	Frequency n (%)
Gender	
Male	201 (40.20)
Female	299 (59.80)
Age	
Mean age (years)*	46.15 ± 16.79
Age categories	
< 30 Years (Adult)	110 (22)
30–60 years (Middle age)	292 (58.40)
> 60 years (Elderly)	98 (9.60)
Marital status	
Single	94 (18.8)
Married	326 (65.20)
Widower	54 (10.80)
Divorced	26 (5.20)
BMI	
Underweight	15 (3)
Normal weight	169 (33.8)
Pre-obesity	168 (33.6)
Obesity	148 (29.6)
Nationality	
Saudi	490 (98)
Non-Saudi	10 (2)
Education level	
Less than high school	38 (7.60)
High school or equivalent	147 (29.40)
Bachelor's degree	175 (35)
Advanced degree (Masters, Doctorate, professional degree, etc.)	22 (4.4)
Diplomas and other	79 (15.80)
Uneducated	39 (7.80)
Employment status	
Government employee	162 (32.40)
Private employee	41 (8.20)
Unemployed	211 (42.20)

(*Continued*)

Table 1 (Continued).

Variable	Frequency n (%)
Retired	71 (14.20)
Students	15 (3)
Monthly income	
Less than 5000 SAR	126 (25.20)
5000–9999 SAR	90 (18)
10,000–14,999 SAR	78 (15.60)
15,000 SAR or greater	33 (6.60)
Declined to respond	173 (34.6)
Smoking status	
Never smoked	417 (83.40)
Current smoker	83 (16.60)
Duration of smoking (years)**	16 ± 19.29
Methods of smoking	
Cigarette	60 (12)
e-smoking / vape	2 (0.40)
Shisha	5 (1)
More than one form	8 (1.60)
Mixture of all forms	7 (1.40)
Disability	
No	484 (96.80)
Yes	16 (3.20)

Notes: *Mean ± SD age in years, **Those who smoked in mean ± SD.
Abbreviations: SAR, Saudi Riyal; SD, standard deviation; BMI, body mass index.

of the participants was female (n = 299, 59.80%), the majority were married (n = 326, 65.20%), had normal BMI (n = 169; 33.8%), almost all were Saudi National (n = 490, 98%), and had Bachelors' degree as their highest qualification (175, 35%). The mean BMI of the study participants was 27.50 ± 5.63 kg/m^2. A higher proportion of the participants were unemployed (n = 211, 42.20%); however, those who were employed were working in the government sector (n = 162, 32.40%). Of those who responded (n = 327; 65.40%) regarding their income earned less than 5000 SAR (n = 126, 25.20%). Moreover, the majority had no disability (n = 484, 96.80%) and were non-smokers (n = 417, 83.40%); but those who smoked had been smoking for a mean period of 16 ± 9.29 years.

Clinical and Disease-Related Characteristics of the Study Participants

The clinical and disease-related characteristics of the study participants are summarized in Table 2. The most prevalent chronic disease reported in the current study was DM (n = 249, 49.80%), of which DM type II was in larger proportion (n = 206, 41.20%), followed by hypertension (n = 139, 27.80%) and hypercholesterolemia (n = 53, 10.60%). The lowest HRQoL index score was reported in participants with kidney failure (0.65 ± 0.26), venous thromboembolism (0.67 ± 0.26), and cardiovascular diseases (0.69 ± 0.28). On the contrary, participants with higher HRQoL were suffering from Psoriasis, Obesity, and

Table 2 Clinical and Disease-Related Characteristics of the Study Participants

Chronic Diseases	Frequency n (%)	EQ–5D–5L Index Score According to Diseases (Mean ± SD)	p–value*	Overall Duration of Illness (Mean ± SD) years	p–value**	Duration of Illness in Relation to Comorbidities (Mean ± SD) years		p–value***
						<2	>2	
Diabetes Mellitus	249 (49.80)	0.79 ± 0.23	0.001*	10.53 ± 8.07	0.001*	9.99 ± 8.01	14.19 ± 7.67	0.006*
DM Type 1	43 (8.60)	0.82 ± 0.21	0.939	13.30 ± 9.58	0.001*	12.79 ± 10.18	15.5 ± 6.35	0.478
DM Type 2	206 (41.20)	0.78 ± 0.23	<0.001*	9.93 ± 7.61	0.027*	9.42 ± 7.42	13.75 ± 8.14	0.009*
Hypertension	139 (27.80)	0.77 ± 0.23	<0.001*	7.89 ± 6.72	0.223	7.40 ± 6.67	9.31 ± 6.79	0.143
Hypercholesterolemia	53 (10.60)	0.79 ± 0.20	0.245	6.26 ± 5.34	0.096	4.45 ± 3.15	8.82 ± 6.69	0.003*
Irritable bowel syndrome	50 (10)	0.82 ± 0.21	0.911	8.50 ± 5.45	0.363	8.29 ± 5.27	10.40 ± 7.30	0.417
Cardiovascular diseases	48 (9.60)	0.69 ± 0.28	<0.001*	8.46 ± 7.84	0.057	7.55 ± 6.24	9.84 ± 9.83	0.327
Asthma	44 (8.80)	0.78 ± 0.20	0.200	16.57 ± 12.21	0.931	15.95 ± 12	20.5 ± 14.04	0.403
Migraine	36 (7.20)	0.88 ± 0.09	0.060	7.67 ± 5.32	0.005*	7.63 ± 5.39	9.0	0.803
Rheumatoid arthritis	30 (6)	0.75 ± 0.16	0.048*	7.83 ± 5.51	0.485	7.63 ± 5.75	8.67 ± 4.80	0.687
Venous thromboembolism	10 (2)	0.67 ± 0.26	0.017*	6.70 ± 7.15	0.768	7.33 ± 8.52	5.75 ± 5.50	0.753
Kidney failure	8 (1.60)	0.65 ± 0.26	0.016*	4.75 ± 6.23	0.966	5.14 ± 6.62	2.0	0.672
Hypothyroidism	18 (3.60)	0.82 ± 0.24	0.929	10.11 ± 6.41	0.162	10.56 ± 6.55	6.50 ± 4.95	0.414
Cancer	6 (1.20)	0.82 ± 0.17	0.979	5.25 ± 3.77	0.604	5.25 ± 3.77	–	–
Gout	3 (0.60)	0.91 ± 0.08	0.411	1.50 ± 0.50	0.673	1.50 ± 0.50	–	–
Herniated disc	3 (0.60)	0.80 ± 0.13	0.900	19.67 ± 5.69	0.525	16.50 ± 2.12	26.0	0.170
Anemia	2 (0.4)	0.90 ± 0.13	0.551	7.50 ± 3.40	–	7.50 ± 3.54	–	–
Psoriasis	5 (1)	0.95 ± 0.07	0.139	12 ± 6.36	0.442	12 ± 6.36	–	–
Hepatitis	1 (0.2)	1.0	0.369	1	–	1	–	–
Obesity	1 (0.2)	0.94 ± 0.01	0.543	10	–	10	–	–

Notes: *p-value obtained by one-way ANOVA to check the association between EQ-5D index score and individual diseases, **p-value obtained by Pearson correlation between EQ-5D index score and duration of illness, ***p-value obtained by one-way ANOVA to check the association between EQ-5D index score and duration of illness in relation to co-morbidities; p-value is statistically significant at < 0.05.
Abbreviation: DM: diabetes Mellitus; SD: standard deviation.

Gout; however, they were statistically not significant. Moreover, DM being the most prevalent disease in the study population, the HRQoL score associated with it was 0.79 ± 0.23.

Overall Health-Related Quality of Life (HRQoL)

Health profile: As shown in Table 3, about one-fourth (n = 105, 21%) of the population had full health profile, ie, 11111, indicating no problem in any domain at any level, followed by participants with no problem in 1st, 2nd, 3rd, and 5th domain, ie, 11121 (n = 42, 8.40%). On the other hand, the worst health profile reported in the current study was 55541 (n = 1, 0.2%).

Categorizing the health states further, the majority of the population represented imperfect health, ie, <1 EQ-5D index score (n = 390, 78%), enlisted in Table 3. Furthermore, the mean score of 5-dimensions of health is also evaluated. Among the 5D, the Pain/discomfort score reported the highest mean score of 2.04 ± 0.99. Regarding 5 Levels, the majority of the participants agreed on having no problem (level 1) in terms of MO (n = 357, 71.4%), SC (n = 439, 87.8%), UA (n = 302, 60.4%), P/D (n = 169, 33.8%), and A/D (n = 305, 61%). As shown in Figure 2, the SC dimension reported no problem (87.8%), whereas the UA dimension reported an extreme problem (4%).

Table 3 Most Reported Health State and Its Frequency by EQ-5D-5L

Health Related Study Outcomes	**Mean ± SD**
Overall HRQoL index score (EQ-5D index)	0.82 ± 0.20
Categories of health state	**Frequency (%)**
Perfect health	105 (21)
Imperfect health	390 (78)
Death	–
Worse than dead	5 (1)
Mean score of 5-dimensions	**Mean ± SD**
Mobility score	1.50 ± 0.93
Self-care score	1.21 ± 0.69
Usual activity score	1.68 ± 1.05
Pain/discomfort score	2.04 ± 0.99
Anxiety/depression score	1.64 ± 0.96
EQ-VAS score	78.59 ± 18.61
The most frequent Health state	**Frequency (%)**
11111	105 (21)
11121	42 (8.40)
11122	31 (6.2)
11221	25 (5)
11112	15 (3)
11131	15 (3)
11123	13 (2.6)
11211	13 (2.6)
21121	11 (2.2)
11222	10 (2)
21221	10 (2)
The worst health state reported in the study	**Frequency (%)**
55541	1 (0.2)
55533	2 (0.4)
55112	1 (0.2)
55111	1 (0.2)
54552	1 (0.2)

Notes: EQ-5D index score: 0 (death), less than 1 (imperfect health), equal to 1 (perfect/full health), and negative values (worse than death), EQ-5D-VAS score range: 0 (worst health state) to 100 (best imaginable state).
Abbreviation: SD, standard deviation.

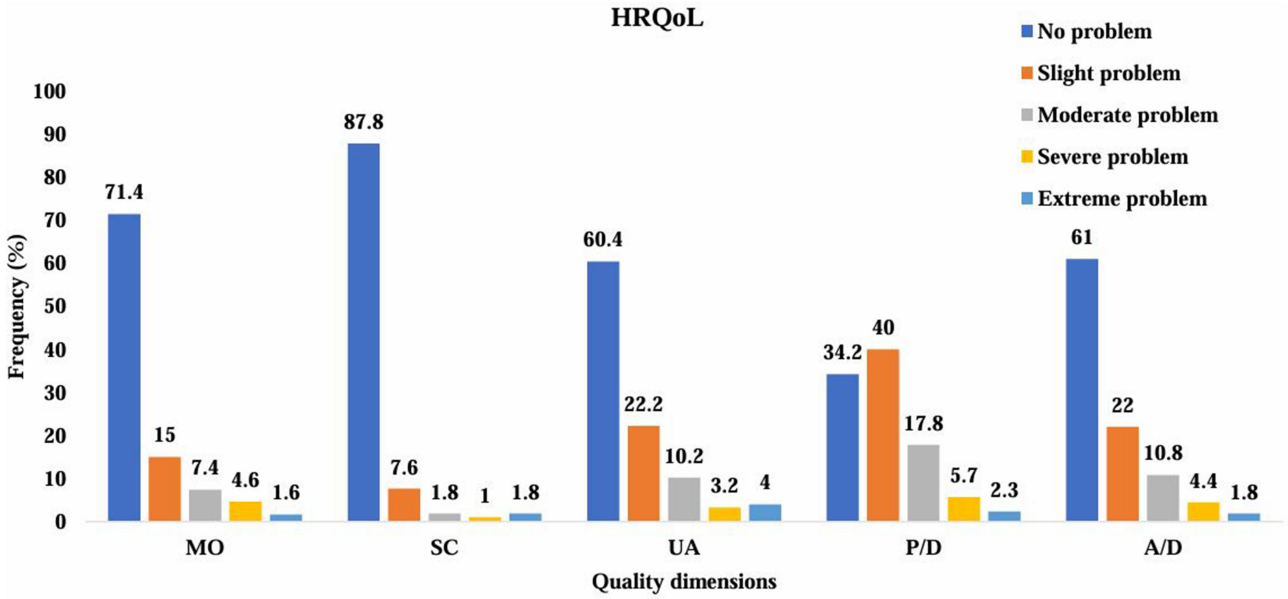

Figure 2 Overall health-related quality of life (HRQOL) on EQ-5D-5L.

$EQ\text{-}5D_{index}$: This 5-digit health profile is converted to a single value, ie, EQ-5D $_{index}$ score using value sets of the United Kingdom as reference.[19,25] The mean $EQ\text{-}5D_{index}$ score represented the HRQoL of patients with chronic diseases, ie, 0.82 ± 0.20 (CI: 0.81–0.84; p-value < 0.001). The association of this EQ-5D $_{index}$ score with socio-demographic factors and duration of illness and comorbidities is further represented in Table 2 and Table 4.

Table 4 Association of Demographic Characteristics and Comorbidities of the Study Participants with EQ-5D and EQ-VAS (N = 523)

Variable	N	$EQ\text{-}5D_{index}$ Score (Mean ± SD)	p-value	$EQ\text{-}5D_{VAS}$ Score (Mean ± SD)	p-value
Overall HRQoL scores[a]	253	0.82 ± 0.20	<0.001*	78.59 ± 18.61	<0.001*
Gender[b]			<0.001*		<0.001*
Male	201	0.87 ± 0.16	<0.001*	82.25 ± 16.20	<0.001*
Female	299	0.78 ± 0.21	<0.001*	76.13 ± 19.71	<0.001*
Age (years)[c]			<0.001*		0.001*
< 30 Years (Adult)	110	0.90 ± 0.11	<0.001*	83.35 ± 14.74	0.001*
30–60 years (Middle age)	292	0.83 ± 0.19	0.443	77.83 ± 18.90	0.277
> 60 years (Elderly)	98	0.72 ± 0.25	<0.001*	74.97 ± 20.47	0.032*
BMI (kg/m^2)[c]			<0.001*		0.025*
Underweight	15	0.88 ± 0.05	0.214	80.33 ± 18.07	0.713
Normal	169	0.84 ± 0.19	0.058	79.80 ± 18.49	0.297
Overweight	168	0.85 ± 0.17	0.024*	80.63 ± 15.97	0.082
Obese	148	0.75 ± 0.23	<0.001*	74.72 ± 21.02	0.002*

(*Continued*)

Table 4 (Continued).

Variable	N	EQ-5D$_{index}$ Score (Mean ± SD)	p-value	EQ-5D$_{VAS}$ Score (Mean ± SD)	p-value
Marital status[c]			<0.001*		0.045*
Single	94	0.89 ± 0.13	<0.001*	83.06 ± 15.60	0.010
Married	326	0.83 ± 0.19	0.201	77.93 ± 19.34	0.276
Widower	54	0.68 ± 0.25	<0.001*	75.61 ± 18.15	0.213
Divorced	26	0.76 ± 0.24	0.112	76.92 ± 18.17	0.639
Nationality[b]			0.355		0.230
Saudi	490	0.82 ± 0.20		78.79 ± 18.53	
Non-Saudi	10	0.78 ± 0.22		84.60 ± 14.50	
Educational level[c]			<0.001*		<0.001*
Less than high school	38	0.69 ± 0.22	<0.001*	78.42 ± 21.53	0.954
High school or equivalent	147	0.83 ± 0.19	0.332	80.20 ± 17.19	0.213
Bachelor's degree	175	0.87 ± 0.15	<0.001*	79.91 ± 17.37	0.243
Advanced degree	22	0.91 ± 0.06	0.033*	87.41 ± 13.08	0.032*
Diplomas and other	79	0.84 ± 0.13	0.313	75.99 ± 18.99	0.176
Uneducated	39	0.59 ± 0.33	<0.001*	67.75 ± 23.02	<0.001*
Employment status[c]			<0.001*		0.004*
Government employee	162	0.90 ± 0.10	<0.001*	81.14 ± 16.45	0.034*
Private employee	41	0.85 ± 0.16	0.246	80.98 ± 18.98	0.392
Unemployed	338	0.90 ± 0.10	<0.001*	81.14 ± 16.45	0.034*
Retired	71	0.79 ± 0.22	0.217	78.72 ± 17.75	0.950
Students	15	0.85 ± 0.14	0.563	89.33 ± 13.90	0.023*
Monthly income[c]			0.004*		0.238
Less than 5000 SAR	126	0.78 ± 0.23	0.010*	76.33 ± 18.85	0.114
5000–9999 SAR	90	0.86 ± 0.16	0.021*	78.84 ± 17.37	0.886
10,000–14,999 SAR	78	0.87 ± 0.14	0.017*	76.71 ± 19.03	0.331
15,000 SAR or greater	33	0.86 ± 0.10	0.189	84.48 ± 13.76	0.060
Declined to respond	173	0.79 ± 0.22		79.83 ± 19.48	
Smoking status[b]			0.148		0.141
Smoker	83	0.85 ± 0.18		81.34 ± 17.64	
Non-smoker	417	0.81 ± 0.20		78.04 ± 18.77	
Disability[b]			<0.001*		0.002
Yes	16	0.56 ± 0.29		64.38 ± 22.79	
No	484	0.83 ± 0.19		79.06 ± 18.30	

(*Continued*)

Table 4 (Continued).

Variable	N	EQ-5D$_{index}$ Score (Mean ± SD)	p-value	EQ-5D$_{VAS}$ Score (Mean ± SD)	p-value
Comorbidities[c]			<0.001*		<0.001*
< 2 diseases	482	0.84 ± 0.18		79.99 ± 17.99	
≥ 2 diseases	41	0.65 ± 0.26		66.83 ± 19.55	

Notes: [a]Pearson correlation test was used to check the correlation between the EQ-5D index and VAS scores. [b]p-value obtained from independent *t*-test. [c]p-value obtained from one-way ANOVA *p-value < 0.05 is considered statistically significant.
Abbreviations: EQ-5D, EuroQoL-5 dimension; SD, standard deviation; VAS, visual analogue scales; HRQoL, health-related quality of life; CVD, cardiovascular disease; IBS, irritable bowel syndrome.

EQ-5D $_{VAS}$: Self-assessment of health state by the participants using an analogue scale yielded a mean EQ-5D $_{VAS}$ score of 78.59 ± 18.61. Of the total participants, the majority (93%) self-opted 100 on the scale, perceiving their health to be perfect, as shown in Figure 3.

Association of Socio-Demographic Characteristics with HRQoL

Factors affecting and predicting the QoL are summarized in Table 4. There was a statistically significant association between the mean EQ-5D$_{index}$ and EQ-5D$_{VAS}$ score (Pearson correlation coefficient: 0.493; $p < 0.001$), indicating that the EQ-5D index score obtained is equivalent to the health state as perceived by the study participants. Both EQ-5D index and VAS scores were reported to be significantly influenced by gender, age, marital status, educational level, employment status, disability, and comorbidities. Females had lower average EQ-5D index and EQ-5D VAS scores as compared to male gender. Patients aged less than 30 years had both EQ-5D$_{index}$ and EQ-5D$_{VAS}$ scores higher as compared to other age groups.

Moreover, single participants, having advanced degrees as compared to those who were uneducated and without any sort of disability, had both higher EQ-5D$_{index}$ and EQ-5D$_{VAS}$ than the other reported higher QoL scores. Nonetheless, government employees had higher EQ-5D$_{index}$. However, participants who were obese and had a BMI >30 kg/m^2 had lower HRQoL score. Overall, there was no statistically significant association between HRQoL and variables, such as nationality, smoking status (both EQ-5D$_{index}$ and EQ-5D$_{VAS}$), monthly income (EQ-5D$_{VAS}$), and any sort of disability (EQ-5D$_{VAS}$).

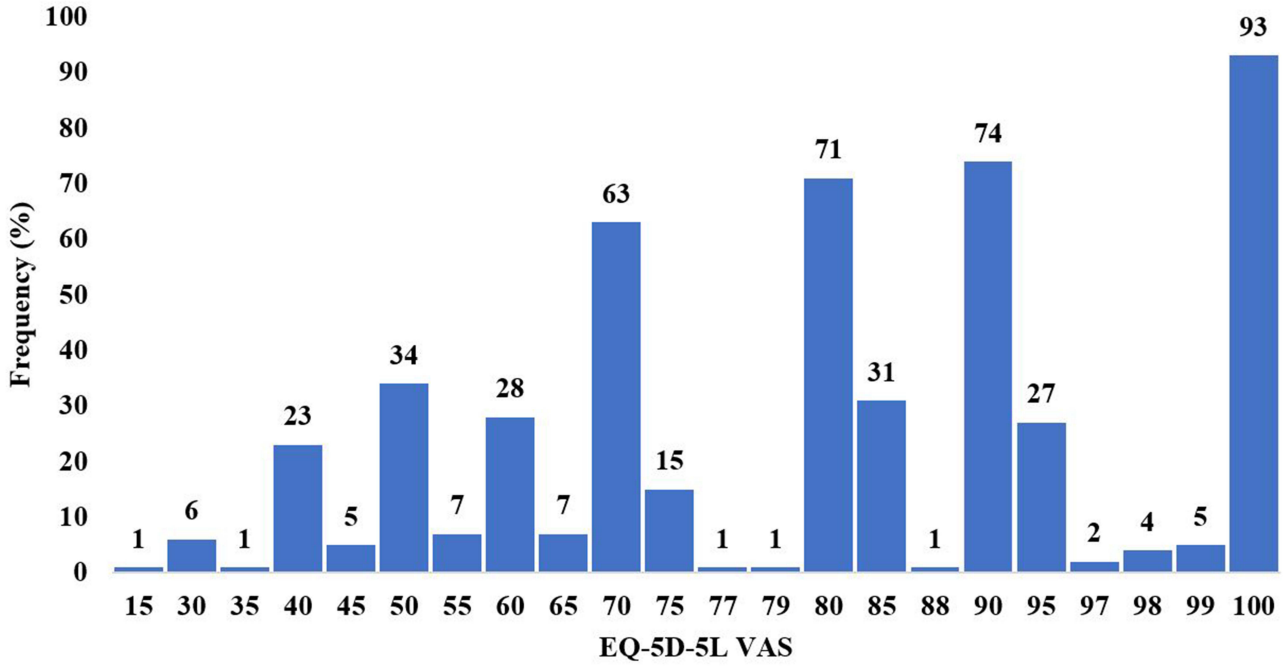

Figure 3 Self-reported quality of life by EQ-5D-5L VAS scale.

Correlation of Duration of Illness with the Quality of Life

There is a significant impact on QoL due to certain chronic diseases. In the present study, asthma has the most prolonged duration of illness, ie, 16.57 ± 12.21 years, represented in Table 2. DM being the most prevalent disease reported in the current study with a mean duration of illness, ie, 10.53 ± 8.07 years ($p < 0.001$) has a significant correlation with the HRQoL, followed by Migraine 7.67 ± 5.32 years ($p = 0.005$).

Correlation of the Number of Comorbidities with the Quality of Life

The present survey reported the presence of multimorbidity, with the majority proportion having less than two chronic diseases (n = 459, 91.80%) and reported significantly higher scores in both EQ-$5D_{index}$ (0.84 ± 0.18; $p < 0.001$) and EQ-$5D_{VAS}$ (79.99 ± 17.99; $p < 0.001$), summarized in Table 4.

Correlation of Comorbidities and Duration of Illness

In addition to primary chronic disease, multimorbidity in participants was reported and was further categorized into two classes, ie, <2 diseases and 2 or more diseases. Comorbidities showed a correlation with the duration of the disease. The more the number of comorbidities the participants reported, the more prolonged the duration of illness is observed. For instance, in the presence of DM and 2 or more co-morbid conditions, the duration of illness was statistically higher as compared to those having less than 2 comorbid conditions (14.19 ± 7.67 vs 9.99 ± 8.01 years; $p < 0.001$), followed by hypercholesteremia. Evidently, the presence of comorbidities tends to prolong the duration of chronic illness, as summarised in Table 2.

Predictors of Health-Related EQ-$5D_{index}$ Score

To further determine the predictors of HRQoL, multiple linear regression analysis was performed to model the relationship between the statistically significant variables and EQ-5D index score, tabulated in Table 5. Overall, the linear regression model for test variables significantly predicted QoL, $F(23, 476) = 8.159$, $p < 0.001$, $R^2 = 0.283$. Of the

Table 5 Multiple Linear Regression Model – Predictors of Health-Related EQ-$5D_{index}$ Score

Variable	Linear Regression Analysis EQ-5D Index		
	OR	**p-value**	**95% CI**
Gender			
Male	0.053	0.007*	0.014–0.092
Female	*Reference*		
Age categories			
< 30 Years (Adult)	0.109	0.002*	0.040–0.179
30–60 years (Middle age)	0.050	0.054	−0.001–0.101
> 60 years (Elderly) *(Reference)*	*Reference*		
Marital status			
Married	0.069	0.079	−0.008–0.146
Widower	−0.074	0.110	−0.164–0.017
Single	0.126	0.079	0.042–0.210
Divorced	*Reference*		

(*Continued*)

Table 5 (Continued).

Variable	Linear Regression Analysis EQ-5D Index		
	OR	**p-value**	**95% CI**
BMI			
Underweight	0.040	0.454	−0.064–0.873
Overweight	0.005	0.827	−0.037–0.047
Obese	−0.089	<0.001*	−0.133 – (−0.046)
Normal	*Reference*		
Level of education			
Less than high school	0.086	0.036*	0.006–0.166
High school or equivalent	0.170	<0.001*	0.103–0.238
Bachelor's degree	0.183	<0.001*	0.110–0.256
Advanced degree	0.200	<0.001*	0.095–0.304
Diplomas and other	0.177	<0.001*	0.099–0.254
Uneducated	*Reference*		
Employment status			
Government employee	0.048	0.126	−0.013–0.108
Private employee	−0.009	0.808	−0.081–0.063
Retired	−0.007	0.846	−0.073–0.060
Students	0.032	0.506	−0.062–0.125
Income			
Less than 5000 SAR	−0.027	0.738	−0.290–0.409
5000–9999 SAR	−0.006	0.841	−0.061–0.050
10,000–14,999 SAR	−0.014	0.643	−0.074–0.046
15,000 SAR or greater	−0.031	0.462	−0.116–0.053
Declined to respond	*Reference*		
Disability			
No	0.143	0.002*	0.052–0.233
Yes	*Reference*		
Comorbidities			
Less than 2 diseases	0.112	<0.001*	0.052–0.171
2 or more diseases	*Reference*		
Chronic disease			
DM type 1	0.022	0.906	−0.348–0.393
DM type 2	0.030	0.872	−0.340–0.401

(*Continued*)

Table 5 (Continued).

Variable	Linear Regression Analysis EQ-5D Index		
	OR	p-value	95% CI
Hypertension	−0.168	<0.001*	−0.214 – (−0.121)
Cardiovascular disease	−0.117	0.019*	−0.215 – (−0.020)
Rheumatoid Arthritis	−0.140	0.140	−0.326–0.046
Venous thromboembolism	−0.091	0.336	−0.277–0.095
Kidney failure	−0.256	0.056	−0.518–0.006

Notes: *p-value is statistically significant at <0.05 Positive value indicates an increase in quality of life.
Abbreviations: OR, odds ratio; CI, confidence interval.

variables run in the linear model, gender, age, level of education, disability, comorbidities, and duration of illness broadly added statistical significance to the prediction of HRQoL ($p < 0.05$). These findings indicate that gender is a significant predictor of QoL, with males having better QoL than females (OR: 0.053; $p < 0.001$). Moreover, patients aged less than 30 years tend to have better QoL (OR: 0.109; $p = 0.002$). Likewise, BMI indicated that obesity (OR: −0.089; $p < 0.001$) has a significant and negative correlation with HRQoL score. In addition, participants with no disability (OR: 0.143; $p = 0.002$) and fewer than two chronic diseases (OR: 0.112; $p < 0.001$) have a greater impact on QoL. Moreover, participants with any level of qualification had better HRQoL than those who were uneducated. Overall, hypertension and cardiovascular diseases significantly influence the quality of life. In contrast, marital status was not a predictor of better QoL, as divorced participants (OR: −0.049; $p = 0.263$) reported lower 5D index scores as compared to the other marital statuses. Similarly, the employment status and income of the participants were not significant.

Discussion

Measuring health-related quality of life is the most reliable and practical tool used for evaluating the management of chronic diseases and aids in the identification of the factors affecting the QoL of patients.[13,15,16,20,29,30] To the best of our knowledge, this is the first study of its kind and to assess QoL using EQ-5D-5L in participants with multiple chronic diseases in a remote region of Al-Jouf, Saudi Arabia. The present study can be considered novel in its nature as it specifically targets the population of Al-jouf region. Additionally, study covers multiple chronic diseases including diabetes mellitus, hypertension, hepatitis, migraine, and hypercholesterolemia which was not covered in previously conducted studies. Furthermore, all the mentioned chronic diseases were found to be significantly associated with poor QoL.

Health-related quality of life scores reflect the health status of the individuals. Overall, the present study highlighted low QoL index score in the population, with the majority having imperfect health. This corroborates with the findings of the study conducted on the diabetic cohort of the population in Riyadh.[21] Surprisingly, the majority of the participants in the present study reported 11,111 as an EQ-5D health profile. However, no problem was found in the SC domain, which is contrary to the findings of a study conducted in Norway and Saudi Arabia on patients with DM (21, 31). Furthermore, EQ-5D index and VAS scores were also correlated with each other and found to be statistically significant in the present study, which is consistent with the findings of the previous study in Riyadh.[21] This suggests that patients' perception of their health and their actual quality of life are associated with one another.

DM is the most prevalent disease, responsible for the world's highest morbidity as well as mortality rates. In previous studies, participants with DM reported worse QoL than those without DM.[32,33] The majority of the studies conducted in Saudi Arabia were solely focused on QoL in the management of DM, whereas our study incorporated a variety of other frequently occurring chronic diseases.[19–21,34–39] However, the current study reported DM as the most prevalent chronic illness which corroborates with the results of a meta-analysis and review articles previously conducted, validating the reason why previous studies were limited to DM only.[9,18] The mean score in DM type 2 patients in our study was 0.78 which indicates imperfect health (<1) and is similar to previously conducted studies with 0.71, 0.74, 0.70, 0.70, 0.79, and 0.69 index scores. Lower EQ index score of 0.77,

similar to previously conducted studies, was also reported for another most commonly reported chronic diseases, ie, hypertension.[21,39–42] The index score tends to decrease as the disease progresses. On the contrary, patients suffering from Hepatitis reported the best quality of life in our study followed by psoriasis; however, this could be due to the limited number of cases, and the average score might differ if there were more patients with similar diseases.

The duration of chronic disease also tends to affect the quality of life of an individual. For patients with DM (Type I and II) and migraine, there is a significant correlation between duration of illness and EQ-5D index scores. Patients with DM for more than 5 years reported lower EQ-5D index scores. This trend indicates that as the duration of the illness increases, the QoL of the patient regresses; this depiction is in line, with previous studies showing a significant association between increased duration of illness and a reduced HRQoL in Iran, Canada and Sweden study population.[39,42,43] Similar results were reported in studies conducted in Saudi Arabia on diabetic study populations, experiencing a decline in HRQoL as a result of the increased severity and duration of chronic disease.[19–21,34] Patients need to be educated on the importance of undergoing at least a biannual examination and on how to effectively manage their diseases to further enhance their QoL. Additionally, family members must also undergo periodic disease screening as a precautionary measure.

Comorbidities and presence of any sort of disability are also the significant contributors to poor QoL. Not a larger proportion of previous studies reported co-morbidities, those studies were more single-disease-oriented. However, the present study reported that 92% of the participants had less than or at least two comorbidities, whereas surveys conducted in the USA reported that 40% of adults were affected.[2,44] Previous research has demonstrated that the presence of cardiovascular diseases in patients with DM hurts their QoL.[45,46] The number and type of comorbid conditions gravely impact the QoL of an individual. The current study highlighted the fact that participants with two or more co-morbidities had reduced QoL, these outcomes corroborate with those of previous research in diabetic patients residing in KSA.[34,36] Patients with two or more than two comorbid conditions had an index score of 0.65. This trend was found to be similar to other studies reporting similar results of a health index score of 0.66 in Palestinian patients with hypertension with more than two comorbid conditions.[47] Moreover, patients with chronic diseases and comorbidities tend to have lower HRQoL, which is in line with the findings of a previously conducted study in KSA.[48] The mean EQ-5D $_{index}$ score was 0.82 ± 0.2 which is higher than a previously conducted study in Saudi Arabia on a diabetic study population.[21] Multiple chronic diseases make it difficult for the patient to manage their conditions. This indicates that the lower the number of comorbid conditions the patient has, the easier it is to manage the disease, hence, the higher the QoL score. Additionally, patients with any sort of disability tend to have lower QoL than those without any disability. This may be the result of decreased disease burden on the patient and their ability to manage their own health-related needs rather than relying on others.

Additionally, other factors including demographic characteristics of the patients and their social status also impact the HRQoL of the patients. The current study revealed that both the EQ-5D index and VAS score tend to decrease with the increase in age, represented by the QoL score being highest in those under 30 years of age. These findings are consistent with the results from previously conducted studies on chronic diseases such as DM.[21,39,41,49] Individuals above 60 years of age reported the lowest health index of 0.72 which was similar to a study conducted in Japan on chronic obstructive pulmonary disease (COPD) with a health utility of 0.77.[50] Gender was another demographic factor influencing the QoL of the patients. There was a statistically significant difference in the EQ-5D $_{index}$ and EQ-5D $_{VAS}$ score between genders; in the current study, female participants had a mean score lower than male participants. This was confirmed by the multiple linear regression model and is consistent with previous studies conducted in Saudi Arabia on the most common chronic diseases.[20,21,23,27,34–37,41,49,51] These gender related differences in QoL might be a result of comparable lifestyle differences between both genders. Cultural restrictions on women may contribute to their sedentary lifestyle in comparison to men's active lifestyle.[21,52,53] Therefore, strategies to improve the HRQoL, particularly for women are of utmost importance.

Other factors impacting the HRQoL of the participants included BMI, level of education, and marital status. The mean BMI of the current study was 27.50 ± 5.63 kg/m^2 and leaned towards overweight which was in line with another study conducted in Riyadh, with patients having chronic diseases. Additionally, obese participants were reported to have lower mean QoL scores (OR: –0.089; $p < 0.001$) as compared to others, indicating a decrease in the overall quality of participants' life.[54] Regarding the level of education, the present study reported a significant adverse impact on the QoL of the participants. Participants with no education or less level had lower QoL scores, in comparison to those with advanced educational degrees. These results are consistent with those of numerous international studies, indicating that a higher education level tends to improve overall quality

of life.[19,20,55–57] In the future, essential and pertinent education on self-management of chronic diseases would be useful in enhancing the QoL of the patients suffering from these diseases, especially in remote areas and those having lower educational status. Additionally, single participants had higher index scores as compared to participants with other marital statuses. These findings are in contrast to other studies where married people showed higher QoL scores.[21] However, marital status and monthly income had no statistically significant influence on HRQoL.

Overall, low quality of life in the management of chronic diseases was reported in the present study. Educational programs to create awareness and facilitate disease management are needed to optimize the patient's health and improve disease outcomes. Additionally, disease screening is needed to prevent and effectively manage chronic diseases as earliest as possible. Awareness campaigns to educate patients about chronic diseases, their predictors, and their management are needed in remote areas, especially at the Government level. Although the methodology used in the present study was already been adapted by some previously conducted in KSA metropolitan cities, however, current study can be considered novel in its nature as it specifically targets the Al-jouf region of KSA. Moreover, the present study covers multiple chronic diseases including Diabetes Mellitus, hypertension, Hepatitis, migraine, and hypercholesterolemia as compared to previous studies focused on one disease and no comorbidities. Furthermore, all the mentioned chronic diseases in the present study were found to be significantly associated with imperfect health and poor QoL. Indicators of HRQoL are significant predictors of patient's ability to productivity and to preserve the long-term health.[7,19] In this context, HRQoL is crucial for evaluating the burden of disease and facilitating the healthcare professionals and policymakers to improve the patient care and policy making decisions.

Limitations and Strength

The present study has a cross-sectional study design, due to which it is not possible to infer a causal relationship between chronic diseases and their various dimensions and levels. There is a substantial possibility that some chronic diseases were not included in the current study. Future studies with a longitudinal study design need to be conducted on all other frequently occurring chronic illnesses. Furthermore, after a few years, a similar study can be repeated on the same cohorts to evaluate the shift in the trend of QoL in the same population of Saudi Arabia. Several questions might not be enough to determine all of the clinical aspects of an individual.

Despite its limitations, the current study provides valuable insight into the facilitators and predictors of HRQoL. A larger sample size and multi-centered study setting make it possible to extrapolate the data and generalize the findings to the general population. Moreover, the present study identified the factors affecting the HRQoL, especially the gender of the patient, evaluating its role as a contributing factor. This study was conducted in a remote area with limited health facilities, which demonstrates the difference in healthcare facilities, accessibilities to these facilities, and QoL as compared to the metropolitan cities where the majority of the previous studies are conducted. Future investigations can compare these findings with data from metropolitan cities and provide factual insight into the relationship between them and the current healthcare scenarios. The outcomes of the present study will assist policymakers in developing and ensuring the implementation of appropriate policies that are lacking in remote areas.

Conclusions

The findings of the current study indicate that chronic diseases, duration of illness, and number of comorbid conditions among residents of Al-Jouf region are associated with imperfect health and contributed to low HRQoL index score. Single participants, having advanced degrees as compared to those who were uneducated and without any sort of disability, had both higher EQ-$5D_{index}$ and EQ-$5D_{VAS}$ than the other reported higher QoL scores. This study identifies various factors linked with poor quality of life. These findings necessitate the need for timely measures to improve quality of life among people living with comorbidities in the region. There is a dire need to develop programs and campaigns to create awareness among the patients and to ensure their implementation even in remote regions of the country. Present study will help the policymakers and stakeholders to play a crucial role in the development and implementation of advanced policies, particularly for women and those with lower levels of education.

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Disclosure

The authors declare no conflict of interests in this work.

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