The impact of chronic disease and accompanying bio-psycho-social factors on health-related quality of life

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ABSTRACT

Background: Most chronic illnesses lead to poor health outcomes. Bio-psycho-social sequelae and accompanying depression lead to further deterioration in health-related quality of life (HRQoL). This study explored the HRQoL of patients with major chronic diseases in a public tertiary health care institution in Trinidad and Tobago. Methods: This cross-sectional study was conducted on a convenience sample of adult patients with chronic illnesses in a public health institute in Trinidad. Data were collected using face-to-face interviews and consenting patients' records. A 43-item questionnaire comprising demographic, medical, and lifestyle questions, the nine-item patient health questionnaire (PHQ-9) on depression, and the EQ-5D-5L HRQoL questionnaire were used. Psychological and social variables were divided into six groups: Group 1 (community attachment variables), Group 2 (family and friends), Group 3 (life satisfaction), Group 4 (depression symptoms), Group 5 (social support), and Group 6 (lifestyle variables). The impact of these variables on HRQoL was investigated using regression and canonical correlation analysis. Results: Patients were primarily female (70.3%), Indo-Trinidadian (63.9%), having diabetes mellitus (46.0%) or cancer (35.8%). The quality of life was lower than Trinidad and Tobago EQ-5D-5L population norms. Females and older patients had worse HRQoL than males and younger patients, respectively. Furthermore, kidney failure, all cancer patients, and middle-aged female cancer patients fared worse than other categories. Life satisfaction and exercise were significantly associated with better HRQoL. Depressive symptoms were consistently and significantly negatively associated with HRQoL. Conclusions: HRQoL was lower among participants with chronic disease than in the general population. Depressive symptoms led to worse HRQoL, whereas life satisfaction and exercise significantly improved HRQoL. The EQ-5D dimension most frequently affected was anxiety/depression.

Keywords: Chronic diseases, depression, EQ-5D-5L, health-related quality of life, HRQoL, PHQ-9

Background

As a significant burden to the individual and society, chronic diseases affect health-related quality of life (HRQoL).¹² Accompanying psychosocial factors such as depression, the lack of social support, and economic hardships often compromise HRQoL.¹³ The type of chronic disease, personal influences, and cultural adaptation may also impact HRQoL. Co-morbid psychiatric disorders affect the course of chronic physical diseases (CPDs).¹⁴ CPD can also lead to psychopathological manifestations.¹⁵ HRQoL is a marker of clinical outcome and has been reported for many chronic diseases such as chronic back pain¹⁶ and cancer.¹⁶

Local data on HRQoL of patients in the English-speaking Caribbean with chronic disease are lacking. Such data would help patients and healthcare providers, including primary care physicians, identify chronic disease patients at a greatest risk for poor HRQoL and gaps in care and policy, and facilitate appropriate interventions to improve HRQoL outcomes. HRQoL was evaluated for the selected chronic diseases [diabetes...
mellitus, cancer, human immunodeficiency virus (HIV), ischemic heart disease (IHD), and chronic kidney diseases] because they were common in Trinidad.[9]

This study is the first to evaluate HRQoL among chronic disease patients in the Caribbean using the EQ-5D-5L instrument. More specifically, the study aims to evaluate the HRQoL (overall and specific health dimensions) of patients with chronic disease and to determine the association between medical, demographic, and psycho-socio-economic factors and HRQoL.

**Methods**

This cross-sectional study was conducted on adult clinic attendees of a public health institute, a 745-bed capacity hospital, and the largest public tertiary health care institute in Trinidad, serving a catchment area of 600,000 citizens.[10] The hospital provided free 24-hour service and was open to all. This level of accessibility allowed the majority of citizens to seek medical care at this institution.

**Recruitment**

Patients suffering from chronic diseases [diabetes mellitus, cancer, IHD, and end-stage renal disease (ESRD)] were identified from the medical records. Selected patients obtained by convenience sampling were briefed on the nature of the study and asked about their willingness to participate. Participants were assured about confidentiality, anonymity, and privacy of all information. The inclusion criteria were as follows: adults more than 18 years of age and clinic attendees for more than 1 year, having a non-curable illness such as cancer, diabetes, hypertension, HIV, ESRD, or IHD. The exclusion criteria were patients with problems of cognition or those who were unable to communicate clearly. Patients who provided verbal consent were included in the study.

All prospective participants who were approached gave consent. Five were rejected because of communication or transportation problems. The demographic profiles of these patients resembled those accepted in the study.

**Data collection**

Data collection was carried out by the lead researcher and medical students from November 21, 2016, to March 31, 2017, using a pilot-tested questionnaire. This questionnaire allowed for changes in question-wording to ensure clarity and uniformity of responses. Information was obtained using case notes and face-to-face interviews, documented using a questionnaire. The 43-item questionnaire comprised questions on demographics (age, sex, ethnicity, marital status), socioeconomic issues (income, employment, social, family, or economic support), medical history (diabetes, hypertension, abdominal obesity, stressful life/depression, family history of IHD, hypercholesterolemia, history of IHD, chronic obstructive pulmonary disease (COAD), cancer, ESRD, HIV), lifestyle history (smoking, alcohol use, daily intake of fruits and vegetables, exercising at least three times per week), and psychological issues.

The nine-item patient health questionnaire (PHQ-9) was used to assess depression [Supplemental Table 1].[11] It is a self-administered version of the PRIME-MD diagnostic instrument for common mental disorders. Each item is rated on a 0–3 scale, where 0 = not at all, 1 = several days, 2 = more than half the days, 3 = nearly every day. The total scores of 0–4, 5–9, 10–14, 15–19, and 20–27 are equated to no, mild, moderate, moderately severe, and severe depression, respectively. Clinical depression was diagnosed in patients with a PHQ-9 score of greater than 9. Clinical depression (PHQ scores between 10 and 27 inclusive) has high sensitivity (77.5%) and specificity (86.7%).[12] Life satisfaction was measured using the Pavot and Diener Satisfaction with Life Scale (SWLS).[13] [Supplementary Table 2]. Satisfaction ratings were scored on a scale of 1 (strongly disagree) to 7 (strongly agree) with standardized life satisfaction statements.

The EQ-5D-5L classification system comprises five dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each dimension has five levels, from “no problems” to “extreme problems.” In the absence of an EQ-5D-5L value set for Trinidad and Tobago, the index values were calculated using a 5L value set based on a crosswalk algorithm to map Trinidad and Tobago EQ-5D-3L values onto EQ-5D-5L states.[14,15]

| Table 1: Characteristics of the sample | n  | Percentage |
|--------------------------------------|----|------------|
| Age Group                            |    |            |
| 18-24                                | 8  | 2.1%       |
| 25-34                                | 14 | 3.7%       |
| 35-44                                | 33 | 8.8%       |
| 45-54                                | 58 | 15.5%      |
| 55-64                                | 102| 27.3%      |
| >64                                  | 159| 42.5%      |
| Sex                                  |    |            |
| Male                                 | 111| 29.7%      |
| Female                               | 250| 66.8%      |
| Ethnicity                            |    |            |
| Afro                                 | 107| 28.6%      |
| Indo                                 | 239| 63.9%      |
| Other                                | 16 | 4.3%       |
| Education                            |    |            |
| Less than Primary                    | 11 | 2.9%       |
| Primary                              | 193| 51.6%      |
| Secondary                            | 144| 38.5%      |
| Tertiary                             | 22 | 5.9%       |
| Diagnosis                            |    |            |
| Cancer                               | 134| 35.8%      |
| Kidney                               | 40 | 10.7%      |
| Diabetes                             | 172| 46.0%      |
| Heart                                | 34 | 9.1%       |
| Number of Illnesses                  |    |            |
| 0                                    | 62 | 16.6%      |
| 1                                    | 248| 66.3%      |
| 2                                    | 60 | 16.0%      |
| 3                                    | 4  | 1.1%       |
| 4                                    | 0  | 0.0%       |
Data analysis

Data were entered and stored in Microsoft Excel and analyzed using STATA version 14. We assessed change in respondent health status by comparing ceiling levels (the percentage of respondents reporting EQ-5D-5L state 11111), mean EQ-5D-5L index values, and levels of problems reported on the EQ-5D-5L dimensions with population norms \[16\] for Trinidad and Tobago. In addition, EQ-5D-5L index values were compared by age–sex sub-groups for each disease group in the study: cancer, kidney disease, diabetes, cardiac, and patients with at least one of these diagnoses and an overall mean for all the patients in the study.

Two approaches were taken to investigate the impact of psychosocial (psychological and social) variables on EQ-5D health outcomes. Six groups of psychological and social variables were created: 1 = community attachment variables, 2 = family and friends, 3 = life satisfaction (SWLS), 4 = depression symptoms, 5 = social support, 6 = lifestyle variables \[Supplemental Table 3\].

In the first approach, ordinary least squares (OLS) regression models were fitted for all Group 1 through 6 variables. We chose OLS over running models with all group variables because of high levels of within-group correlation. Patients with at least one of the four illnesses included in this study were included in these models. The regression models tested the impact of each variable selected on health outcomes captured by EQ-5D-5L index values controlling for age and sex. If the OLS model failed the Breusch–Pagan test for homoscedasticity, the models were re-run using robust standard errors. If the OLS models failed the Shapiro–Wilk test for normality of residuals, generalized linear models (GLMs) with log links and Poisson distributions were used. \[17\] Because of negative utility values, a new dependent variable, “disutility” (1–index value), was used in the GLM analyses. For all regression models, coefficients were considered statistically significant if they had \[P\] values of ≤0.05.

The second approach, canonical correlation analysis, was used to test for relationships between the five EQ-5D variables (the

| Age Group | Population Norms | Patient Groups |
|-----------|------------------|----------------|
|           | All respondents  | Cancer         | Kidney | Diabetic | Heart | Any of the four Illnesses |
| 18-24     | 84.7%            | 0.0%           | 0.0%   | 0.0%     | 0.0%  | 0.0%                       |
| 25-34     | 83.9%            | 7.1%           | 0.0%   | -        | 0.0%  | -                          |
| 35-44     | 77.2%            | 12.5%          | 8.3%   | 0.0%     | 25.0% | 100.0%                     |
| 45-54     | 66.9%            | 21.8%          | 25.0%  | 0.0%     | 30.0% | 50.0%                      |
| 55-64     | 59.0%            | 16.2%          | 8.3%   | 11.1%    | 22.9% | 10.0%                      |
| >64       | 44.4%            | 12.2%          | 2.1%   | 21.7%    | 17.1% | 14.3%                      |

| Sex       |                  |                |        |          |       |                            |
|-----------|------------------|----------------|--------|----------|------|---------------------------|
| Male      | 76.2%            | 15.0%          | 6.3%   | 26.3%    | 22.5%| 25.0%                     |
| Female    | 67.2%            | 14.0%          | 9.2%   | 7.1%     | 19.6%| 11.1%                     |

| Table 2: EQ-5D-5L ceiling effects by disease group |
|--------------------------------------------------|
| Population Norms | All respondents | Cancer | Kidney | Diabetic | Heart | Any of the four Illnesses |
|------------------|-----------------|--------|--------|----------|------|--------------------------|
| 18-24            |                 |        |        |          |      |                          |
| Male             | 0.981           | 0.973-0.989 | 0.819  | 0.819    | -    | -                        |
| Female           | 0.973           | 0.963-0.983 | 0.835  | 0.815    | -    | 0.827                    |
| 25-34            |                 |        |        |          |      |                          |
| Male             | 0.98            | 0.973-0.986 | 0.851  | 0.814    | -    | -                        |
| Female           | 0.977           | 0.969-0.984 | 0.824  | 0.751    | -    | 0.824                    |
| 35-44            |                 |        |        |          |      |                          |
| Male             | 0.97            | 0.961-0.980 | 0.885  | 0.921    | -    | -                        |
| Female           | 0.961           | 0.950-0.971 | 0.831  | 0.819    | 0.824| 0.864                    |
| 45-54            |                 |        |        |          |      |                          |
| Male             | 0.95            | 0.936-0.964 | 0.852  | 0.821    | -    | 0.905                    |
| Female           | 0.931           | 0.918-0.945 | 0.863  | 0.874    | 0.817| 0.879                    |
| 55-64            |                 |        |        |          |      |                          |
| Male             | 0.943           | 0.928-0.958 | 0.818  | 0.694    | 0.819| 0.858                    |
| Female           | 0.905           | 0.887-0.924 | 0.812  | 0.774    | 0.734| 0.858                    |
| >64              |                 |        |        |          |      |                          |
| Male             | 0.913           | 0.892-0.934 | 0.813  | 0.764    | 0.855| 0.830                    |
| Female           | 0.862           | 0.839-0.884 | 0.772  | 0.742    | 0.771| 0.778                    |

7=poorest health 1=full health

| Table 3: EQ-5D-5L Mean index values compared to population norms |
|---------------------------------------------------------------|
| Population Norms | All respondents | Cancer | Kidney | Diabetic | Heart | Any of the four Illnesses |
|------------------|-----------------|--------|--------|----------|------|--------------------------|
| 18-24            |                 |        |        |          |      |                          |
| Male             | 0.981           | 0.973-0.989 | 0.819  | 0.819    | -    | -                        |
| Female           | 0.973           | 0.963-0.983 | 0.835  | 0.815    | -    | 0.827                    |
| 25-34            |                 |        |        |          |      |                          |
| Male             | 0.98            | 0.973-0.986 | 0.851  | 0.814    | -    | -                        |
| Female           | 0.977           | 0.969-0.984 | 0.824  | 0.751    | -    | 0.824                    |
| 35-44            |                 |        |        |          |      |                          |
| Male             | 0.97            | 0.961-0.980 | 0.885  | 0.921    | -    | -                        |
| Female           | 0.961           | 0.950-0.971 | 0.831  | 0.819    | 0.824| 0.864                    |
| 45-54            |                 |        |        |          |      |                          |
| Male             | 0.95            | 0.936-0.964 | 0.852  | 0.821    | -    | 0.905                    |
| Female           | 0.931           | 0.918-0.945 | 0.863  | 0.874    | 0.817| 0.879                    |
| 55-64            |                 |        |        |          |      |                          |
| Male             | 0.943           | 0.928-0.958 | 0.818  | 0.694    | 0.819| 0.858                    |
| Female           | 0.905           | 0.887-0.924 | 0.812  | 0.774    | 0.734| 0.858                    |
| >64              |                 |        |        |          |      |                          |
| Male             | 0.913           | 0.892-0.934 | 0.813  | 0.764    | 0.855| 0.830                    |
| Female           | 0.862           | 0.839-0.884 | 0.772  | 0.742    | 0.771| 0.778                    |

0=poorest health 1=full health
levels on the five dimensions) and each of Groups 1, 2, 3, 4, and 6 of the psychological and social variables. Canonical correlation has been used with EQ-5D in other studies.\cite{18,19}

Correlation matrices were produced for each group of variables. Variables in each group were then removed to eliminate pairs with correlation coefficients of 0.7 or greater to avoid multi-collinearity while retaining the member of each pair with the lowest absolute average correlation coefficient with the rest of the group. All correlation coefficients in the correlation matrix for EQ-5D dimensions were below 0.7.

Canonical correlation analysis was then used to test the association between EQ-5D dimensions and the biopsychosocial variables at the group level. The correlation was considered at least moderate if the canonical correlation coefficient was 0.3 or higher. When at least a moderate correlation between groups was observed, we investigated the canonical correlates to determine which variables in each group had significant (p < 0.05) effects on the EQ-5D health outcomes group.

**Ethics**

This study received ethical approval from the Ethics Committee of the Southwest Regional Health Authority. All participants provided verbal consent to participate in the study.

**Results**

Participants were predominantly female (66.8%) and Indo-Trinidadian (63.9%). At least one of the four primary diagnoses was present in 312 participants in this study. Most participants (66.3%) had only one illness, while none had all four [Table 1].

**EQ-5D-5L ceiling levels**

The EQ-5D ceiling levels were much lower than population norms for Trinidad and Tobago in all patient groups [Table 2]. Among participants with cancer, males reported a lower ceiling. However, when all four illnesses were combined and all study participants were considered separately, the ceiling effects for the two sexes were almost equal but lower than the population norms [Figure 1].

All the age–sex patient groups in this study had mean index values below the lower bound of the respective 95% confidence interval from the population norms. Table 3. Participants with cancer had overall lower mean index values across all age–sex groups.

Participants in the four disease groups reported problems on all five dimensions (mobility, self-care, usual activities, pain/discomfort, and anxiety/depression) of EQ-5D-5L as lower scores than population norms indicate. The dimensions with the largest differences were usual activities and anxiety/depression.

**Biopsychosocial association with HRQOL**

**Regression models**

The OLS analyses produced models with statistically significant coefficients for 28 variables (physical, psychological, and social). However, no model passed tests for normality of residuals. Generalized linear models were then run on each of the variables. This calculation produced four variables with statistically significant coefficients. These were all Group 4 (PHQ-9), presented in Table 4. Depression issues shown in Table 4 were associated with overall HRQoL. Three other variables from Group 3 (SWLS) and the relationship with the family variable in Group 2 (family and friends) had coefficients of a similar magnitude but P values between 0.051 and 0.084.

**Canonical Correlation Analysis (CCA)/Group association with HRQoL**

The second approach, canonical correlation analysis (CCA), explored relationships between the EQ-5D dimensions and the five groups of psychosocial factors [Figure 2 and Supplemental Table 4 in Appendix].

The analysis revealed associations between Group 2 (family and friends), Group 3 (SWLS), Group 4 (PHQ-9), and Group 5 (EQ5D dimensions). Figure 2 and Supplemental Table 4 in Appendix show the standardized canonical coefficients between variables and the canonical functions that had canonical correlation coefficients of over 0.3. Each block shows the coefficients for variables that were found to be statistically significant (p < 0.05) in the respective canonical correlates that met the criterion of having a correlation coefficient of 0.3 or higher.

Thus, for Group 1 (community attachment variables), all three of the canonical functions had canonical correlation coefficients of less than 0.3, so no coefficients are reported in Appendix Supplemental Table 4 or in Figure 2.

For Group 2 (family and friends), only the first canonical function had a canonical correlation of over 0.3 (0.3678). Wilk’s Lambda was 0.889 (p = 0.0003). In the first canonical function, the EQ-5D canonical variate had two variables with statistically significant coefficients. These were all Group 4 (PHQ-9), presented in Table 4. Depression issues shown in Table 4 were associated with overall HRQoL. Three other variables from Group 3 (SWLS) and the relationship with the family variable in Group 2 (family and friends) had coefficients of a similar magnitude but P values between 0.051 and 0.084.

**Figure 1:** Ceiling effects by disease group, age, and sex

**Figure 2:** Canonical correlation analysis (CCA)/Group association with HRQoL
significant coefficients (p < 0.05). The coefficients for mobility and anxiety/depression were 0.642 and 0.741, respectively, so that an increase of one level of problem with mobility would be associated with an increase in the family and friends canonical variate of 0.642 and an increase of one level of problems with anxiety/depression would be associated with an increase in the family and friends canonical variate of 0.741 (with the level for mobility held constant). Within the friends and family canonical variate, two variables had statistically significant coefficients. Positive change in the relationship with family had a coefficient of 0.548. Having a special person with whom joys/sorrows could be shared had a coefficient of –0.327.

In Group 3 (Pavot and Diener), the first canonical function had a correlation coefficient of 0.3570, Wilk’s Lambda of 0.8418, and a P value of 0.000. In the first canonical function, the EQ-5D canonical variate had two variables with statistically significant coefficients (p < 0.05). The coefficients for self-care and anxiety/depression were 0.697 and 0.979, respectively. Both the variables in the life satisfaction canonical variate had negative coefficients with P < 0.05.

Group 4 (PHQ-9) had the highest canonical correlation coefficients. The first two canonical functions had correlation coefficients with the EQ-5D Group of 0.7631 and 0.4719, respectively. Wilk’s Lambda was 0.2900 (p = 0.000). In the EQ-5D canonical variate of the first canonical function, usual activities, pain/discomfort, and anxiety/depression all had significant (p < 0.05) coefficients, but the coefficient for the latter was much larger than those for the other two EQ-5D

Table 4: Generalized linear model (GLM) coefficients

| Last 2 weeks: Little interest or pleasure in doing things | 0.3324 | 0.1654 | 0.045 | 0.0081 | 0.6566 |
| Last 2 weeks: Feeling down, depressed, hopeless | 0.3803 | 0.1621 | 0.019 | 0.0626 | 0.6979 |
| Trouble falling or staying asleep or sleeping too much | 0.3246 | 0.1440 | 0.024 | 0.0424 | 0.6069 |
| Feeling tired or having little energy | 0.3177 | 0.1484 | 0.032 | 0.0269 | 0.6085 |
dimensions. In the PHQ-9 canonical variate, all the variables had significant coefficients except those related to appetite and feeling bad about oneself [Appendix Supplemental Table 4]. For the second canonical function, the EQ-5D canonical variate included mobility but not pain/discomfort as a variable with a significant coefficient, and for the PHQ-9 canonical variate, only three variables had significant coefficients.

**Discussion**

**General**

Our study revealed an overall poorer HRQoL (i.e., lower ceiling levels) among chronic disease patients than the general population. The mean EQ-5D-5L index values of chronic disease patients were significantly lower than corresponding age–sex values for Trinidad’s general population [Table 2]. This result has been found in other regions.[20–28] Participants in the four disease groups (cancer, IHD, diabetes mellitus, and kidney disease) reported quality of life problems with all five dimensions of EQ-5D-5L. Of the four chronic diseases studied (diabetes, IHD, cancer, and kidney disease), cancer patients had the lowest mean index values across all age–sex groups, excluding females aged 45–54 and 46–64, for which those with kidney disease had lower mean index values. Low or varying values are not unique to any sub-group,[26–28] HRQoL may also vary with the type of disease, such as heart failure[29] and the stage of the disease.[30,31] Another study on chronic diseases (mental disorder, hypertension, hypercholesterolemia, fatigue disorder, diabetes and migraines, sleeping problems, and ulcers) reported poorer HRQoL among mental disorders, followed by emphysema and asthma patients.[32] Samiei Siboni et al.[33] reported lower quality of life with asthma and chronic obstructive airway disease. A relationship has also been found between lower HRQoL and increasing numbers of chronic conditions.[4]

**Sex and age**

The lower ceiling effects (worse HRQoL) among females is consistent with Trinidad and Tobago population norms and other study findings.[34] We also found the increasing age of participants to be associated with poorer HRQoL. These findings were corroborated by Arrospide et al.,[4] who found that older women, obese people, and lower socioeconomic status (SES) individuals had poorer QOL. According to Tan et al.,[21] male gender, higher level of education, being employed, younger age, urban residence, access to free medical service, and higher levels of physical activity were associated with higher EuroQol-visual analog scale (EQ-VAS) scores. Zyoud et al.[35] also found that older age, being unemployed, and number of co-morbid diseases were significantly associated with HRQoL.

**Association of depressive symptoms and HRQoL**

Among participant groups in this study, depressive symptoms (indicating a mental disorder) were associated with the lowest HRQoL as found in other research.[32] These findings were corroborated by those of Gallegos–Carrillo et al.[34] and Gaynes et al.,[37] who found lower HRQoL scores accompanying depressive symptoms. The symptom impact increased when chronic diseases were also present. Other studies report that the lack of social support,[39] economic support,[38] or co-morbid clinical depression[40] is associated with poor QOL. In Trinidad and Tobago, treatment optimization by improving social support, financial assistance, pain and depression management, and rehabilitation to increase usual activities (traveling, leisure, sports, and employment-related problems) has been inadequate.[41]

**Group associations with HRQoL**

There were no significant associations with community attachment variables nor social support and HRQoL [Appendix Supplemental Table 4]. This finding is noteworthy because the opposite was demonstrated in a different study with older adults.[42] However, Group 2 (family and friends) variables demonstrated significant correlation with HRQoL (p < .005). A positive effect on family relationships was associated with improved health (particularly involving mobility and anxiety/depression).[29] Our findings contrast with Sarla et al.,[35] who suggested that social support was associated with HRQoL. Although family and social support may provide a greater chance for better HRQoL, changing times and socio-cultural values may have forced people to be more independent and rely less on family support.

Life satisfaction (Group 3) was associated with improved HRQoL, particularly in self-care and anxiety/depression. In particular, significant correlations were obtained for two questions (“The conditions of my life are excellent” and “If I could live my life over, I would change almost nothing”). Older people who feel good about their health tend to be more satisfied with their lives in general.[43] Our findings on life satisfaction corroborate those of Zyoud et al.,[35] who found that life satisfaction was associated with better HRQoL.

In the first canonical correlate, the association of depressive feelings with worse HRQoL significantly affected EQ-5D dimensions of usual activities, pain/discomfort, and anxiety/depression. This finding aligns with a longitudinal study by Liu et al.,[44] who reported a similar association in adult patients with diabetes mellitus. Depressive symptoms interfere with a person’s mood and activities.[46] In addition, increased physical activity is associated with decreased depressive symptoms.[47]

**Conclusion**

This study highlights the strong association of lifestyles and social and psychological conditions of chronic disease patients and HRQoL. HRQoL is lower among chronic disease patients than in the general population. Females and the elderly tend to have lower HRQoL. HRQoL varies with the type of chronic disease, with cancer patients having worse HRQoL. Regardless of the chronic illness, depressed patients experience poorer HRQoL in all EQ5D quality of life domains. Higher life satisfaction and adequate exercise were associated with higher HRQoL. However, positive family relationships did not lead to better HRQoL.
Limitations
This study is not without limitations. The convenience sample used was relatively small. Information collected on depressive symptoms and satisfaction with life is subjective. For specific questions, recalled information may not have been accurate. In this study, because of the nature of the clinic, resource, and time constraints, mainly cancer, kidney disease, diabetes, cardiac, and chronic diseases were included. The wide variation in disease states may have led to wide variations in HRQoL and may have affected the HRQoL of sub-groups. This limitation can be avoided by stratified sampling with larger samples for sub-groups.

List of abbreviations
IHD: Ischemic heart disease
EQ-5D-5L: European Quality of Life Five Dimension
HRQoL: Health-related quality of life.
PHQ-9: Patient health questionnaire.

Ethics approval and consent to participate
This study received ethical approval from the Ethics Committee of South–West Regional Health Authority. All participants gave verbal consent to participate in the study.

Availability of data and material
The data that support the findings of this study are available from the corresponding author on request.

Author’s contributions
MB conceptualized, designed, conducted, and reviewed the study and wrote and revised the manuscript.

HB performed statistical analysis, reviewed, edited, and revised manuscript.

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Conflicts of interest
There are no conflicts of interest.

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### Appendix

#### Supplementary Table 1: PHQ-9 depression questions

| PHQ-9 depression questions |
|----------------------------|
| Little interest or pleasure in doing things |
| Feeling down, depressed, or hopeless |
| Trouble falling or staying asleep or sleeping too much |
| Feeling tired or having little energy |
| Poor appetite or overeating |
| Feeling bad about yourself—or that you are a failure or have let yourself or your family down |
| Trouble concentrating on things, such as reading the newspaper or watching television |
| Moving or speaking so slowly that other people could have noticed? Or the opposite—being so fidgety or restless that you have been moving around a lot more than usual |
| Thoughts that you would be better off dead or of hurting yourself in some way |

#### Supplementary Table 2: Satisfication with life scale by Pavot and Diener (SWLS)\(^9\) questions

| SWLS questions |
|----------------|
| In most ways, my life is close to my ideal. |
| The conditions of my life are excellent. |
| I am satisfied with my life. |
| So far, I have gotten the important things I want in life. |
| If I could live my life over, I would change almost nothing. |
### Supplementary Table 3: Characteristics of each group

| Groups | Group characteristics |
|--------|------------------------|
| Group 1 (community attachment variables) | 1Social challenges with respect to physical involvement in your community (gym membership, community sporting events)?  
Reduction in social activities after illness as a result of others (alienation by family, friends, and peers)?  
* 1Experienced a positive change in your sense of duty toward the society (aid and support of others in similar situations)?  
Have your cultural or religious practices been affected as a result of your illness? (dropped)  
† 1Have you become more religious and prayerful (praying or church/temple/mosque going)?  
* 1Has your relationship with your family been positively affected?  
Has the support from your family improved?  
There is a special person who is around when I am in need  
There is a special person with whom I can share my joys and sorrows  
My family really tries to help me  
† 1I get the emotional help and support I need from my family  
I have a special person who is a real source of comfort to me  
My friends really try to help me  
I can count on my friends when things go wrong  
I can talk about my problems with my family  
I have friends with whom I can share my joys and sorrows  
* 1There is a special person in my life who cares about my feelings  
My family is willing to help me make decisions  
† 1I can talk about my problems with my friends |
| Group 2 (family and friends) | 1In most ways, my life is close to my ideal  
* 1The conditions of my life are excellent  
* 1I am satisfied with my life  
So far, I have gotten the important things I want in life  
† 1If I could live my life over, I would change almost nothing |
| Group 3 (Satisfaction with Life Scale) | 1Last 2 weeks: Little interest or pleasure in doing things  
1Last 2 weeks: Feeling down, depressed, hopeless  
† 1Trouble falling or staying asleep or sleeping too much  
† 1Feeling tired or having little energy  
† 1Poor appetite or overeating  
† 1Feeling bad about yourself or that you are a failure or have let yourself or your family down  
† 1Trouble concentrating on things, such as reading the newspaper or watching television  
† 1Moving or speaking so slowly that other people could have noticed? Or the opposite—being so fidgety or restless that you have been moving around a lot more than usual  
* 1Thoughts that you would be better off dead or of hurting yourself in some way |
| Group 4 (PHQ-9) | *Oneself  
Spouse  
Children  
Friend  
Other (dropped from analysis) |
| Group 5 (social support) | 1Current smoking  
* 1History of obesity  
† 1Eat vegetables and fruits daily  
† 1Exercise 3x per week for 20 minutes or more  
† 1Consumes alcohol |
| Group 6 (lifestyle variables) | Variables indicated with asterisks (*) were investigated using regression methods, whereas those indicated with crosses (†) were investigated using canonical correlation analysis |
### Supplementary Table 4: Canonical correlation results

| Group and Canonical Correlation Coefficient | Variable (abbreviated for some questions) | Higher value of variable indicates | Coefficient | S.E. | P | 95% confidence interval |
|---------------------------------------------|------------------------------------------|-----------------------------------|-------------|-----|---|------------------------|
| Group 2. 0.3678                             | Mobility                                  | Higher level                      | 0.642       | 0.227 | 0.016 | 1.087                  |
|                                             | Anxiety/Depression                        | Higher level                      | 0.741       | 0.161 | 0.005 | 1.057                  |
|                                             | Has your relationship with the family been positively affected? | Disagreement                      | 0.548       | 0.126 | 0.000 | 0.300                  |
|                                             | There is a special person with whom I share joys/sorrows. | Agreement                      | -0.327      | 0.081 | -0.487 | -0.167                 |
|                                             | Self-Care                                 | Higher level                      | 0.697       | 0.291 | 0.017 | 0.125                  |
|                                             | The conditions of my life are excellent.  | Agreement                      | -0.145      | 0.049 | 0.003 | -0.242                  |
|                                             | If I could live my life over, I would change almost nothing. | Agreement                      | -0.331      | 0.081 | 0.000 | -0.491                  |
| Group 3. 0.3570                             | Mobility                                  | Higher level                      | 0.697       | 0.291 | 0.017 | 0.125                  |
|                                             | Anxiety/Depression                        | Higher level                      | 0.741       | 0.161 | 0.000 | 0.300                  |
|                                             | Has your relationship with the family been positively affected? | Disagreement                      | 0.548       | 0.126 | 0.000 | 0.300                  |
|                                             | There is a special person with whom I share joys/sorrows. | Agreement                      | -0.327      | 0.081 | -0.487 | -0.167                 |
|                                             | Self-Care                                 | Higher level                      | 0.697       | 0.291 | 0.017 | 0.125                  |
|                                             | The conditions of my life are excellent.  | Agreement                      | -0.145      | 0.049 | 0.003 | -0.242                  |
|                                             | If I could live my life over, I would change almost nothing. | Agreement                      | -0.331      | 0.081 | 0.000 | -0.491                  |
| Group 4. First canonical correlates, 0.7631 | Unusual Activities                       | Higher level                      | 0.175       | 0.079 | 0.028 | 0.019                  |
|                                             | Pain/Discomfort                           | Higher level                      | 0.155       | 0.068 | 0.024 | 0.021                  |
|                                             | Anxiety/Depression                        | Higher level                      | 0.883       | 0.058 | 0.000 | 0.769                  |
|                                             | Last 2 weeks: Little interest in doing    | Agreement                      | 0.162       | 0.079 | 0.041 | 0.006                  |
|                                             | Last 2 weeks: Feeling down, depressed, and hopeless | Agreement                      | 0.568       | 0.085 | 0.000 | 0.401                  |
|                                             | Trouble falling or staying asleep or sleeping too much | Agreement                      | 0.272       | 0.064 | 0.000 | 0.147                  |
|                                             | Feeling tired or having little energy     | Agreement                      | 0.136       | 0.062 | 0.028 | 0.015                  |
|                                             | Trouble concentration on things such as newspaper or TV | Agreement                      | 0.194       | 0.074 | 0.009 | 0.048                  |
|                                             | Moving or speaking so slowly or opposite (fidgeting) | Agreement                      | 0.430       | 0.092 | 0.000 | 0.249                  |
|                                             | Thoughts that you would be better off dead | Agreement                      | 0.442       | 0.146 | 0.003 | 0.156                  |
| Group 4. Second canonical correlates, 0.4719| Mobility                                  | Higher level                      | 0.509       | 0.177 | 0.004 | 0.161                  |
|                                             | Unusual Activities                       | Higher level                      | 0.612       | 0.175 | 0.001 | 0.268                  |
|                                             | Anxiety/Depression                        | Higher level                      | -0.771      | 0.128 | 0.000 | -1.023                 |
|                                             | Last 2 weeks: Feeling down, depressed, and hopeless | Agreement                      | -0.627      | 0.187 | 0.001 | -0.995                 |
|                                             | Feeling tired or having little energy     | Agreement                      | 0.786       | 0.136 | 0.000 | 0.518                  |
|                                             | Feeling bad about self                    | Agreement                      | -0.870      | 0.171 | 0.000 | -1.206                 |

Key: Group 2=Friends and family variables; Group 3=Satisfaction with Life Scale variables; Group 4=Depression (PHQ-9) variables. Note: Each block in Table 3 shows the coefficients for variables that were found to be statistically significant (P<0.05) in the respective canonical correlates that met the criterion of having a correlation coefficient of 0.3 or higher.