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Health-related quality of life and healthcare utilization in multimorbidity: results of a cross-sectional survey

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Abstract
Purpose We assessed the associations between multimorbidity and health-related quality of life (HRQL), and healthcare utilization, based on 16 common self-reported chronic conditions.
Methods A cross-sectional questionnaire survey including the EQ-5D was conducted in a sample of the general population of adults (≥18 years) living in Alberta, Canada. Multiple linear and logistic regressions were used to assess the association between multiple chronic conditions and HRQL, hospitalization and emergency department (ED) use.
Results A total of 4,946 respondents reported their HRQL, noting problems mostly with pain or discomfort (48.0 %). All chronic conditions were associated with a clinically important reduction in HRQL, the highest burden with anxiety or depression (−0.19, 95 % CI −0.21, −0.16) and chronic pain (−0.19, 95 % CI −0.21, −0.17). Multimorbidity was associated with a clinically important reduction in the EQ-5D index score (−0.12, 95 % CI −0.14, −0.11) and twice the likelihood of being hospitalized (OR = 2.2, 95 % CI 1.7, 2.9) or having an ED visit (OR = 1.8, 95 % CI 1.4, 2.2).
Conclusions Pain or discomfort is a common problem in people living with chronic conditions, and the existence of multimorbidity in these individuals is associated with a reduction in the HRQL as well as frequent hospitalization and emergency department visits.

Keywords Chronic conditions · Multimorbidity · Quality of life · Hospitalization

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Introduction

Technological advancement, in concert with improved medical care and public health policy, has increased the proportion of patients who survive chronic medical conditions that, otherwise, would be fatal. This, in parallel with aging of the population, has led to the unintended increase in the number of individuals who present with co-existing chronic conditions, known as multimorbidity [1]. Multimorbidity has been linked with adverse health outcomes such as more frequent and longer hospitalizations, higher healthcare costs, readmissions, reduced quality of life and mortality [1–3]. Although multimorbidity is increasingly prevalent in younger populations [4], research has been primarily centered in the elderly population [5–7], suggesting that it is a condition of the elderly.

Quality of life (QOL) is a construct of people's well-being related to their culture and environment in relation to the value systems [8]. The relationship between multimorbidity and measures of QOL has been previously investigated [7, 9–12]. In a systematic review of 7 studies [1], the authors found evidence to support an inverse association between multimorbidity and QOL. Most of the studies were patient-based or restricted to the elderly patients. Still, later studies [11, 12] have focused on patients in primary care.

Apart from measuring QOL, health-related quality of life (HRQL) is increasingly considered as a measure of health status in public health research. HRQL is a more specific subjective construct based on people's assessment of their health-related well-being. Although different authors have suggested the inclusion of varied specific dimensions in its definition, Revicki [13] defined HRQL as a "*multi-dimensional concept that encompasses the physical, emotional, and social components associated with an illness or treatment.*" HRQL has been used as a health indicator in health surveys and in assessing effectiveness of medical interventions. Instruments for measuring HRQL could be disease-specific or generic types. Generic instruments (e.g. the EQ-5D) are important in comparing HRQL between populations or among patients with different conditions [14] that might be vital for healthcare planning and resource allocation.

The effect of co-existing chronic conditions on HRQL has been assessed in disease-specific groups [15–18]. Research on the effect of multimorbidity on HRQL in the general population is sparse. A recent population-based study [19] included only participants aged 65 years and above, and the definition of multimorbidity was based on only eight chronic conditions. More studies that incorporate a wider spectrum of chronic conditions in a cross-section of the general population are warranted.

The purpose of this study was firstly to determine the influence of particularly chronic conditions on HRQL and secondly to determine the relationship between multimorbidity and HRQL in a general adult population sample. We also studied the association between multimorbidity and healthcare utilization. Compared to previous studies, our study adds differential findings on cumulative effects by number of chronic conditions (including multimorbidity) and on specific effects of a wide spectrum of 16 different conditions.

Methods

Study setting and population

The study is based on data from the Health Quality Council of Alberta (HQCA) 2010 Patient Experience Survey [20]. This is a cross-sectional survey that evaluated a sample of adult Albertans aged 18 years or older, representative of the general adult population, on their experiences and satisfaction with the quality of health services they receive in the past year (12 months). The survey was a telephone-based questionnaire, administered by Random-Digit Dialing (RDD). The sampling design oversampled households from smaller health regions. Sampling weights were applied at the analysis to adjust for oversampling.

Chronic conditions and socio-demographic factors

Respondents were asked about their health status in the past 12 months, including if they had "any of the following chronic conditions": diabetes, chronic obstructive pulmonary disorder, asthma, hypertension, high cholesterol, sleep apnea, congestive heart failure, obesity, depression or anxiety, chronic pain, arthritis, heart disease, stroke (or related) and cancer. Apart from these 14 chronic conditions, respondents also reported any other chronic conditions not listed. Analysis of the open-ended item yielded two additional chronic conditions, diseases of the gastrointestinal tract and kidney diseases. This study, therefore, captured 16 chronic conditions.

Apart from their disease status, respondents also gave information on their age, sex, educational attainment, household income, and on the number of children and adults living in the same household.

Outcome variables

The outcomes of interest in this study were HRQL and healthcare utilization. HRQL was measured using the EQ-5D, a self-reported multi-attribute health utility instrument for describing and valuing health states. It has five dimensions (mobility, self-care, usual activity, pain/discomfort and anxiety/depression) with three levels on each dimension and has been previously validated in the study population [21]. The EQ-5D produces an index score that represents the utility of a given health state. The EQ-5D also records respondents' perception of overall health on a visual analogue scale (EQ-VAS). The EQ-VAS scores range from 0, the worst imaginable health state, to 100, the best imaginable health state.

Since the EQ-5D index is a weighted summary score of five items representing different dimensions of health, changes in the EQ-5D index score may arise from different patterns of impairments across these individual dimensions. To examine how the selected chronic conditions affected the EQ-5D health dimensions, we merged the categories "moderate problems" and "severe problems" into one category to form a dichotomous dependent variable with "no problem"/"any problem" on the measured dimension.

Our HRQL outcomes therefore included the following:

1. The frequency of reported "any problems" in each of the EQ-5D dimensions.
2. The EQ-5D index scores derived using US national scoring algorithms [22]. That is, the scores are based on US general population-based preference weights, ranging from −0.11 to 1.00. A difference of 0.03 (3 %) was considered to be clinically important [23].

3. The EQ-VAS scores.

Respondents were also asked whether they had received care as an overnight patient in an Alberta hospital, and the number of times they had gone to an ED in Alberta to receive care for an illness or injury during the previous year. For this analysis, healthcare utilization was measured by the dichotomous variables, hospitalization and ED visits (Yes/No).

Statistical methods

Descriptive statistics were calculated for the health status and socio-demographic characteristics of respondents. Shapiro–Wilk test for normality showed that the EQ-5D index and EQ-VAS scores were not normally distributed. Thus, proportions and medians (range) were calculated with 95 % confidence intervals. We tested for differences between proportions and across socioeconomic characteristics using the chi-square (χ^2) test, Mann–Whitney test and Kruskal–Wallis test. The relationship between chronic diseases and the odds of having a problem in any of the dimensions of the EQ-5D was examined by logistic regression. A similar model was fitted to examine the relationship between multimorbidity and problems in EQ-5D dimensions. Multiple linear regression analyses were used to determine the effect of chronic conditions and cumulative morbidity status (including multimorbidity) on the EQ-5D index score. Logistic regression models were used to test for associations between morbidity status and two healthcare utilization outcomes: hospitalization and ED visits. Analyses were adjusted for age, sex, household income, educational level and family structure. A P value < 0.05 was considered statistically significant, and no adjustment was done for multiple comparisons [24]. All analyses were performed using Stata version 11 (StataCorp LP. 2009). The Health Research Ethics Board (HREB) at the University of Alberta approved the data collection protocols and survey instruments.

Table 1 Sample characteristics of the EQ-5D questionnaire respondents

Characteristic	*N* (4,946)	%
Mean age (SD), years	46.6 (16.5)	
Sex		
Females	2,361	47.7
Males	2,585	52.3
Education		
≥High school or less	2,336	47.2
College	1,419	28.7
University	1,191	24.1
Household income (CAD)		
<30,000	579	13.5
30,000–59,999	1,019	23.8
60,000–99,999	1,230	28.7
≥100,000	1,454	34.0
Hospitalization		
No	4,343	88.0
Yes	592	12.0
ED visits		
No	3,513	71.4
Yes	1,408	28.6
Family structure		
Living with children		
No	1,770	35.8
Yes	3,172	64.2
Living with adults		
No	3,843	77.7
Yes	1,103	22.3
EQ-5D index (Mean, SD)	0.87 (0.15)	
Morbidity status		
0	3,271	66.5
1	732	14.9
2	374	7.6
3	213	4.3
4	145	3.0
5 or more	187	3.8

Results

The overall response rate for the Health Quality Council of Alberta (HQCA) 2010 Patient Experience Survey was 38 %, providing a total of 5010 respondents [20], of whom 4946 (98.7 %) gave complete data on their health status. After applying the sampling weights, the respondent sample represented the demographic characteristics of the adult Alberta population [20]; 52.3 % were male, and the mean (SD) age was 46.6 (16.5) years (Table 1). Among the respondents, 3271 (66.5 %) did not have any of the selected chronic conditions, 732 (14.9 %) had one, 374 (7.6 %) had two, 213 (4.3 %) had three, 145 (3.0 %) had four, and 187 (3.8 %) had five or more (Table 1).

The proportion of participants reporting a problem (moderate or extreme problem) in each of the five EQ-5D dimensions is illustrated in Table 2. The median response was "no problem" in all dimensions. Problems in the pain/discomfort dimension were most frequently reported (48.0 %), and problems with self-care were the least frequently reported (3.5 %). Older respondents reported a significantly greater prevalence of problems (moderate or extreme) on all dimensions, except for anxiety/depression (Table 3). The proportion of females reporting problems in

Table 2 Distribution of responses in different EQ-5D dimensions in the general population

Dimension	Level[a]	*N* (%)
Mobility	1	4,038 (82.9)
	2	890 (16.7)
	3	18 (0.4)
Self-care	1	4,773 (96.7)
	2	165 (3.1)
	3	8 (0.2)
Usual activity	1	4,071 (82.8)
	2	815 (15.8)
	3	60 (1.4)
Pain/discomfort	1	2,571 (53.3)
	2	2,198 (43.4)
	3	177 (3.4)
Anxiety/depression	1	3,799 (77.1)
	2	1,051 (20.9)
	3	96 (1.9)

[a] Levels definition (*1* no problem, *2* some/moderate problem and *3* extreme problem). Population sampling weights are applied

the anxiety/depression and usual activity dimensions was significantly greater than in males (Table 3).

Chronic conditions and HRQL

Figure 1 illustrates the percentage of respondents reporting any problems on each EQ-5D dimensions for the selected chronic conditions. Respondents having congestive heart failure reported the most problems (moderate or extreme) in three of the EQ-5D dimensions: mobility, self-care and usual activity. Table 4 compares the odds of reporting any problem (moderate or extreme) in the EQ-5D dimensions (adjusted for age, sex, income and educational level) for respondents by chronic conditions with the reference group (not having the selected chronic condition).

Overall, the presence of a chronic condition was associated with statistically significant increases in the odds of reporting any problem in at least one of the dimensions (Table 4). As expected, the odds of reporting any problem in the dimension of anxiety/depression were highest among respondents with depression or anxiety (OR = 48.5, 95 % CI 28.9, 81.3). Similar findings were observed for participants with chronic pain in the pain/discomfort dimension (OR = 25.1, 95 % CI 15.0, 42.0).

In the multivariate linear regression models, all other chronic conditions, except for a history of kidney disease, were associated with clinically important reduction in the EQ-5D index score (Table 5). The greatest reduction was observed in participants who reported having anxiety or depression (−0.19, 95 % CI −0.21, −0.16) or chronic pain (−0.19, 95 % CI −0.21, −0.17).

Multimorbidity and HRQL

Compared to respondents not reporting any chronic conditions, having at least one of the conditions was associated with a significant reduction in the EQ-5D index score (Table 6). Multimorbidity (defined as 2 or more chronic conditions) was associated with a significant reduction in the EQ-5D index score (−0.12, 95 % CI −0.14, −0.11). The highest reduction was observed in respondents reporting five or more chronic conditions (−0.21, 95 % CI −0.25, −0.17).

Compared to respondents not having any chronic conditions, having morbidity was associated with increased odds of hospitalization and ED visits. Having multimorbidity also tended to double the odds of hospitalization (OR = 2.2, 95 % CI 1.7, 2.9) and having an ED visit (OR = 1.8, 95 % CI 1.4, 2.2), compared to those without multimorbidity. Respondents reporting five or more chronic conditions had the highest odds of hospitalization (OR = 3.2, 95 % CI 1.9, 5.3) and having an ED visit (OR = 2.5, 95 % CI 1.6, 3.9).

Discussion

In this population-based study, we found that chronic pain is commonly reported in the general adult population and that having a chronic condition, including obesity and high cholesterol, is associated with a clinically important reduction in HRQL. We also observed that individuals with multimorbidity have twice the likelihood of being hospitalization, or having an emergency department (ED) visit.

This is, to our knowledge, the largest population-based study to evaluate the association between multimorbidity, including a range of common chronic conditions such as obesity and high cholesterol, and HRQL as well as its association with health utilization. Previous studies on multimorbidity and HRQL have been largely limited to the elderly or to specific patient populations [10, 11, 19, 25]. Our study included a cross-section of adults in the general population, potentially boosting the external validity of our findings. Moreover, the HRQL was measured using the EQ-5D, a generic measure of HRQL that is applicable to a wide range of health conditions. The EQ-5D has a good construct validity as a measure of HRQL and is simpler and briefer than many other HRQL measures [21]. In our study, virtually all individuals with anxiety or depression and chronic pain noted having a problem in the anxiety/depression and pain/discomfort dimensions of the EQ-5D, confirming the construct validity for the measure.

Older respondents reported a greater proportion of problems in all dimensions, except in depression or anxiety, a finding that has been previously reported in Canadian

Table 3 Responses to EQ-5D by demographic characteristics

Variable	% Responding with a problem (moderate and extreme problems combined)							
	N	Mobility[a]	Self- care[a]	Usual activity[a]	Pain/discomfort[a]	Anxiety/ depression[a]	EQ-5D VAS median (range)	EQ-5D index median (range)
Age group								
18–24	455	8.3	0.9	10.4	32.9	22.8	85 (90)	1.00 (0.83)
25–44	1,931	9.7	2.3	11.0	39.2	22.5	80 (98)	0.84 (1.04)
45–64	1,833	20.7	4.0	22.6	55.4	24.1	80 (100)	0.83 (0.91)
65+	771	37.1***	7.0***	27.5***	60.9***	20.9	80 (100)[b]***	0.83 (0.87)[b]***
Gender								
Males	2,382	15.6	2.9	15.3	44.0	19.8	80 (100)	0.84 (0.92)
Females	2,598	18.5	3.8	19.0**	49.8***	25.9***	80 (100)[c]*	0.83 (1.04)[c]**
Education								
High school or less	2,353	20.9	4.2	21.1	51.8	24.7	80 (100)	0.83 (1.02)
College	1,420	14.5	3.3	15.9	47.1	22.7	80 (99)	0.84 (1.03)
University	1,207	13.5***	2.3*	12.6***	39.1***	20.1*	80 (100)[b]***	1.00 (1.02)***
Income								
<30,000	590	36.3	10.5	36.3	61.0	38.8	75 (100)	0.83 (1.02)
30,000–59,999	1,022	20.6	3.5	18.1	50.4	25.8	80 (99)	0.83 (1.02)
60,000–99,999	1,235	14.6	1.7	14.6	47.7	22.7	80 (99)	0.83 (0.92)
≥100,000	1,462	7.7***	0.7***	9.9***	38.0***	17.2***	81 (98)[b]***	1.00 (0.87)[b]***
Morbidity status								
0	3,271	9.1	1.4	8.4	35.9	17.7	85 (100)	1.00 (1.04)
1	732	21.7	4.6	25.0	58.5	25.9	78 (98)	0.83 (1.02)
2	374	38.1	7.6	36.9	74.0	33.0	75 (100)	0.81 (0.87)
3	213	38.4	4.7	40.7	82.0	45.1	75 (90)	0.80 (0.91)
4	145	40.9	13.7	48.2	82.7	39.6	70 (98)	0.80 (0.87)
≥5	187	69.1***	18.6***	63.4***	88.0***	50.8***	60 (95)[b]***	0.77 (0.83)[b]***

Range for the EQ-5D index score could be more than 1.00, because the possible index scores range from −0.11 to 1.00 (based on the US general population-based preference weights)

[a] Chi-square statistic, [b] Kruskal–Wallis test, [c] Mann–Whitney test

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$ by chi-square for difference in the proportion of respondents responding any problem (moderate or extreme problem) across variables

[21] and German [10] study populations. HRQL is a subjective measure, largely depending on an individual's life expectations [26]. Persons having chronic conditions for a long period of time may alter their expectations, resulting in changes in their internal standards, values and conceptualization of HRQL, referred to as "*response shift*" [27, 28]. This phenomenon may explain the lack of difference observed in the measurement of psychiatric health (anxiety/depression) among older populations.

Overall, respondents with each chronic condition, as well as those with increasing morbidity status, reported lower HRQL. Notably, obesity and high cholesterol, which may be considered disease risk factors, were associated with clinically important reductions in HRQL. In another study, the relationship between body mass index and HRQL was found to be U-shaped [19]. These findings highlight the importance of including conditions such as high cholesterol and obesity in studies on HRQL and multimorbidity.

In one study based on the elderly [19], the authors observed reductions in HRQL due to occurrence of chronic conditions, as well as synergistic effects of different chronic conditions on HRQL. The study was limited to only six chronic conditions, however, and did not include a psychiatric condition. Psychiatric morbidities are independent predictors of the HRQL in people with multimorbidity [29–31], and a strong case for their inclusion in multimorbidity research has been made [1]. Anxiety or depression was included in the list of chronic conditions in our study. However, the measurement of psychiatric conditions in subsequent studies should be based on standardized scales [32].

Our study showed that persons with multimorbidity were twice as likely to be hospitalized or visit an emergency department compared to persons without

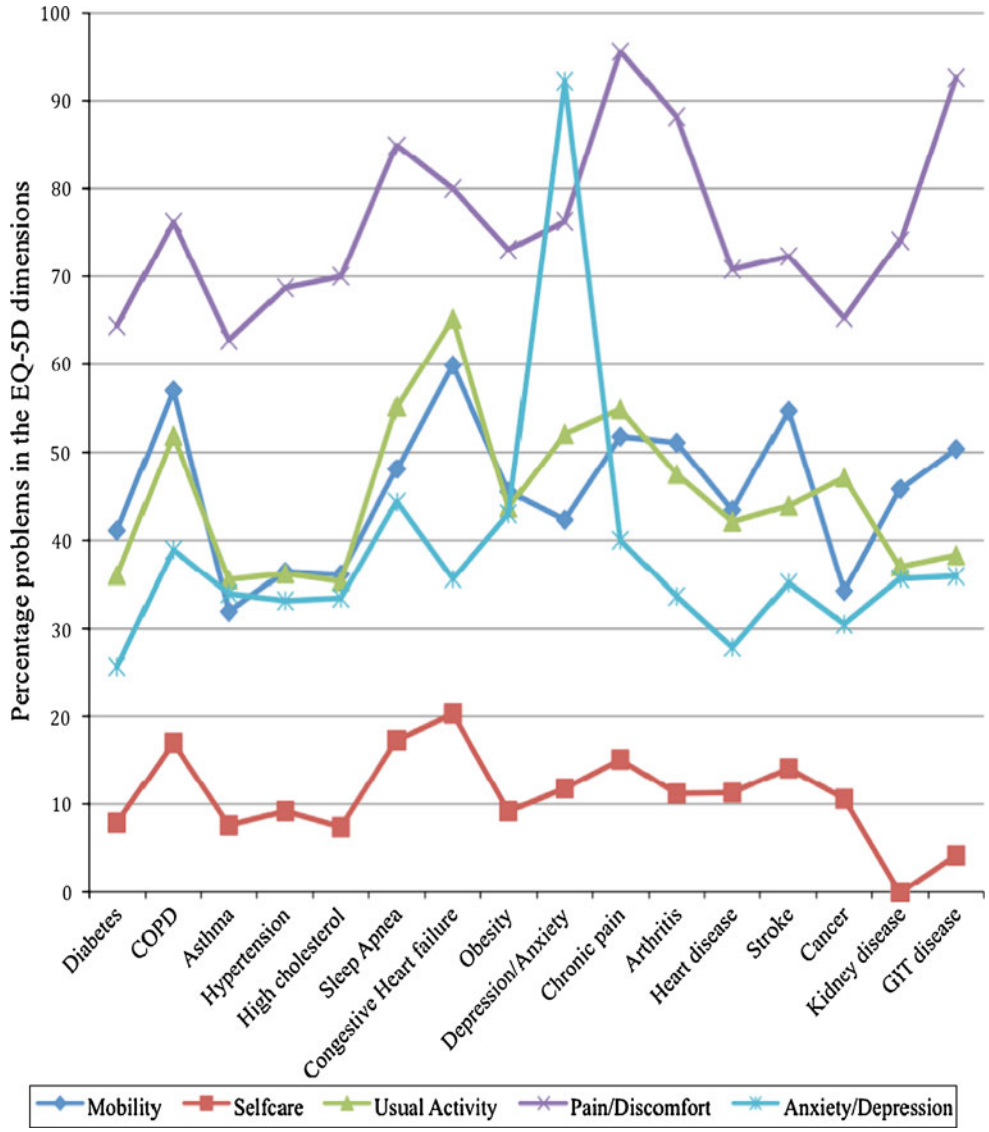

Fig. 1 Percentage respondents reporting problems (moderate or extreme) in the EQ-5D dimensions by chronic conditions (population sampling weights are applied)

multimorbidity, an observation that has been reported in other studies [33, 34]. Multimorbidity is associated with increased likelihood of referrals [35], increasing costs of care and preventable hospitalization in patient populations [33]. To further understand the impact of multimorbidity on the balance of use of healthcare resources, more research is needed that takes into account the severity of the chronic conditions and length of stay. This will, potentially, provide evidence necessary to formulate recommendations for optimal disease management programs to achieve reduced hospitalization among people with multimorbidity.

The strength of our study lies on the large sample size and the population representativeness of the study sample. HRQL is a subjective measure, and results obtained using primary care study populations will not reflect that of the general population. A limitation of our study is that chronic condition status was based on self-reports. Chronic conditions can be especially subtle, making it possible for patients to confuse symptoms or minor ailments with more severe disease states. However, studies evaluating the associations between HRQL and multimorbidity are largely based on self-reported data [19, 36, 37]. Our study included most of the common widespread chronic conditions. Another limitation is that we did not account for the severity of the disease nor the time since diagnosis. In an earlier Canadian study, the authors assessed disease severity using the Cumulative Illness Rating Scale (CIRS) [11] and observed strong associations of HRQL with multimorbidity.

In conclusion, this general adult population-based study shows that pain and discomfort are important problems in people living with chronic conditions in Alberta and that multimorbidity in these individuals is associated with

Table 4 The likelihood of reporting any problem (moderate and extreme problems combined) in the dimensions of the EQ-5D by chronic conditions

Chronic conditions	*N*	Mobility OR (95 % CI)	Self-care OR (95 % CI)	Usual activity OR (95 % CI)	Pain/discomfort OR (95 % CI)	Anxiety/ depression OR (95 % CI)	EQ-5D VAS median (range)	EQ-5D index median (Range)
Diabetes	287	2.5 (1.8, 3.6)	2.0 (1.0, 3.8)	2.0 (1.4, 2.9)	1.6 (1.2, 2.3)	1.1 (0.8, 1.6)	70.0 (100)	0.82 (1.02)
Chronic obstructive pulmonary disorder	70	3.0 (1.5, 6.1)	2.8 (1.2, 6.7)	3.0 (1.5, 5.8)	2.0 (1.0, 3.9)	1.7 (0.9, 3.2)	72.5 (98)	0.81 (0.83)
Asthma	254	2.2 (1.5, 3.1)	2.5 (1.4, 4.6)	2.6 (1.6, 3.7)	1.8 (1.3, 2.6)	1.6 (1.1, 2.2)	75.0 (98)	0.81 (1.02)
High blood pressure	553	2.1 (1.6, 2.8)	2.5 (1.5, 4.1)	2.2 (1.6, 2.9)	1.9 (1.5, 2.5)	1.8 (1.4, 2.4)	75.0 (100)	0.82 (0.86)
High cholesterol	354	2.1 (1.5, 3.0)	1.9 (1.0, 3.3)	2.2 (1.6, 3.0)	2.1 (1.5, 2.8)	1.7 (1.3, 2.3)	75 (100)	0.81 (0.80)
Sleep apnea	178	3.3 (2.1, 5.2)	4.5 (2.5, 8.4)	5.2 (3.4, 8.1)	4.6 (2.6, 7.9)	2.8 (1.9, 4.0)	68 (99)	0.78 (0.83)
Congestive heart failure	41	3.0 (1.3, 6.9)	5.0 (1.8, 13.5)	5.0 (2.3, 10.5)	1.9 (0.8, 4.9)	2.5 (1.1, 5.6)	50 (84)	0.78 (0.83)
Obesity	207	3.7 (2.5, 5.5)	2.9 (1.6, 5.4)	3.5 (2.4, 5.2)	2.4 (1.6, 3.6)	2.5 (1.7, 3.6)	66.5 (93)	0.80 (0.80)
Depression or anxiety	331	3.2 (2.3, 4.3)	3.4 (2.1, 5.5)	4.9 (3.6, 6.6)	3.2 (2.3, 4.5)	48.5 (28.9, 81.3)	70 (99)	0.77 (0.91)
Chronic pain	559	7.1 (5.4, 9.2)	7.2 (4.5, 11.2)	7.9 (6.1, 10.2)	25.1 (15.0, 42.0)	2.4 (1.9, 3.1)	70 (100)	0.78 (0.92)
Arthritis	657	4.5 (3.5, 5.9)	2.6 (1.7, 4.2)	4.1 (3.2, 5.4)	7.1 (5.1, 9.8)	1.7 (1.3, 2.1)	75 (100)	0.80 (0.91)
Heart disease	182	2.1 (1.4, 3.3)	2.8 (1.4, 5.6)	2.0 (1.3, 3.0)	1.6 (1.0, 2.5)	1.2 (0.7, 1.9)	70 (100)	0.81 (0.79)
Stroke (or related)	53	3.5 (1.5, 8.0)	2.6 (0.9, 7.6)	2.4 (1.2, 5.1)	1.8 (0.7, 4.3)	1.5 (0.7, 3.2)	65 (99)	0.80 (0.80)
Cancer	96	1.5 (0.8, 2.9)	2.0 (0.8, 5.4)	3.5 (1.9, 6.3)	1.6 (0.9, 3.0)	1.6 (0.9, 2.9)	75 (90)	0.82 (0.87)
Kidney disease	18	4.0 (1.1, 14.6)	–	2.6 (0.6, 10.2)	2.2 (0.6, 8.1)	1.9 (0.5, 7.2)	66.5 (65)	0.82 (0.60)
GIT disease	41	6.3 (2.8, 14.2)	1.3 (0.2, 9.3)	3.1 (1.4, 7.4)	14.0 (5.0, 39.1)	2.0 (0.9, 4.3)	65 (74)	0.81 (0.55)
Morbidity status								
0	3,271	1.0	1.0	1.0	1.0	1.0	85 (100)	1.00 (1.04)
1	732	2.4 (1.8, 3.2)	3.9 (2.1, 7.2)	3.3 (2.5, 4.4)	2.4 (1.9, 2.9)	1.8 (1.4, 2.3)	78 (98)	0.83 (1.02)
2	374	4.2 (3.0, 5.9)	3.8 (1.7, 8.1)	5.5 (3.9, 7.7)	4.4 (3.2, 6.0)	2.9 (2.2, 4.0)	75 (100)	0.81 (0.87)
3	213	4.5 (3.1, 6.7)	1.7 (0.6, 4.5)	7.0 (4.7, 10.5)	6.0 (3.8, 9.3)	4.3 (3.0, 6.3)	75 (90)	0.80 (0.91)
4	145	4.3 (2.6, 7.2)	7.5 (3.1, 18)	8.1 (5.0, 13.0)	6.4 (3.5, 11.5)	2.8 (1.7, 4.5)	70 (98)	0.80 (0.87)
≥5	187	14.6 (9.0, 23.6)	13.8 (6.8, 28.0)	14.1 (8.9, 22.2)	8.7 (4.8, 15.6)	6.2 (4.0, 9.4)	60 (95)	0.77 (0.83)

OR the odds of reporting *any* problem (moderate or extreme) of respondents with the selected chronic conditions compared with the reference group of respondents without the specific chronic condition. OR are adjusted for age, sex, income and educational level. NB: in each situation, some of the respondents have more than one condition. Population sampling weights are applied

Table 5 Association between specific chronic conditions and EQ-5D index

Chronic conditions	*N*	EQ-5D index score Coef. (95 % CI)[a]	EQ-5D index score Coef. (95 % CI)[b]
Diabetes	287	−0.07 (−0.10, −0.04)	−0.05 (−0.08, −0.02)
Chronic obstructive pulmonary disorder	70	−0.15 (−0.21, −0.09)	−0.10 (−0.16, −0.04)
Asthma	254	−0.08 (−0.11, −0.05)	−0.06 (−0.09, −0.03)
High blood pressure	553	−0.09 (−0.11, −0.07)	−0.06 (−0.08, −0.04)
High cholesterol	354	−0.07 (−0.09, −0.05)	−0.05 (−0.07, −0.03)
Sleep apnea	178	−0.16 (−0.20, −0.12)	−0.13 (−0.16, −0.09)
Congestive heart failure	41	−0.19 (−0.27, −0.10)	−0.12 (−0.21, −0.03)
Obesity	207	−0.10 (−0.13, −0.08)	−0.08 (−0.11, −0.05)
Depression or anxiety	331	−0.21 (−0.24, −0.18)	−0.19 (−0.21, −0.16)
Chronic pain	559	−0.21 (−0.23, −0,19)	−0.19 (−0.21, −0.17)
Arthritis	657	−0.15 (−0.17, −0.14)	−0.12 (−0.14, −0.10)
Heart disease	182	−0.10 (−0.14, −0.07)	−0.06 (−0.10, −0.02)
Stroke (or related)	53	−0.13 (−0.21, −0.06)	−0.11 (−0.19, −0.02)
Cancer	96	−0.08 (−0.12, −0.03)	−0.06 (−0.11, −0.01)
Kidney disease	18	−0.08 (−0.20, 0.04)	−0.07 (−0.19, 0.06)
GIT disease	41	−0.10 (−0.13, −0.06)	−0.10 (−0.12, −0.06)

[a] Crude (unadjusted) and [b] adjusted (age, sex, education and income) EQ-5D index values

Table 6 Associations between multimorbidity and HRQL, and healthcare utilization

Morbidity status	EQ-5D index score Coef. (95 % CI)	Hospitalization OR (95 % CI)	Emergency department visit OR (95 % CI)
0	Reference	1.0	1.0
1	−0.07 (−0.09, −0.06)	1.2 (0.9, 1.7)	1.8 (1.4, 2.3)
2	−0.11 (−0.14, −0.09)	1.8 (1.2, 2.7)	1.6 (1.2, 2.2)
3	−0.14 (−0.17, −0.11)	2.3 (1.4, 3.7)	2.7 (1.8, 4.0)
4	−0.13 (−0.17, −0.09)	2.9 (1.7, 5.0)	1.9 (1.2, 3.0)
≥5	−0.21 (−0.25, −0.17)	3.2 (1.9, 5.3)	2.5 (1.6, 3.9)
Multimorbidity			
No	Reference	1.0	1.0
Yes	−0.12 (−0.14, −0.11)	2.2 (1.7, 2.9)	1.8 (1.4, 2.2)

Adjusted for age, sex, education, income and family structure (children and adults living in the same household)

clinically important reductions in the HRQL. Individuals with multimorbidity were twice as likely to be hospitalized or to visit an emergency department when compared to those without multimorbidity. These findings emphasis the importance of pain or discomfort, decreased HRQL and increased health utilization associated with multimorbidity in the general adult population.

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