Original Research Article

The effect of obesity, hypertension and diabetes on health-related quality of life among the elderly in Saudi Arabia's Eastern Province

ABSTRACT

Aims: This study explores the cumulative effects of cardiovascular risk factors on the health-related quality of life (HRQL) among the elderly.

Study design: Our study comprises a cross-sectional design.
Place and duration of study: The Nov 2021 population-based research represents the Saudi Eastern Province population aged 60 years and above.
Methodology: Information was collected through home-based personal interviews using a structured questionnaire on the participants' health. The participants provided informed verbal consent. On each scale of the SF-36 questionnaire, multiple linear regression examined the relationships between obesity, hypertension, diabetes and HRQL after adjusting for sociodemographic data and lifestyle factors.
Results: Diabetes and hypertension registered the worst HRQL among males on all the scales (–53.8 to –22.0 points according to the scale) in the two-factor cluster and male clusters except social functioning and role-emotional. Obesity and diabetes registered the worst HRQL on all the scales (–24.4 to –40.4 points according to the scale) in the two-factor female cluster except physical functioning, bodily pain and general health, and on all scales in female clusters except physical functioning, bodily pain, general health, social functioning and role-emotional.
Conclusion: Our study shows that obesity, hypertension and diabetes (as separate factors and in combination) negatively affect HRQL.

Keywords: cardiovascular risk factors, elderly, quality of life, gender, Saudi Arabia

1. INTRODUCTION

Obesity, hypertension and diabetes are correlated; obesity and diabetes are growing on an epidemic scale and widespread worldwide [1–3]. Diabetes in Saudi Arabia is commonly comorbid with obesity and hypertension. Research shows that diabetes is 19.9% prevalent among the obese population compared to 10.7% among people who are not obese. Moreover, diabetes is 33.4% prevalent among hypertensive people compared to 9.6% among those not hypertensive [4]. Saudi Arabia is one of the top ten countries globally, with the highest prevalence of diabetes [5]. According to a Saudi Arabian Ministry of Health survey report, approximately 0.9 million people were diagnosed with diabetes in 1992. However, the number had grown to 2.5 million people in 2010, representing a 2.7 times increase in the incidence rates in less than two decades. The Saudi Burden of Disease 2010 study showed that high plasma fasting glucose was the third-ranked risk factor in disability-adjusted life years (DALYs) [4]. In 2015,

4,660 patients with diabetes attended family and medical clinics across Saudi Arabia [6].

The Saudi Burden of Disease 2010 study showed that hypertension (elevated blood pressure) was the fourth-ranked risk factor for DALYs in Saudi Arabia [7]. Moreover, in 2017, the prevalence of hypertension reached 3.2% in the 15–24 years age group, 51.2% among those aged 55–64 years, and up to 70% among people aged 65 years and older. In addition, growing prehypertension cases were observed, reaching 46.5% (3 million) in males and 34.3% (more than 2 million) in females [8]. Concerning obesity, the Saudi Burden of Disease 2010 study showed that elevated body mass index (BMI) was the single leading risk factor for DALYs in Saudi Arabia in 2010 [9]. Furthermore, obesity, defined as a BMI of 30 kg/m^2 or greater, was 28.7% prevalent in 2013. The prevalence was higher among females than males, at 33.5% and 24.1%. Prevalence increased with age and was highest among people aged 55–64 years, with levels of 48.0% [9].

Moreover, the burden of obesity, hypertension and diabetes is globally considered significant in morbidity, mortality and healthcare costs [1, 2]. For example, in 2010, diabetes cost Saudi Arabia an estimated $0.9 billion. In addition, people diagnosed with diabetes have medical healthcare expenditures ten times higher than those without diabetes [10]. Therefore, health-related quality of life (HRQL) is a critical health outcome, representing a fundamental goal of medical interventions. Also, HRQL assessment is essential in quality assurance and accountability for good-quality care delivery. Therefore, it is important to medically assess the effect of cardiovascular factors more extensively by studying patients' HRQL.

Several studies have demonstrated and concluded the adverse and negative effects of cardiovascular risk factors on HRQL globally [11–17]. However, the effects of obesity, hypertension and diabetes on HRQL have been studied less, particularly in the elderly Saudi population [18–24]. Although some research has been conducted on smaller sample sizes [20, 22, 23, 24], other studies have not included all HRQL scales [18, 20, 21] or lifestyle factors [18,19, 20, 21, 22, 23]. Moreover, ageing deteriorates cardiovascular health [16].

This study examines the effect of obesity, hypertension and diabetes (as separate cardiovascular factors and in combination) on the physical and mental dimensions of HRQL [25, 26] among a representative sample of the elderly population in Saudi Arabia's Eastern Province. Specifically, this study hypothesises that obesity, hypertension and diabetes, as separated cardiovascular factors and in combination, are associated with a poor HRQL. In addition, the study investigates whether lifestyles, such as physical activity, smoking, chronic diseases and sociodemographic gender data, affect and explain these three cardiovascular factors on the physical and mental dimensions of HRQL.

2. METHODOLOGY

This study is a cross-sectional survey covering a sample representation of the Saudi Arabian population in the Eastern Province aged above 60 years. The study has been approved by the Deanship of Scientific Research and Ethics Committee, King Faisal University (Al-Ahsa city, Saudi Arabia).

Probabilistic, multistage, and cluster sampling selected the study participants. First, clusters were stratified by region of residence and town size. Next, districts were randomly selected per cluster. Then, in sex-based and age-based groups, individual households and participants were selected to obtain the HRQL assessment information.

Information was collected through home-based personal interviews, using a structured questionnaire on the participants' health. Informed consent was requested from the participants and obtained. The 396 participants provided complete information on all the study variables subsequently analysed. The sample size calculation for this study was $(n = [(z)^2 (p) (p-1)] / (E)^2$, where n was the sample size; z was the reliability coefficient [z = 1.96 for 95% confidence interval]; and p was the expected proportion of the population comprising elderly patients with the previously mentioned cardiovascular risk factors = 50% =0.5, E margin error, by default equals 0.05). According to the equation, the minimum sample size was 385. Therefore, as the investigators expected a response rate of 97%, the estimated sample size was 396 patients.

In this study, a (widely accepted) BMI of 30 or higher denoted obesity [2]. Hypertension was defined as a systolic blood pressure (SBP) of 140 mm Hg or higher, diastolic blood pressure (DBP) of 90 mm Hg or higher, patients taking antihypertensive medication or patients diagnosed by clinicians on at least two occasions as having hypertension [27]. The participants or their physicians reported individual diabetes, hypertension or obesity conditions.

The study assessed the HRQL in elderly patients with diabetes, HTN or obesity as combined and separate cardiovascular factors. The Medical Outcomes Study (MOS) short form (SF-36) is a 36-item tool for assessing health status and outcomes from the patients' perceptions [25]. The RAND-36 English version was reliable for HRQL assessment, with Cronbach's alpha values ranging from 0.78 to 0.93 [25]. This questionnaire, translated into Arabic, has been previously tested for internal consistency and reliability in a sample of the Saudi Arabian population [26] and found to be equivalent to the English RAND-36 version [25, 26, 28]. Previous research used the Arabic version of the RAND-36 to assess HRQL, but the study was conducted in an adolescent population of patients with sickle cell anaemia [29]. In our study, elderly patients with diabetes, HTN or obesity assessed their HRQL in terms of their satisfaction and feelings concerning eight different components, with a total of 36 items addressing eight health concepts: physical function (10 items); physical health (4 items); emotional functioning (3 items); vitality (4 items); emotional wellbeing (5 items); social functioning (2 items); bodily pain (2 items); and general health perceptions (5 items). Data from the SF-36 questionnaire were scored based on the RAND Health scoring system. Each component has a single summary variable ranging from 0 = poor health to 100 = good health. The internal consistency and reliability of the SF-36 were investigated in a pilot study of 80 elderly patients with diabetes, HTN or obesity. High internal consistency (Cronbach's alpha > 0.6) was reported for physical function (Cronbach's alpha = 0.83); physical health (Cronbach's alpha = 0.85); emotional functioning (Cronbach's alpha = 0.86); vitality (Cronbach's alpha = 0.81); emotional wellbeing (Cronbach's alpha = 0.71); social functioning (Cronbach's alpha = 0.69); bodily pain (Cronbach's alpha = 0.85); and general health (Cronbach's alpha = 0.63). In addition, the presence of chronic disease (chronic obstructive pulmonary disease, ischaemic cardiopathy, cerebrovascular disease, arthrosis, cancer, dyslipidaemia and stroke) was reported by the individuals or their physicians during the interview.

The data collected by conducting home-based personal interviews utilising a structured health questionnaire was stored for processing and analysis in version 25 of the IBM SPSS statistics programme database.

2.1 Statistical analysis

Multiple linear regression models statistically analysed the effect of obesity,

hypertension and diabetes, or any combination of the three, on HRQL. Seven independent variables were modelled: solely obesity, solely hypertension, solely diabetes, obesity and hypertension, obesity and diabetes, hypertension and diabetes and all three risk factors. The reference group comprised the absence of the three risk factors (no factors, participants with a BMI lower than 30 and participants who did not report diabetes or hypertension. The $P < 0.05$ criterion was used for statistical significance, but the results were stratified in three levels: $P < 0.05$; < 0.01; and < 0.001. Descriptive statistics, such as mean and standard deviation (mean ± SD), described the quantitative variables. Frequencies and percentages, n (%), described all categorical variables, and dummies modelled all independent categorical variables. Data were also collected for sociodemographic variables, including age, educational level, living alone, residents' town sizes, lifestyle habits (smoking), physical activity during leisure and chronic diseases. The sociodemographic variables and lifestyle factors were adjusted and sorted into several categories, including four levels of education (no formal education, primary, secondary and university), three categories of town sizes (50,000–100,000; 100,000–500,000; and > 500,000 inhabitants), three smoking categories (never smoked, ex-smokers and current smokers) and four physical activity categories (inactive, light, moderate and intense). Finally, living alone and chronic disease were categorised dichotomously.

3. RESULTS

The participants' mean age was 67.14 (SD ± 4.90) years for males and 69.9 (SD ± 4.78) years for females. Of the 396 participants included in the study, 52.8% were male, and 47.2% were female, as shown in Table 2. The sociodemographic characteristics of participants with obesity, hypertension and diabetes are shown in Table 1.

In the male sample, participants with obesity, hypertension and diabetes represent the highest percentage (16.7%) of the male sample, and those with obesity and hypertension represent the lowest percentage (7.2%) of the male sample. In addition, the participants with only diabetes represent the highest mean age: 70.94 (SD ± 3.89) years, and those with hypertension and diabetes represent the lowest mean age: 63.79 (SD ± 3.99) years of male participants. Moreover, the participants with hypertension and diabetes represent the highest level of education (24.7%). Males with only diabetes represent the highest percentage of physical inactivity during leisure time (25.6%), with the no factors category representing the highest percentage of intense physical activity (55.6%) among males. The participants with no factors represent the highest percentage of non-smokers (23.7%) and no chronic diseases (44.6%). Males with hypertension and diabetes represent the highest percentage of smokers (23.3%), with obesity, hypertension and diabetes representing the highest percentage of other chronic diseases (19.6%), with only hypertension representing the highest percentage of living alone (40%), and solely hypertension representing the highest percentage of residents with a 100,000–500,000 town population (18.2%) among male participants.

In the female sample, the participants with obesity and diabetes represent the highest percentage (17.1%) of the female sample, with obesity and hypertension, and solely hypertension representing the lowest percentage (8%). In addition, the participants with only diabetes represent the highest mean age, 75.15 (SD ± 3.33), and females with only obesity represent the lowest mean age, 64.73 (SD ± 2.53), and the highest level of education (44.8%). Obesity, hypertension and diabetes represent the highest percentage of physical inactivity during leisure time (21.4%), with the no factors category representing the highest percentage of intense physical activity

(55.6%). Obesity and diabetes represent the highest percentage of non-smokers (17.7%). The categories solely hypertension and obesity and hypertension represent the highest percentage of smokers (40%), with obesity, hypertension and diabetes representing the highest percentage of other chronic diseases (18.9%). Moreover, obesity and hypertension represent the highest percentage of living alone (85.7%), with obesity and hypertension representing the highest percentage of residents in towns of 100,000–500,000 populations (18.5%) among female participants.

Of the SF-36 scale's crude mean scores, general health showed the lowest crude mean score, 55.55 (SD ± 26.57), and social function showed the highest crude mean score, 71.89 (SD ± 22.42), for males regardless of the risk factor considered. However, physical function had the lowest crude mean score, 53.18 (SD ± 25.87), and social function represented the scale with the highest crude mean score, 69.79 (SD ± 21.17), for females regardless of the risk factor considered, as shown in Table 2.

Table 1: Sample characteristics of the study

		Diseases							
		No factor	Solely obesity	Solely hypertension	Solely diabetes	Obesity and hypertension	Obesity and diabetes	Hypertension and diabetes	Obesity, hypertension and diabetes
Male (N & %)		31 14.8%	16 7.7%	30 14.4%	32 15.3%	15 7.2%	21 10.0%	29 13.9%	35 16.7%
Age (years) (mean ± SD)		64.52 ± 3.09	65.88 ± 5.50	65.83 ± 4.41	70.94 ± 3.89	66.40 ± 3.50	70.43 ± 3.30	63.79 ± 3.99	68.83 ± 5.37
Educational level (N & %)	No formal education	0 0.0%	3 10.0%	2 6.7%	3 10.0%	2 6.7%	11 36.7%	0 0.0%	9 30.0%
	Primary	4 6.8%	2 3.4%	10 16.9%	23 39.0%	2 3.4%	4 6.8%	6 10.2%	8 13.6%
	Middle	0 0.0%	0 0.0%	3 75.0%	0 0.0%	1 25.0%	0 0.0%	0 0.0%	0 0.0%
	Secondary	10 37.0%	0 0.0%	3 11.1%	2 7.4%	2 7.4%	4 14.8%	1 3.7%	5 18.5%
	University	17 19.1%	11 12.4%	12 13.5%	4 4.5%	8 9.0%	2 2.2%	22 24.7%	13 14.6%
Smokers (N & %)	Non-smokers	28 23.7%	13 11.0%	12 10.2%	19 16.1%	7 5.9%	17 14.4%	6 5.1%	16 13.6%
	Ex-smokers	0 0.0%	0 0.0%	1 20.0%	0 0.0%	1 20.0%	0 0.0%	3 60.0%	0 0.0%
	Smokers	3 3.5%	3 3.5%	17 19.8%	13 15.1%	7 8.1%	4 4.7%	20 23.3%	19 22.1%
Physical activity during leisure time (N & %)	Inactive	2 2.4%	7 8.5%	9 11.0%	21 25.6%	11 13.4%	7 8.5%	9 11.0%	16 19.5%
	Light	3 4.2%	7 9.7%	10 13.9%	9 12.5%	3 4.2%	11 15.3%	15 20.8%	14 19.4%
	Moderate	14 35.0%	2 5.0%	9 22.5%	2 5.0%	1 2.5%	3 7.5%	4 10.0%	5 12.5%
	Intense	12 80.0%	0 0.0%	2 13.3%	0 0.0%	0 0.0%	0 0.0%	1 6.7%	0 0.0%

Other chronic diseases (N & %)	No	25 44.6%	4 7.1%	9 16.1%	4 7.1%	1 1.8%	2 3.6%	6 10.7%	5 8.9%
	Yes	6 3.9%	12 7.8%	21 13.7%	28 18.3%	14 9.2%	19 12.4%	23 15.0%	30 19.6%
Living Alone (N & %)	No	28 14.4%	16 8.2%	24 12.4%	28 14.4%	14 7.2%	20 10.3%	29 14.9%	35 18.0%
	Yes	3 20.0%	0 0.0%	6 40.0%	4 26.7%	1 6.7%	1 6.7%	0 0.0%	0 0.0%
Size of town of residence (N & %)	> 50,000–100,000	1 6.7%	0 0.0%	1 6.7%	1 6.7%	0 0.0%	1 6.7%	6 40.0%	5 33.3%
	> 100,000–500,000	25 15.7%	13 8.2%	29 18.2%	22 13.8%	15 9.4%	17 10.7%	23 14.5%	15 9.4%
	> 500,000	5 14.3%	3 8.6%	0 0.0%	9 25.7%	0 0.0%	3 8.6%	0 0.0%	15 42.9%
Female (N & %)		21 11.2%	22 11.8%	15 8.0%	26 13.9%	15 8.0%	32 17.1%	27 14.4%	29 15.5%
Age (years) (mean ± SD)		67.62 ± 4.34	64.73 ± 2.53	69.53 ± 2.56	75.15 ± 3.33	67.20 ± 4.28	73.34 ± 3.00	69.85 ± 4.79	68.59 ± 3.20
Educational level (N & %)	No formal education	6 8.8%	1 1.5%	4 5.9%	24 35.3%	6 8.8%	16 23.5%	10 14.7%	1 1.5%
	Primary	7 12.1%	1 1.7%	8 13.8%	2 3.4%	8 13.8%	13 22.4%	6 10.3%	13 22.4%
	Middle	3 11.1%	6 22.2%	1 3.7%	0 0.0%	1 3.7%	2 7.4%	1 3.7%	13 48.1%
	Secondary	2 40.0%	1 20.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	1 20.0%	1 20.0%
	University	3 10.3%	13 44.8%	2 6.9%	0 0.0%	0 0.0%	1 3.4%	9 31.0%	1 3.4%
Smokers (N & %)	Non-smokers	21 12.0%	22 12.6%	10 5.7%	25 14.3%	14 8.0%	31 17.7%	23 13.1%	29 16.6%
	Ex-smokers	0 0.0%	0 0.0%	1 50.0%	1 50.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%
	Smokers	0 0.0%	0 0.0%	4 40.0%	0 0.0%	1 10.0%	1 10.0%	4 40.0%	0 0.0%
Physical activity during leisure time (N & %)	Inactive	1 1.4%	14 20.0%	6 8.6%	11 15.7%	7 10.0%	10 14.3%	6 8.6%	15 21.4%
	Light	2 2.7%	8 10.7%	6 8.0%	8 10.7%	7 9.3%	17 22.7%	14 18.7%	13 17.3%
	Moderate	13 39.4%	0 0.0%	2 6.1%	6 18.2%	1 3.0%	4 12.1%	6 18.2%	1 3.0%
	Intense	5 55.6%	0 0.0%	1 11.1%	1 11.1%	0 0.0%	1 11.1%	1 11.1%	0 0.0%
Other chronic diseases (N & %)	No	9 23.1%	4 10.3%	4 10.3%	6 15.4%	3 7.7%	7 17.9%	5 12.8%	1 2.6%
	Yes	12 8.1%	18 12.2%	11 7.4%	20 13.5%	12 8.1%	25 16.9%	22 14.9%	28 18.9%
Living alone (N & %)	No	21 11.7%	22 12.2%	15 8.3%	25 13.9%	9 5.0%	32 17.8%	27 15.0%	29 16.1%
	Yes	0 0.0%	0 0.0%	0 0.0%	1 14.3%	6 85.7%	0 0.0%	0 0.0%	0 0.0%
Size of town of residence	> 50,000–100,000	1 7.7%	0 0.0%	3 23.1%	1 7.7%	0 0.0%	2 15.4%	3 23.1%	3 23.1%

(N & %)	> 100,000–500,000	20 12.7%	22 14.0%	11 7.0%	19 12.1%	15 9.6%	29 18.5%	19 12.1%	22 14.0%
	> 500,000	0 0.0%	0 0.0%	1 5.9%	6 35.3%	0 0.0%	1 5.9%	5 29.4%	4 23.5%

Table 2: Sample characteristics of the study

Male (N & %)	209	52.8%
Age (years) (mean & SD)	67.14	4.90
Physical function (mean & SD)	55.89	26.06
Physical role health (mean & SD)	58.85	26.23
Bodily pain (mean & SD)	57.18	25.60
Vitality (mean & SD)	65.72	24.04
General health (mean & SD)	55.55	26.57
Social function (mean & SD)	71.89	22.42
Emotional role functions (mean & SD)	64.23	23.98
Mental health (mean & SD)	65.00	25.58
Female (N & %)	187.00	47.2%
Age (years) (mean & SD)	69.90	4.78
Physical function (mean & SD)	53.18	25.78
Physical role health (mean & SD)	56.60	24.49
Bodily pain (mean & SD)	57.81	23.69
Vitality (mean & SD)	64.06	22.14
General health (mean & SD)	55.37	24.34
Social function (mean & SD)	69.79	21.17
Emotional role functions (mean & SD)	63.21	26.20
Mental health (mean & SD)	67.09	23.11

Beta estimators of the cardiovascular factors' effect on the HRQL scales before adjustment of the sociodemographic variables and lifestyle factors for males and females are shown in Tables 3 and 4, respectively. Patients with solely obese, hypertensive or diabetic conditions registered a poorer HRQL (negative values of the b regression coefficient) more frequently on all scales than those without the three risk factors. Statistical significance ($P < 0.05$) was absent in both genders for some relationships except social functioning (0.286 b regression coefficient) in females. Diabetes was significantly associated with the most significant reduction in HRQL on all scales (–29.3 to –41.2 points according to the scale) in the male single-factor cluster. In addition, the two-factor and three-factor clusters registered a poorer HRQL (negative values of the b regression coefficient) more frequently on all scales than those without the three risk factors, although statistical significance ($P < 0.05$) was absent for

some relationships in both genders. For males, diabetes and hypertension registered the poorest HRQL on all scales (–20.9 to –47.5 points according to the scale) in the two-factor cluster and all clusters except physical functioning, social functioning and role-emotional. Obesity and diabetes registered the poorest HRQL (–36.6 b regression coefficient) for physical functioning, solely diabetes registered the poorest HRQL (–35.9 b regression coefficient) for social functioning, and obesity, hypertension and diabetes registered the poorest HRQL (–36.7 b regression coefficient) for the role-emotional category in all clusters. In females, obesity was significantly associated with the most significant reduction in HRQL on all scales (–17.4 to –30.05 points according to the scale) in the single-factor cluster, except for bodily pain. Solely hypertension registered the poorest HRQL (–27.3 b regression coefficient) for bodily pain in the single-factor cluster. Obesity and diabetes registered the poorest HRQL on all scales (–30.3 to –43.8 points, according to the scale) in the two-factor female cluster except physical functioning, general health and all scales in female clusters except the physical functioning, general health and role-emotional categories. Obesity and diabetes registered the poorest HRQL (–41.3 and –48.4 b regression coefficient) for physical functioning and general health in all the female clusters, respectively. Obesity, hypertension and diabetes registered the poorest HRQL (–49.6 b regression coefficient) for the role-emotional category in the female clusters.

Table 3: Beta estimators of the cardiovascular factors' effect on the HRQL scale (male)

	Single-factor cluster			Two-factor cluster			Three-factor cluster
	Solely obesity β (95% CI)	Solely hypertension β (95% CI)	Solely diabetes β (95% CI)	Obesity and hypertension β (95% CI)	Obesity and diabetes β (95% CI)	Hypertension and diabetes β (95% CI)	Obesity, hypertension and diabetes β (95% CI)
Physical functioning	–21.190 (–34.973; –7.406)**	–7.231 (–18.699; 4.237)	–29.315 (–40.599; –18.030)***	–14.065 (–28.148; 0.019)	–36.636 (–49.291; –23.981)***	–34.616 (–46.184; –23.048)***	–33.065 (–44.108; –22.021)***
Role-physical	–22.419 (–36.121; –8.718)**	–8.919 (20.319; 2.480)	–37.107 (–48.324; –25.890)***	–18.086 (–32.085; –4.087)*	–34.086 (–46.665; –21.507)***	–40.006 (–51.504; –28.507)***	–27.562 (–38.540; –16.585)***
Bodily pain	–31.935 (–45.271; –18.600)	–13.102 (–24.197; –2.007)*	–32.092 (–43.009; –21.174)***	–14.602 (–28.228; –0.976)*	–30.269 (–42.513; –18.025)***	–42.453 (–53.645; –31.261)***	–33.078 (–43.763; –22.393)***
General health	–31.794 (–44.899; –18.689)***	–9.919 (–20.823; –0.984)	–40.076 (–50.804; –29.347)***	–19.086 (–32.476; –5.696)**	–37.181 (–49.213; –25.149)***	–47.592 (–58.590; –36.594)***	–30.848 (–41.348; –20.348)***

Vitality	–14.587 (–27.568; –1.605)*	–12.274 (–23.075; –1.474)*	–35.993 (–46.621; –25.365)*	–30.441 (–43.705; –17.177)***	–21.774 (–33.693; –9.855)***	–30.912 (–41.807; –20.017)***	–23.917 (–34.318; –13.516)***
Social functioning	–6.079 (–18.039; 5.882)	–12.349 (–22.301; –2.398)*	–34.047 (–43.839; –24.256)***	–20.516 (–32.737; –8.295)**	–28.564 (–39.545; –17.582)***	–25.895 (–35.933; –15.858)***	–13.373 (–22.956; –3.790)**
Role-emotional	–24.083 (–36.841; –11.324)***	–11.978 (–22.594; –1.363)*	–30.176 (–40.622; –19.731)***	–13.645 (–26.681; –0.609)*	–31.598 (–43.312; –19.883)***	–20.990 (–31.698; –10.282)***	–36.788 (–47.011; –26.565)***
Mental health	–7.611 (–19.885; 4.663)	–10.548 (–20.760; –0.336)*	–41.205 (–51.253; –31.156)***	–13.548 (–26.090; –1.007)*	–31.406 (–42.675; –20.136)***	–45.617 (–55.919; –35.316)***	–27.977 (–37.811; –18.143)***

Multiple linear regression models before adjustment of the sociodemographic variables and lifestyle factors: b, beta estimator; CI, confidence interval, *P < 0.05, ** P < 0.01, *** P < 0.001

Table 4: Beta estimators of the cardiovascular factors' effect on the HRQL scale (female)

	Single-factor cluster			Two-factor cluster			Three-factor cluster
	Solely obesity β (95% CI)	Solely hypertension β (95% CI)	Solely diabetes β (95% CI)	Obesity and hypertension β (95% CI)	Obesity and diabetes β (95% CI)	Hypertension and diabetes β (95% CI)	Obesity, hypertension and diabetes β (95% CI)
Physical functioning	–24.589 (–37.771; –11.406)***	–12.952 (–27.560; 1.655)	–7.683 (–20.361; 4.994)	–9.619 (–24.226; 4.988)	–32.359 (–44.493; –20.224)***	–41.323 (–53.895; –28.751)***	–35.435 (–47.816; –23.054)***

Role-physical	–25.877 (–83.589; –13.164)***	–15.286 (–29.372; –1.199)*	–12.555 (–254.780; –0.329)*	–15.286 (–29.372; –1.199)*	–43.817 (–55.519; –32.115)***	–31.508 (–43.632; –19.384)***	–21.872 (–33.812; –9.932)***
Bodily pain	–24.351 (–37.137; –11.564)***	–27.381 (–41.550; –13.564)***	–7.637 (–19.934; 4.660)	–27.048 (–41.217; –12.878)***	–32.589 (–44.360; –20.819)***	–29.974 (–42.168; –17.779)***	–30.369 (–42.379; –18.360)***
General health	–27.933 (–40.079; –15.787)***	–22.190 (–35.650; –8.731)**	–19.716 (–31.397; –8.035)**	–22.857 (–36.317; –9.398)**	–35.305 (–46.486; –24.124)***	– 48.413 (–59.997; –36.829)***	–41.765 (–53.173; –30.357)
Vitality	–22.738 (–34.334; –11.142)***	–0.238 (–13.088; 12.611)	–16.2 (–27.351; –5.048)**	–23.571 (–36.421; –10.722)***	–33.207 (–43.881; –22.532)***	–28.757 (–39.816: –17.697)***	–29.031 (–39.922; –18.14)***
Social functioning	–29.881 (–40.932; 18.830)***	0.286 (–11.960; 12.532)	–10.842 (–21.470; –0.215)*	–12.714 (–24.960; –0.468)*	–30.350 (–40.523; –20.177)***	–17.196 (–27.735; –6.656)**	–25.140 (–35.519; –14.760)***
Role-emotional	–17.435 (–30.573; –4.297)*	–18.238 (–32.796; –3.68)*	–10.11 (–22.745; 2.525)	–31.571 (–46.13; –17.013)***	–34.04 (–46.134; –21.946)***	–30.423 (–42.953; –17.893)***	–49.606 (–61.945; –37.267)***
Mental health	–30.054 (–42.735; –17.373)***	–8.19 (–22.242; 5.861)	–11.96 (–24.155; 0.236)	–15.19 (–29.242; –1.139)*	–31.659 (–43.332; –19.986)***	–25.82 (–37.914; –13.726)***	–18.604 (–30.514; –6.694)**

Multiple linear regression models before adjustment of the sociodemographic variables and lifestyle factors: b, beta estimator; CI, confidence interval, *P < 0.05, ** P < 0.01, *** P < 0.001

Beta estimators for the cardiovascular factors' effect on the HRQL scales after adjusting the sociodemographic variables and lifestyle factors for males and females are shown in Tables 5 and 6. Patients with solely obese, solely hypertensive or solely diabetic conditions registered a poorer HRQL (negative values of the b regression coefficient) more frequently on all scales than those without the three risk factors, except social functioning (3.2 b regression coefficient) in females, although statistical significance (P < 0.05) was absent for some relationships in both genders. In males, diabetes demonstrated the most significant reduction in HRQL on all scales (–19.6 to –40.6 points according to the scale) in the single-factor cluster, except the bodily pain and role-emotional categories. Obesity registered the poorest HRQL for bodily pain and role-emotional in the male single-factor cluster (–38.7 and –23.14 points according to the scale, respectively). In addition, the two-factor and three-factor clusters registered a poorer HRQL (negative values of the b regression coefficient) more frequently on all scales than those without the three risk factors, although statistical significance (P < 0.05) was absent for some relationships in both genders, except solely diabetes in males, which showed a more significant decline in most HRQL scales than the combinations of obesity and hypertension and obesity and diabetes, and the three-factor combination. In males, diabetes and hypertension registered the poorest HRQL on all scales (–53.8 to –22.0 points according to the scale) in the two-factor cluster and all clusters except social functioning and role-emotional. Obesity and diabetes registered the poorest HRQL (–28.1 b regression coefficient) for social functioning in all the male clusters and the poorest HRQL (–24.0 b regression coefficient) for the role-emotional category in the two-factor cluster. Obesity, hypertension and diabetes registered the poorest HRQL (–28.0 b regression coefficient) for role-emotional in all the male clusters. In the female group, obesity was associated with the most significant reduction in HRQL on all scales (–9.3 to –28.7 points according to the scale) in the single-factor cluster, except for the bodily pain, vitality and role-emotional categories. However, physical functioning, vitality and role-emotional were not statistically significant (P < 0.05). Solely hypertension registered the poorest HRQL (–31.2 b regression coefficient) for bodily pain and (–19.9 b regression coefficient) for role-emotional, and solely diabetes registered the poorest HRQL (–20.0 b regression coefficient) for vitality in the single-factor cluster. Obesity and diabetes registered the worst HRQL on all the scales (–24.4 to –40.4 points according to the scale) in the two-factor female cluster, except for physical functioning, bodily pain and general health, and all the scales in female clusters except physical functioning, bodily pain, general health social functioning and role-emotional. Obesity and hypertension registered the poorest HRQL (–32.7, –35.0 and –37.3 b regression coefficient) for physical functioning, bodily pain and role-emotional in the two-factor cluster. Hypertension and diabetes registered the poorest HRQL (–43.5 b regression coefficient) for general health in the two-factor and female clusters. Solely obesity registered the poorest HRQL (–24.6 b regression coefficient) for social functioning in the female clusters. Finally, obesity, hypertension and diabetes registered the poorest HRQL (–36.0, –38.8, and –48.3 b regression coefficient) for physical functioning, bodily pain and role-emotional in the female clusters, respectively. Therefore, the results of our study varied substantially. The beta estimators of the cardiovascular factors' effect on the HRQL scales were affected after adjusting the sociodemographic variables and lifestyle factors.

Table 5: Beta estimators of the cardiovascular factors' effect on the HRQL scale (male)

	Single-factor cluster			Two-factor cluster			Three-factor cluster
	Solely obesity β (95% CI)	Solely hypertension β (95% CI)	Solely diabetes β (95% CI)	Obesity and hypertension β (95% CI)	Obesity and diabetes β (95% CI)	Hypertension and diabetes β (95% CI)	Obesity, hypertension and diabetes β (95% CI)
Physical functioning	–16.3 (–31.7; –0.9)*	–10.9 (–24.2; 2.4)	–19.6 (–34.4; –4.8)*	–15.2 (–31.5; 1.16)	–26.4 (–41,9; –11.0)**	–41.0 (–55.3; –26.7)***	–24.9 (–39.1; –10.6)**
Role-physical	–19.2 (–35.2; –3.3)*	–10.8 (–24.6; 3.0)	–32.2 (–47.6; –17.0)***	–16.9 (–33.8; –0.02)	–27.7 (–43.6; –11.7)**	–39.0 (–53.0; –24.2)***	–23.6 (–38.4; –8.9)**
Bodily pain	–38.7 (–54.6; –22.8)***	–22.8 (–36.5; –9.1)**	–36.8 (–52.0; –21.6)***	–22.4 (–39.2; –5.6)**	–39.4 (–55.3; –23.5)***	–53.8 (–68.6; –39.1)***	–40.3 (–55.0; –25.7)***
General health	–31.1 (–46.8; –15.3)***	–14.5 (–28.2; –0.9)*	–34.4 (–49.5; –19.3)***	–20.6 (–37.3; –4.0)*	–34.2 (–49.9; –18.4)***	–52.0 (–66.7. –37.4)***	–26.6 (–41.2; –12.1)***
Vitality	–19.9 (–35.5; –4.3)*	–20.5 (–34.0; –7.0)**	–38.6 (–53.6; –23.6)***	–35.5 (–52.0; –18.9)***	–27.9 (–43.5; –12.3)**	–39.0 (–53.5; –24.5)***	–26.7 (–41.1; –12.3)***
Social functioning	–6.2 (–20.1; 7.6)	–12.5 (–24.5; –0.5)*	–33.8 (–47.1; –20.5)***	–17.2 (–31.9; –2.6)*	–28.1 (–41.9; –14.2)***	–26.3 (–39.2; –13.5)***	–10.3 (–23.1; 2.5)
Role-emotional	–23.14 (–37.9; –8.4)**	–14.0 (–26.8; –1.3)*	–23.07 (–37.2; –8.9)**	–9.0 (–24.6; 6.7)	–24.0 (–38.7; –9.2)**	–22.0 (–35.7; –8.3)**	–28.0 (–41.6; –14.4)***
Mental health	–4.1 (–18.7; 10.5)	–11.6 (–24.2; 1.1)	–40.6 (–54.6; –26.5)***	–13.3 (–28.8; 2.2)	–34.4 (–49.1; –19.8)***	–40.6 (–54.2; –26.9)***	–26.5 (–40.0; –13.0)***

Multiple linear regression models after adjustment of the sociodemographic variables and lifestyle factors. b, beta estimator; CI, confidence interval. *P < 0.05, ** P < 0.01, *** P < 0.001

Table 6: Beta estimators of the effect of cardiovascular factors on HRQL scale (female)

	Single-factor cluster			Two-factor cluster			Three-factor cluster
	Solely obesity β (95% CI)	Solely hypertension β (95% CI)	Solely diabetes β (95% CI)	Obesity and hypertension β (95% CI)	Obesity and diabetes β (95% CI)	Hypertension and diabetes β (95% CI)	Obesity, hypertension and diabetes β (95% CI)
Physical functioning	–14.9 (–31.5; 1.8)	–11.3 (–28.0; 5.4)	–0.2 (–16.9; 16.5)	–19.5 (–38.9; –0.2)*	–27.1 (–42.0; –12.2)***	–32.7 (–47.6; –17.8)***	–36.0 (–51.4; –20.7)***
Role-physical	–22.3 (–38.1; –6.5)**	–10.0 (–25.8; 6.0)	–9.0 (–24.8; 7.0)	–19.5 (–37.9; –1.1)*	–40.0 (–54.1; –25.8)***	–26.7 (–40.8; –12.5)***	–26.0 (–40.5; –11.3)**
Bodily pain	–25.5 (–41.7; –9.4)**	–31.2 (–47.4; –14.9)***	–7.6 (–23.8; 8.6)	–35.0 (–53.8; –16.3)***	–32.9 (–47.3; –18.4)***	–31.8 (–46.3; –17.4)***	–38.8 (–53.7; –23.8)***
General health	–24.6 (–40.0; –9.3)**	–19.4 (–34.9; –3.9)*	–10.8 (–26.3; 4.6)	–29.8 (–47.7; –12.0)**	–26.3 (–40.1; –12.6)***	–43.5 (–57.3; –29.7)***	–37.4 (–51.6; –23.1)***
Vitality	–9.3 (–23.9; 5.3)	–0.3 (–14.4; –14.9)	–20.0 (–34.7; –5.4)**	–21.5 (–38.5; –4.6)*	–32.8 (–45.9; –19.8)***	–24.5 (–37.6; –11.5)***	–23.3 (–36.8; –9.8)**
Social functioning	–24.6 (–39.0; –10.3)**	3.2 (–11.2; 17.5)	–4.8 (–19.2; 9.5)	–14.2 (–30.9; 2.4)	–24.4 (–37.2; –11.6)***	–10.6 (–23.4; 2.3)	–21.5 (–34.7; –8.2)**
Role-	–14.5	–19.9 (–37.1;	–15.5	–37.3	–36.0 (–51.4;	–30.1 (–45.4;	–48.3 (–64.2;

emotional	(–31.6; 2.7)	–2.7)*	(–32.7; 1.8)	(–57.3; –17.4)***	–20.7)***	–14.7)***	–32.4)***
Mental health	–28.7 (–44.9; –12.4)**	–7.8 (–24.2; 8.5)	–18.3 (–34.7; –2.0)*	–13.9 (–32.8; 5.0)	–33.0 (–47.5; –18.4)***	–26.8 (–41.4; –12.2)***	–19.6 (–34.7; –4.6)*

Multiple linear regression models after adjustment of the sociodemographic variables and lifestyle factors: b, beta estimator; CI, confidence interval, *P < 0.05, ** P < 0.01, *** P < 0.001

4. DISCUSSION

Generally, our study showed that obesity, hypertension and diabetes (as separate cardiovascular factors and in combination) negatively affected all the physical and mental dimensions of HRQL among our representative sample of the Saudi Arabian elderly population in the Eastern Province. The results of this study correspond to several global studies that report the negative impact of obesity, hypertension and diabetes on patients' HRQL, as shown in Tables 5 and 6. For example, in Sweden, the results of a cross-sectional study in three Stockholm County community health centres showed a decreasing and poor HRQL in elderly diabetic subjects [15]. In central India, the results of a cross-sectional study in the medical outpatient department of a 780–bed rural medical college found a decreasing and poor HRQL equally in both groups (diabetic and non-diabetic) [17]. In the Netherlands, a cross-sectional study showed that weight and obesity conditions are associated with quality of life impairment [12]. In China, a cross-sectional study found that hypertension impairs quality of life in terms of physical and mental health [14].

Furthermore, the results of our study correspond to several local studies that report the negative impact of obesity, hypertension and diabetes on patients' HRQL. In Saudi Arabia, the results of a cross-sectional study in two Eastern Province health centres found a moderate HRQL among patients with type two diabetes [18]. Another cross-sectional study, conducted in the Qassim region of Saudi Arabia, showed low self-perceived HRQL in patients with type two diabetes [19]. In the Al-Khobar area, a case-control study was conducted in PHC centres and showed that HRQL in type two diabetic patients was lower than controls [24]. In Abha, a cross-sectional study showed that obese patients in nutrition and obesity clinics of the Aseer Central Hospital have poor HRQL [23]. In Alkhober, the results of a case-control study in PHC centres found that the HRQL of hypertensive patients was substantially impaired compared to the control group.

In general, our study found that a combination of cardiovascular factors, including two-factor and three-factor clusters, showed a more significant decline in HRQL in the female sample than the separate cardiovascular factors (single-factor cluster), as shown in Table 6. In contrast, the male sample's combination of factors generally showed a lower than expected reduction in HRQL, as shown in Table 5. Notably, diabetes alone more significantly declined in most HRQL scales than the combination of obesity and hypertension, obesity and diabetes, and the combination of the three factors. This finding's possible cause is that the sole diabetes sample had many patients with other chronic diseases and risk factor burdens, such as smoking and physical inactivity. In addition, the sole diabetes sample contained a high number of patients living alone. Several studies showed that living alone is associated with visit-to-visit HbA1c variability and an independent predictor of type two diabetes in men

but not women [30, 31]. Our study showed that in female patients, obesity and any combinations with obesity registered the poorest HRQL on most of the scales in female clusters. Possibly, this is because of the significant association of the female gender with obesity and higher body dissatisfaction [32]. A previous study found that body dissatisfaction seriously affects women's social, professional and emotional self [33].

Our study observed that the female sample generally demonstrated a more significant decline in physical functioning in most cardiovascular risk factors (including sole hypertension, obesity and hypertension, obesity and diabetes, and obesity, hypertension and diabetes) than the male sample, as shown in Tables 5 and 6. This more significant decline in physical functioning could be associated with post-menopausal females. A study showed that post-menopausal women have more limitations in physical functioning than pre-menopausal women, suggesting that the physiology of menopause leads to direct physical functioning limitations [34]. Pathophysiological changes of the menopausal transition, including an increased ratio of fat mass to lean mass [35], increased visceral fat [36], and bone mass loss [37], may lead to impairment and functional limitation due to oestrogen reduction. In addition, another study has shown that women have an accelerated decline in muscle strength around the time of menopause. In contrast, males' muscle strength gradually declines (specifically in isometric knee extension strength and handgrip strength) between 20 and 80 years old [38].

Our study's results also varied substantially even after adjusting lifestyles, such as physical activity and smoking, due to chronic diseases. In addition, sociodemographic data suggesting that the association between obesity, hypertension and diabetes, as separated cardiovascular factors and in combination, and the physical and mental dimensions of HRQL could be explained by lifestyles such as physical activity and smoking, chronic diseases, as shown in Tables 3–6. For example, the results of a cross-sectional study in Iran found that current smokers had lower HRQL than past smokers and people who had never smoked [39]. In England, a cross-sectional study found that higher physical activity levels are associated with better HRQL [40].

Several limitations were noted in our observational cross-sectional study. First, it shows only relationships, but not necessarily causation. Furthermore, comparison and citation to other studies should be considered, given the different methodological issues and the subjectivity of the surveys. Therefore, Interventional studies are required to assess HRQL in diabetes, obesity and hypertension patients. In addition, study participants were included from only one province in Saudi Arabia, Eastern Province; the findings are not generalisable to other provinces in Saudi Arabia. Therefore, future studies could provide a valuable understanding of obesity, hypertension and diabetes on the HRQL of elderly populations in different provinces of Saudi Arabia.

5. CONCLUSION

Our study showed that obesity, hypertension and diabetes (as separate cardiovascular factors and in combination) negatively affected all HRQL physical and mental dimensions among our representative sample of the elderly Saudi population in the Eastern Province of Saudi Arabia. In addition, the association between obesity, hypertension and diabetes as separate cardiovascular factors and in combination, and the physical and mental dimensions of HRQL can be explained by lifestyle factors, such as physical activity and smoking, chronic diseases and sociodemographic data. Our study also found that a combination of cardiovascular factors showed a more significant decline in HRQL than separate cardiovascular factors in females. In males, the combination of factors generally showed a

lower than expected reduction in HRQL. Obesity in older females and diabetes in older males are the most significant factors adversely affecting the HRQL.

CONSENT

Informed consent was requested and obtained from the participants.

ETHICAL APPROVAL

This study was approved by the Research and Ethics Committee of the Deanship of Scientific Research at King Faisal University (Al–Ahsa city, Saudi Arabia).

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