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Anxiety, Depression, and Common Chronic Diseases, and Their Association With Social Determinants in Saudi Primary Care

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Abstract

Introduction: Patients with chronic diseases can experience psychological conditions, including anxiety and depression. However, the association between chronic diseases and these psychological conditions remains unclear. This study aimed to identify the relationship between anxiety, depression, and common chronic diseases (hypertension, type 2 diabetes, dyslipidemia, and rheumatoid arthritis), and their association with social determinants at an outpatient primary care setting. **Methods:** The validated hospital anxiety and depression scale was administered electronically to eligible participants. For each condition (anxiety and depression), participants were categorized as normal, borderline abnormal, and abnormal, according to their score out of 21 ($\leq$7 = normal, 8-10 = borderline abnormal, $\geq$11 = abnormal). The scores and numbers of participants in each category were analyzed and compared with their demographic characteristics and chronic diseases for associations and relationships. **Results:** We recruited 271 participants (mean age of 51.65 + 11.71 years) attending primary care clinics. Of these patients, 17.7% and 8.9% had borderline abnormal and abnormal depression, respectively, and 10.3% and 8.9% of patients had borderline abnormal anxiety and abnormal anxiety. Common social determinants and lifestyle factors were examined. Age, gender, and sugary drinks' consumption significantly increased the odds of hypertension and type 2 diabetes; vigorous physical activity 3 times a week, decreased the odds of developing these chronic diseases. Adjusted regression models showed a statistically significant association between the hospital anxiety and depression scale score for borderline and abnormal anxiety and the presence of type 2 diabetes (OR 3.04 [95% CI 1.13, 8.19], *P*-value = .03 and OR 4.65 [95% CI 1.63,13.22], *P*-value $<$.03, respectively) and dyslipidemia (OR 5.93 [95% CI 1.54, 22.86], *P*-value = .01, and OR 4.70 [95% CI 0.78, 28.35], *P*-value = .09, respectively). The odds of developing depression were 4 times higher (*P*-value .04) in patients with rheumatoid arthritis. **Conclusion:** Among patients attending primary care outpatient clinics, anxiety, and depression were significantly associated with type 2 diabetes and rheumatoid arthritis, respectively. Social determinants and lifestyle factors play a major role in the development of common chronic diseases in Saudi Arabia. Primary care physicians should consider the patients' psychological status, sociodemographic status, and lifestyle risks during the management of chronic diseases.

Keywords

depression, anxiety, hypertension, diabetes, rheumatoid arthritis, social determinants, lifestyle, prevalence, primary care, Saudi Arabia

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Introduction

The last few decades have seen a prominent shift in the epidemiological progression of diseases toward noncommunicable diseases (NCDs). NCDs, also known as chronic diseases, are challenging, as they present for a long duration, causing multisystem complications.[1] Patients with chronic diseases can have some disruption of their psychoemotional state. The psychological status of patients with physical disorders can exacerbate their health

conditions.[2] Therefore, patients with mental health issues struggle to manage their physical disorders. According to the World Health Organization (WHO), depression, and anxiety are mental disorders characterized by a combination of abnormal thoughts, perceptions, emotions, behaviors, and relationships with others.[2] A systematic analysis of the global burden of depression, conducted in the US showed that depression affects approximately 45 million people worldwide.[3] In the Saudi Arabian city of Riyadh, the prevalence of depression among patients attending the outpatient clinics of 3 large primary care centers was estimated to be 50%, where 31% of patients were categorized as mild, 13.4% were moderately depressed, 4.4% were moderately to severely depressed, and 1% were severely depressed.[4] The burden of depression and anxiety continues to grow with significant impacts on physical and mental health. There is growing evidence of a higher incidence of chronic physical conditions and earlier mortality among individuals with mental disorders.[5]

In 2010, 31.1% of the global adult population had hypertension.[6] The national prevalence of hypertension was 15.2% among Saudis aged >15 years.[7] The prevalence of type 2 diabetes (T2D) is increasing nationally and globally, affecting approximately 6.28% of the world's population.[8-11] The global prevalence of rheumatoid arthritis (RA) is 0.46%.[12] Dyslipidemia is a major modifiable risk factor in cardiovascular diseases. Most studies found that patients with depression and anxiety are prone to the development of dyslipidemia.[12-16]

There is inconsistent evidence about the effect of anxiety and depression on chronic diseases, as the prevalence of the chronic diseases is unequally distributed in populations based on their social determinants. Social determinant is defined as "the conditions in which people are born, grow, work, live and age, and the wider set of forces and systems shaping the conditions of daily life"[17] that account for approximately half of all the variations in health. Several sociodemographic and lifestyle characteristics (including age, gender, marital status, education level, income, dietary habits, and physical activity) have been linked to the existence of chronic diseases, which can increase the risk of anxiety and depression.[1,18,19] Mexicans with diabetes had a high prevalence of depression and anxiety (48.27% and 55.10%, respectively),[20] and Chinese patients with diabetes had lower rates of combined symptoms of anxiety and depression (25.7%).[19] In Saudi Arabia, depression and anxiety were prevalent among hypertensive and diabetic patients.[21,22] However, there is scarce evidence about the effect of socioeconomic inequalities on the relationship between common chronic diseases and anxiety and depression. Previous studies have mainly focused on assessing the prevalence rates, without considering the dimension of social determinants and lifestyle factors.

Therefore, this study aimed to identify the relationships between anxiety, depression, and common chronic diseases (T2D, hypertension, dyslipidemia, and RA), estimate the prevalence of these common chronic diseases in outpatients attending primary care clinics at King Khalid University Hospital (KKUH), determine the association between anxiety, depression, and these common chronic diseases, and determine the associations (if any) between the participants' common sociodemographic factors (ie, social determinants), lifestyle factors (physical activity and dietary habits), and chronic diseases.

Material and Methods

Study Design and Population

An analytical cross-sectional study was conducted between September 1, 2020 and February 14, 2021 among patients diagnosed with common chronic diseases (including hypertension, T2D, dyslipidemia, and RA) who attend the primary care outpatient clinics at KKUH. These clinics are within a national tertiary care hospital that accepts referrals for all age groups across Saudi Arabia and provides immediate medical access to all the patients with suspected chronic diseases.

In this study, we used a simple random sampling technique. Eligible participants were randomly selected and recruited from the KKUH's patient database—the Electronic System for Integrated Health Information (eSiHi), which is a hospital information management system that provides patient information, including their medical notes and contact details. We used this system to search and randomly select patients attending primary care outpatient clinics, who fulfilled the inclusion criteria.

The inclusion criteria were Saudi patients aged ≥18 years, diagnosed with one of the chronic diseases (hypertension, T2D, dyslipidemia, and RA) for ≥3 years, as depression develops overtime and to ensure that the relationship between anxiety, depression, and chronic diseases is accurate and not related to the COVID-19 pandemic. The exclusion criteria were patients already diagnosed with clinical depression or currently taking antidepressants, patients diagnosed with clinical anxiety or currently taking

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anxiolytics, patients diagnosed with other psychiatric disorders, including schizophrenia and psychosis, and patients with type 1 diabetes mellitus.

Sample Size Estimation

The sample size was calculated as n = 382, based on the prevalence of anxiety and depression among patients with chronic diseases (54%).[22] Therefore, we calculated the sample size by using the equation:

$$n = Z^2 \times (p)(1-p) \div e^2$$

where

n = sample size
Z = normal distribution
e = precision
p = proportion (prevalence).

The minimum sample size required was 382 participants, with an additional 20% (76 participants) to compensate for potential nonresponses and incomplete data, and a confidence level (CI) of 95%. The final sample size for the current study was calculated as 458 participants.

Data Collection

The validated HADS-A and HADS-D (Hospital Anxiety and Depression Scale) questionnaires in English and Arabic (Supplemental Appendix A), which can be accessed for academic and research purposes,[23,24] were used. Permission was obtained from the authors before distributing the questionnaire to eligible participants. The questionnaires were distributed electronically (due to the COVID-19 pandemic) to eligible participants by sending the links to their mobile numbers or emails listed in the patients' hospital records. As the response rate for electronic surveys is known to be lower compared to face-to-face interviews,[25] a WhatsApp message reminder was sent to the participants every 3 days for approximately 2 weeks (4-5 reminders). Participants were requested to provide electronic informed consent (Supplemental Appendix B) before enrolling in the study. Additional data about the patients' medical and medication history was obtained from the patients' medical records through eSiHi. A pilot study was conducted on a group of 20 subjects to check the clarity and phrasing of the questionnaire. The results of the pilot study showed Cronbach's alpha to be >.6, indicating that all the items in the depression and anxiety questions were reliable and appropriate to measure depression and anxiety.

This study used Arabic and English questionnaires, which had 3 main sections: sociodemographic characteristics, common chronic diseases, and the hospital anxiety and depression scale (HADS).[23,24] The first section was information about the patients' characteristics and sociodemographic data[1,7] based on epidemiological Saudi data; these social determinants and lifestyle factors include age, sex, marital status, household income, educational level, occupation, health insurance, body mass index (BMI), smoking status, alcohol consumption, level of physical activity, dietary habits, and the effect of the COVID-19 pandemic. Questions about the participants' dietary habits and levels of physical activity were adopted from other validated questionnaires.[26] The second section asked for information about common chronic conditions, including medical and medication history, and laboratory results for blood tests. The third section assessed the current level of the patients' psychological well-being, using the previously validated Arabic version of the HADS, which is a 14-item questionnaire translated to Arabic.[23] It consists of 2 parts: 7 questions about anxiety and 2 questions about depression. Each question can be answered by a response on an ordinal 4-point scale (0 = lowest, 3 = highest). The sums of the total points from the 7 responses in each section were translated into a scoring system to categorize each patient's outcome (normal = 0-7, borderline abnormal = 8-10, abnormal = 11-21). Patients with an abnormal score in each section (anxiety or depression, scores 11-21) were considered to have depression or anxiety, respectively.

Institutional Review Board Approval

This study was conducted according to the guidelines of the Declaration of Helsinki. It was approved by the Institutional Review Board of King Saud University College of Medicine (Ethics Approval Number: E-E-20-5450).

Informed Consent by Participants

The eligible participants gave written informed electronic consent (Supplemental Appendix A) and self-administered the online survey (Supplemental Appendix B). Informed consent was obtained after the nature and possible consequences of the study had been explained to the participants. The confidentiality of data was assured, as the survey tool was anonymous. No incentives or rewards were offered to the participants.

Data Analysis

Data was analyzed using the SPSS v. 26.0.software package (SPSS, Chicago, IL, USA). Descriptive statistics (means, standard deviations, frequencies, and percentages) were used to describe the quantitative and categorical variables. Bivariate statistical analysis was performed using chi-square analysis to examine the association between the common chronic diseases and common social determinants. *P*-values <.05 and 95% confidence intervals (CI) were used to report statistically significant results. Multinomial

regression analysis was performed to examine the associations between chronic diseases, depression, and anxiety. For multinomial logistics regression, the dependent variables were depression (0 = normal, 1 = borderline, and 2 = abnormal) and anxiety (0 = normal, 1 = borderline, and 2 = abnormal). These analyses were adjusted for potential confounders, including age, sex, medical and medication history, marital status, educational level, occupation, income, body mass index, smoking, drinking, health insurance, physical activity, and dietary habits.

Results

A total of 61 969 randomly selected patients from the hospital database had one or more of the chronic diseases of interest in this study. From these, 7500 met the eligibility criteria and were contacted to complete the questionnaire. Only 459 patients responded to the questionnaire and 188 patients had to be excluded as they were diagnosed with clinical depression and/or anxiety during the course of the study, were currently on antidepressants or anxiolytics, were diagnosed with other psychiatric disorders, including schizophrenia and psychosis, or diagnosed with type 1 diabetes. Consequently, only 271 patients participated in this study; there were 91 (33.6%) men and 180 (66.4%) women.

The descriptive statistics of the participants who responded to the questionnaire are shown in Table 1. The mean age of the study participants was 51.65 + 11.71 years (median 52 years), mean body weight was 78.62 ± 16.78 kg (median 78 kg), mean height was 160.92 ± 15.46 cm (median 162 cm), and mean body mass index (BMI) was 30.33 ± 10.15 kg/m^2 (median 29.17 kg/m^2). Most of the study participants (91.5%) were non-smokers, only 3 participants consumed alcohol, and most participants (84.1%) did not have health insurance. During the COVID-19 pandemic, 60% of the participants consulted a physician about their chronic diseases, and 87.8% of the participants took medications (antihypertensive drugs, oral hypoglycemic agents, antirheumatic drugs, corticosteroids, and statins) during the COVID-19 period.

Sociodemographic Factors and Chronic Diseases

Table 2 shows the odds ratios of common chronic diseases in association with sociodemographic factors. Age was significantly associated with the presence of hypertension and T2D. Compared with patients aged <30 years, those aged >60 and 41 to 60 years had 9.5 times and 8.05 times greater odds of developing hypertension and T2D, respectively. Additionally, there were significant statistical differences in the development of hypertension, T2D, and RA between men and women. While the women had lower odds of developing hypertension (OR 0.54, 95% CI 0.33, 0.91) and T2D (OR 0.42, 95% CI 0.25, 0.70), they had higher odds of developing RA (OR 4.98, 95% CI 2.88, 8.62) compared to the men. Dyslipidemia showed no significant associations with the sociodemographic characteristics of the patients.

Other social determinants, including marital status, occupation, income, and smoking status showed significant associations (*P*-value <.05) only with RA; the odds of developing RA were higher in the divorced (*P*-value .03) and unemployed participants (*P*-value .004). Similarly, income showed a significant association with RA (<.001); the higher the participant's income, the lower the odds of RA. On the contrary, those who smoked had 0.284 times lower odds of having RA than participants who did not smoke (*P*-value .003).

Lifestyle Factors and Chronic Diseases

In the week before completing the questionnaire, 88.2% of participants did not do vigorous physical activity. The majority of the study participants (87.5%) did not do any moderate physical activity. The mean physical activity per day was 2.99 ± 4.282 h (median 1 h/day) (Supplemental Table 1). Most of the participants (65%) drank caffeinated drinks almost every day and the majority (60%) of participants did not consume sugary drinks, donuts, cakes, and fast food on a daily basis. Candy and chocolate were consumed 1 to 3 days per week (Supplemental Figures 1–5).

After adjusting for age, gender, obesity (weight), BMI, medical history and medications (oral hypoglycemic agents, antihypertensive, lipid-lowering, and antirheumatic medications), the relationship between chronic diseases and the patients' lifestyle factors is shown in Table 3. Hypertension showed a significant relationship with sugary drinks consumption, vigorous activity, and the sedentary activity. Patients who consumed sugary drinks 1 to 3 times per week had greater odds of having hypertension compared with those who did not consume sugary drinks (OR 2.83, 95% CI 1.42, 5.61). In contrast, the odds of having hypertension were lower in patients who did vigorous physical activity for >3 days per week (OR 0.1, 95% CI 0.01, 0.99) than those who did not do any vigorous physical activity.

T2D showed a significant relationship with the amount of sugary drinks consumption. Patients who consumed sugary drinks 1 to 3 times per week had higher odds of having T2D compared with those who did not consume sugary drinks, with an OR of 2.24 (95% CI 1.15, 4.36, *P*-value .02); the odds of having T2D were higher in those who consumed sugary drinks 4 to 6 times per week (OR 3.60, 95% CI 1.16, 11.19, *P*-value .03) compared to those who consumed sugary drinks 1 to 3 times per week.

HADS Scores for Depression and Anxiety

After calculating the scores of the responses to the questions about depression, the participants were categorized as

Table 1. Demographic Characteristics of the Study Participants (n = 271).

Characteristics	n (%)
Sex	
Male	91 (33.6)
Female	180 (66.4)
Age group (years)	
<30	11 (4.1)
31-40	41 (15.1)
41-60	157 (57.9)
>60	62 (22.9)
Marital status	
Single	22 (8.1)
Married	210 (77.5)
Widowed	22 (8.1)
Divorced	17 (6.3)
Educational level	
Illiterate	12 (4.4)
Can read and write	37 (13.7)
Secondary school	80 (29.5)
University	142 (52.4)
Smoking status	
Smokers	23 (8.5)
Nonsmokers	248 (91.5)
Employment status	
Employed	126 (46.5)
Unemployed	145 (53.5)
Household income (Saudi Arabian Riyal/month)	
<5000	59 (21.8)
5001-10000	86 (31.7)
10001-20000	80 (29.5)
>20000	46 (17)
Body mass index (kg/m^2)	
<18.5 (underweight)	2 (0.7)
18.5-24.9 (normal)	52 (19.2)
25-29.9 (overweight)	87 (32.1)
>30 (obese)	130 (48)
Alcohol consumption	
Yes	3 (1.1)
No	268 (98.9)
Health insurance	
Yes	43 (15.9)
No	228 (84.1)
Type 2 diabetes (n = 62)	
Controlled (HbA1c% < 7)	32 (51.6)
Not controlled (HbA1c% ≥ 7)	30 (48.3)
Hypertension control (n = 211) (Blood pressure > 140/90 mmHg)	
Yes	150 (71)
No	61 (28.9)
Consulted physicians during COVID-19 pandemic	
Yes	163 (60)
No	108 (40)
Medications history[a]	
Yes	238 (87.8)
No	33 (12.2)

[a]Antihypertensive drugs, oral hypoglycemic agents, antirheumatic drugs, corticosteroids, and statins.

normal (73.4%), borderline abnormal (17.7%), and abnormal (8.9%). After calculating the scores for the responses to the questions about anxiety, the participants were categorized as normal (80.8%), borderline abnormal (10.3%), and abnormal (8.9%). The participants with scores classified as abnormal were considered to have either depression and/or anxiety, depending upon the section of the questionnaire (Supplemental Table 2).

Table 4 shows multinomial regression analysis of the HADS scores for anxiety. Hypertensive patients were more likely to have anxiety compared to those without hypertension, although the relationship was not statistically significant. Patients with T2D had higher odds of having borderline (OR 3.04, *P*-value = .03) or abnormal (OR 4.65, *P*-value <.001) levels of anxiety compared to the patients without T2D; and the association remained significant even after adjusting for the common confounders (age, sex, medical and medication history, marital status, educational level, occupation, income, body mass index, smoking, drinking, health insurance, physical activity, and dietary habits). Although dyslipidemia showed an inverse relationship with anxiety in the unadjusted model, patients with dyslipidemia showed higher odds of borderline anxiety and abnormal levels of anxiety when adjusted for the sociodemographic characteristics and lifestyle factors (OR 5.93, *P*-value .01 and OR 4.70, *P*-value .09, respectively).

Table 5 shows multinomial regression analysis of the HADS scores for depression. The unadjusted models showed that there were no significant associations between hypertension, T2D, dyslipidemia, and RA and the level of depression, although these chronic diseases were more likely to increase the odds of developing depression. However, when adjusted for the sociodemographic characteristics and lifestyle factors (physical activity and dietary habits), patients with RA showed 4 times higher odds of developing abnormal levels of depression compared to patients without RA (OR 4.16, *P*-value = .04).

Discussion

To the best of our knowledge, this is the first study in Saudi Arabia to examine the relationship between anxiety and depression in patients and common chronic diseases and their social determinants and lifestyle factors in primary care outpatient clinics. All the participants were classified into levels of anxiety and depression according to their HADS scores (HADS-A 8 or HADS-D 8, respectively).[24] Our study showed a significant association between the HADS score for borderline and abnormal anxiety and the presence of T2D (OR 3.04, *P*-value = .03 and OR 4.65, *P*-value <.03, respectively) and dyslipidemia (OR 5.93, *P*-value = .01 and OR 4.70, *P*-value = .09, respectively). The odds of developing depression were 4 times higher (*P*-value .04) in patients with RA compared with those without RA.

T2D is a growing health problem, due to its increasing prevalence and cardiovascular complications, making it one of the largest worldwide health concerns.[22] In our study, we

Table 2. Distribution of Common Chronic Diseases Based on Patients' Sociodemographic Characteristics (n = 271).

	Hypertension			Type 2 diabetes			Dyslipidemia			Rheumatoid arthritis		
Characteristics	No (%)	Yes (%)	OR (95% CI)	No (%)	Yes (%)	OR (95% CI)	No (%)	Yes (%)	OR (95% CI)	No (%)	Yes (%)	OR (95% CI)
Sex												
Men	47.25	52.75		40.66	59.34		56.04	43.96		57.14	42.86	
Women	62.22	37.78	0.54* (0.33, 0.91)	62.22	37.78	0.42* (0.25, 0.70)	62.78	37.22	0.76 (0.45, 1.26)	21.11	78.89	4.98* (2.88, 8.62)
Age												
≤30 Years	81.80	18.20		90.90	9.10		81.80	18.20		36.40	63.60	
31-40 Years	82.90	17.10	0.93 (0.16, 5.25)	80.50	19.50	2.42 (0.27, 21.79)	82.90	17.10	0.93 (0.16, 5.25)	31.70	68.30	1.23 (0.31, 4.96)
41-60 Years	58.60	41.40	3.18 (0.67, 15.20)	55.40	44.60	8.05* (1.01, 64.38)	58.00	42.00	3.26 (0.68, 15.60)	31.20	68.80	1.26 (0.35, 4.50)
>60 Years	32.30	67.70	9.45* (1.87, 47.85)	30.60	69.40	22.63* (2.70, 189.56)	48.40	51.60	4.80 (0.96, 24.04)	38.70	61.30	0.91 (0.24, 3.42)
Marital status												
Single	63.64	36.36		63.64	36.36		72.73	27.27		40.91	59.09	
Married	57.14	42.86	1.31 (0.53, 3.26)	52.86	47.14	1.56 (0.29, 3.42)	61.43	38.57	1.67 (0.13, 1.59)	36.19	63.81	1.22 (0.08, 1.27)
Divorced	58.82	41.18	1.23 (0.33, 4.49)	58.82	41.18	1.23 (0.63, 3.88)	41.18	58.82	3.81 (0.31, 1.82)	5.88	94.12	11.08* (0.13, 1.20)
Widowed	50.00	50.00	1.75 (0.52, 5.84)	63.64	36.36	1.00 (0.33, 4.49)	54.55	45.45	2.22 (0.48, 6.16)	54.55	45.45	3.12 (0.36, 35.20)
Educational level												
Illiterate	41.67	58.33		41.67	58.33		58.33	41.67		16.67	83.33	
Read and write	48.65	51.35	0.75 (0.20, 2.81)	56.76	43.24	0.54 (0.15, 2.04)	56.76	43.24	1.067 (0.29, 4.00)	18.92	81.08	0.86 (0.15, 4.82)
Secondary school	48.75	51.25	0.75 (0.22, 2.57)	57.50	42.50	0.53 (0.15, 1.81)	62.50	37.50	0.84 (0.25, 2.88)	35.00	65.00	0.37 (0.08, 1.81)
University	65.49	34.51	0.38 (0.11, 1.25)	54.23	45.77	0.60 (0.18, 1.99)	60.56	39.44	0.91 (0.28, 3.02)	37.32	62.68	0.34 (0.07, 1.59)
Occupation												
Unemployed	52.41	47.59		54.48	45 .52		62.07	37.93		25.52	74.48	
Employed	62.70	37.30	0.66 (0.40, 1.07)	55.56	44.44	0.96 (0.59, 1.55)	58.73	41.27	1.15 (0.71, 1.87)	42.06	57.94	0.47* (0.28, 0.79)
Income												
0-5000	59.32	40.68		57.63	42.37		55.93	44.07		13.56	86.44	
5001-10000	61.63	38.37	0.91 (0.46, 1.79)	61.63	38.37	0.85 (0.43, 1.66)	66.28	33.72	0.65 (0.33, 1.28)	31.40	68.60	0.34* (0.14, 0.82)
10001-20000	52.50	47.50	1.32 (0.67, 2.60)	51.25	48.75	1.29 (0.66, 2.55)	56.25	43.75	0.99 (0.50, 1.94)	38.75	61.25	0.25* (0.10, 0.59)
>20000	54.35	45.65	1.23 (0.56, 2.67)	45.65	54.35	1.62 (0.75, 3.52)	63.04	36.96	0.74 (0.34, 1.64)	52.17	47.83	0.14* (0.06, 0.37)
Smoking												
No	56.05	43.95		54.84	45.16		58.87	41.13		30.65	69.35	
Yes	69.57	30.43	0.59 (0.22, 1.40)	56.52	43.48	0.93 (0.40, 2.21)	78.26	21.74	0.40 (0.14, 1.11)	60.87	39.13	0.28* (0.11, 0.69)
Drinking												
No	57.46	42.54		54.85	45.15		60.82	39.18		33.21	66.79	
Yes	33.33	66.67	2.70 (0.24, 30.16)	66.67	33.33	0.61 (0.05, 6.78)	33.33	66.67	3.11 (0.28, 34.67)	33.33	66.67	0.99 (0.09, 11.12)

The association between common chronic diseases and patients' sociodemographic characteristics was adjusted for age, gender, medical and medication factors.
*$P < .05$ is statistically significant.

Table 3. Distribution of Common Chronic Diseases Based on Patients' Lifestyle Factors (n = 271).

	Hypertension		Type 2 diabetes		Dyslipidemia		Rheumatoid arthritis	
Variable	OR (95% CI)	*P*-value	OR (95% CI)	*P*-value	OR (95% CI)	*P*-value	OR (95% CI)	*P*-value
Caffeinated drinks								
Never		.87		.96		.72		.45
1-3 per week	1.02 (0.30, 3.41)	.98	0.91 (0.26, 3.20)	.88	0.56 (0.16, 1.97)	.36	0.56 (0.13, 2.37)	.43
4-6 per week	0.67 (0.19, 2.36)	.53	1.19 (0.33, 4.30)	.79	0.67 (0.18, 2.44)	.54	0.84 (0.20, 3.58)	.81
Everyday	0.85 (0.30, 2.43)	.76	0.95 (0.32, 2.81)	.92	0.54 (0.18, 1.64)	.28	1.18 (0.36, 3.89)	.79
Sugary drink								
Never		.03		.04		.38		.84
1-3 per week	2.83 (1.42, 5.61)	<.001*	2.24 (1.15, 4.36)	.02*	1.69 (0.88, 3.25)	.12	0.77 (0.37, 1.62)	.50
4-6 per week	1.58 (0.56, 4.41)	.39	3.60 (1.16, 11.19)	.03*	1.11 (0.41, 3.04)	.84	0.69 (0.20, 2.38)	.56
Everyday	1.14 (0.31, 4.19)	.84	1.23 (0.34, 4.52)	.75	0.83 (0.24, 2.83)	.76	0.63 (0.15, 2.58)	.52
Donuts, cakes								
Never		.63		.59		.49		.89
1-3 per week	1.41 (0.75, 2.67)	.29	0.65 (0.34, 1.24)	.19	0.90 (0.48, 1.69)	.75	1.31 (0.64, 2.71)	.46
4-6 per week	0.66 (0.14, 3.07)	.59	1.13 (0.23, 5.58)	.88	0.31 (0.07, 1.36)	.12	1.55 (0.29, 8.37)	.61
Everyday	1.3	1	3	1	1.2	1	0	1
Candy, chocolates								
Never		.16		.66		.908		.563
1-3 per week	0.77 (0.40, 1.50)	.45	1.07 (0.55, 2.09)	.85	0.95 (0.50, 1.82)	.88	0.91 (0.42, 1.97)	.82
4-6 per week	2.79 (0.77, 10.08)	.12	2.08 (0.63, 6.88)	.23	1.29 (0.41, 4.03)	.66	1.00 (0.28, 3.59)	1.00
Everyday	2.40 (0.37, 15.35)	.36	1.11 (0.20, 6.15)	.90	1.53 (0.28, 8.45)	.63	3.18 (0.53, 19.26)	.21
Fast food								
Never		.56		.34		.84		.78
1-3 per week	1.02 (0.56, 1.86)	.95	1.55 (0.85, 2.82)	.15	1.07 (0.60, 1.92)	.82	1.36 (0.70, 2.65)	.37
4-6 per week	3.20 (0.46, 22.25)	.24	3.20 (0.43, 23.84)	.26	0.59 (0.09, 3.86)	.58	1.55 (0.20, 11.84)	.67
Everyday	0.41 (0.03, 5.25)	.49	4.17 (0.29, 60.95)	.30	2.19 (0.18, 26.80)	.54	0.62 (0.03, 13.42)	.76
Vigorous physical activity								
No vigorous physical activity per week		.13		.31		.39		.00
1-3 Days per week	0.16 (0.02, 1.70)	.13	0.22 (0.13, 0.03, 1.52)		0.37 (0.05, 2.63)	.32	2.69 (0.43, 16.95)	.29
>3 Days per week	0.10 (0.01, 0.99)	.05*	0.30 (0.05, 1.79)	.19	0.29 (0.05, 1.77)	.18	0.35 (0.06, 2.00)	.24
Moderate physical activity								
No moderate physical activity per week		.36		.21		.27		.02
1-3 Days per week	0.28 (0.05, 1.62)	.15	2.00 (0.38, 10.56)	.42	3.66 (0.75, 17.84)	.11	0.87 (0.15, 5.17)	.88
>3 Days per week	0.43 (0.09, 1.96)	.27	0.64 (0.16, 2.53)	.52	2.34 (0.63, 8.68)	.20	5.13 (1.00, 26.32)	.05*
Sitting hours								
≤5 H per day		.12		.44		.98		.96
6-10 H per day	0.25 (0.07, 0.96)	.40	2.53 (0.59, 10.81)	.21	0.92 (0.27, 3.13)	.89	0.92 (0.23, 3.67)	.90
>10 H per day	0.30 (0.07, 1.19)	.09	2.60 (0.58, 11.75)	.21	0.96 (0.27, 3.45)	.95	0.85 (0.20, 3.57)	.82

The association between common chronic diseases and patients' lifestyle factors was adjusted for age, gender, obesity (weight), BMI, medical and medications (anti-diabetics, antihypertension, anti-lipids, and antirheumatic medications) history.

*$P < .05$ is statistically significant.

Table 4. Multinomial Regression Analysis of the Hospital Anxiety and Depression Scale (HADS) Scores for Anxiety.

	Model 1				Model 2				Model 3			
			CI (95%)				CI (95%)				CI (95%)	
HADS score anxiety	Odds ratio	*P*-value	Lower	Upper	Odds ratio	*P*-value	Lower	Upper	Odds ratio	*P*-value	Lower	Upper
Borderline												
Intercept		.00				.66				1.00		
Hypertension = Yes	1.01	.99	0.41	2.45	1.23	.70	0.42	3.58	0.80	.72	0.23	2.80
Hypertension = No												
T2D = Yes	3.04	.03*	1.13	8.19	3.49	.04*	1.04	11.71	3.08	.001*	0.02	0.38
T2D = No												
Dyslipidemia = Yes	0.92	.87	0.36	2.37	1.12	.84	0.38	3.30	5.93	.01*	1.54	22.86
Dyslipidemia = No												
Rheumatoid arthritis = Yes	1.40	.46	0.58	3.40	1.49	.45	0.53	4.21	1.01	.98	0.31	3.37
Rheumatoid arthritis = No												
Abnormal												
Intercept		.00				.00				.99		
Hypertension = Yes	1.25	.64	0.48	3.24	1.21	.72	0.43	3.39	1.82	.51	0.31	10.82
Hypertension = No												
T2D = Yes	4.65	<.001*	1.63	13.22	8.04	<.001*	2.30	28.12	0.36	.34	0.04	2.94
T2D = No												
Dyslipidemia = Yes	0.29	.02*	0.10	0.83	0.28	.03*	0.09	0.88	4.70	.09	0.78	28.35
Dyslipidemia = No												
Rheumatoid arthritis = Yes	1.01	.98	0.40	2.56	0.98	.97	0.35	2.77	1.05	.95	0.20	5.65
Rheumatoid arthritis = No												

Abbreviation: T2D, type 2 diabetes.
Model 1: chronic diseases with depression and anxiety only; Model 2: chronic diseases with depression and anxiety adjusted for sociodemographic characteristics; Model 3: chronic diseases with depression and anxiety adjusted for sociodemographic characteristics and lifestyle factors (physical activity and dietary habits).
*$P < .05$ is statistically significant.

found that diabetic patients were more likely to develop depression and 3 times more likely to have anxiety than patients without T2D. This association was still significant even after adjusting for confounders, including sociodemographic and lifestyle factors, obesity, and oral hypoglycemic agents medications. In line with our findings, a study conducted in Mexico reported that 48.27% of diabetic patients had depression and 55.10% of them had anxiety.[25] Similarly, a 2007 study of diabetic Chinese patients found that 25.7% of the participants had anxiety and depression.[26] However, these studies only reported the prevalence of T2D, and the impact of the important confounders was not assessed. In contrast, our results showed that 51.6% of patients with T2D had adequate glycemic control, which is higher than that reported in the national Saudi survey (31.6%),[7] and it was adjusted in the regression model along with the common social determinants and lifestyle factors.

Although our study showed no significant relationship between anxiety or depression and hypertension, the presence of hypertension increases the likelihood of developing these psychological disorders. It should be highlighted that about 29% of hypertensive patients in our study had achieved adequate blood pressure control, which might explain why the association between exposure to hypertension and developing anxiety and/or depression did not reach statistical significance. Similar to our findings, a cohort study conducted in Canada between 2005 and 2006, showed that there were higher odds of anxiety in patients with hypertension with an adjusted OR of 4.24 (95% CI 1.29-14.01).[20] In contrast, a cross-sectional study of hypertensive patients from Afghanistan showed the prevalence of anxiety and depression to be 42.3% and 58.1%, respectively.[27] A recent cross-sectional study of Al Khobar's (Saudi Arabia) hypertensive and diabetic primary care patients showed that 48.7% of the participants had depression and 38.4% of the participants had anxiety.[21,22] However, this is an observational study conducted in 1 Saudi Arabian city and these findings cannot be extrapolated to the entire Saudi population. Many important Saudi social determinants of chronic diseases were not examined.[1,7] These Middle Eastern studies were prevalence studies, where the causal relationship between the exposure to chronic diseases and the presence of depression or anxiety cannot be inferred.

Several studies have shown that dyslipidemia is a major modifiable risk factor for many NCDs including mental illness.[28] A study conducted in Riyadh, Saudi Arabia concluded that the prevalence of dyslipidemia in Saudi Arabia has been rising at a dramatic rate and suggested an urgent

Table 5. Multinomial Regression Analysis of the Hospital Anxiety and Depression Scale (HADS) Scores for Depression (n = 271).

	Model 1				Model 2				Model 3			
			CI (95%)				CI (95%)				CI (95%)	
HADS score depression	Odds ratio	*P*-value	Lower	Upper	Odds Ratio	*P*-value	Lower	Upper	Odds Ratio	*P*-value	Lower	Upper
Borderline												
Intercept		.00				.65				.71		
Hypertension = Yes	1.59	.20	0.78	3.22	1.98	.09	0.90	4.37	1.91	.13	0.82	4.46
Hypertension = No												
T2D = Yes	1.40	.40	0.64	3.02	1.73	.24	0.70	4.31	1.55	.38	0.59	4.13
T2D = No												
Dyslipidemia = Yes	0.62	.22	0.29	1.34	0.57	.19	0.24	1.32	0.61	.30	0.24	1.55
Dyslipidemia = No												
Rheumatoid arthritis = Yes	1.54	.24	0.74	3.19	1.44	.40	0.62	3.35	1.44	.43	0.58	3.54
Rheumatoid arthritis = No												
Abnormal												
Intercept		.00				.96				1.00		
Hypertension = Yes	0.90	.83	0.34	2.37	0.76	.63	0.24	2.37	0.91	.90	0.24	3.47
Hypertension = No												
T2D = Yes	1.56	.40	0.56	4.36	1.48	.51	0.46	4.81	1.51	.54	0.41	5.56
T2D = No												
Dyslipidemia = Yes	1.16	.77	0.42	3.20	1.61	.41	0.52	5.05	1.67	.43	0.47	5.99
Dyslipidemia = No												
Rheumatoid arthritis = Yes	2.42	.11	0.83	7.02	2.97	.06	0.94	9.36	4.16	.04*	1.10	15.79
Rheumatoid arthritis = No												

Abbreviation: T2D, type 2 diabetes.
Model 1: chronic diseases with depression and anxiety only; Model 2: chronic diseases with depression and anxiety adjusted for sociodemographic characteristics; Model 3: chronic diseases with depression and anxiety adjusted for sociodemographic characteristics and lifestyle factors (physical activity and dietary habits).
*$P < .05$ is statistically significant.

plan involving multiple sectors, to decrease the incidence of dyslipidemia.[29] In our study, although the patients with dyslipidemia had a clinically relevant level of anxiety, they did not have depression. After controlling for sociodemographic characteristics and lifestyle factors, the patients with dyslipidemia had 5 times higher odds of borderline and abnormal anxiety levels. In line with our findings, a study conducted in Germany revealed that the prevalence of dyslipidemia was 29.3%; and these patients showed higher odds of depression with an adjusted OR of 1.35 (95% CI 1.02-1.79) and generalized anxiety with an adjusted OR of 1.02 (95% CI 0.69-1.51).

The co-occurrence of anxiety and depression in patients with RA is still under-recognized and not managed adequately.[30] In our study, the prevalence of RA was 66.8% and patients with RA were more likely to have depression compared with patients without RA. When we adjust for sociodemographic characteristics, and lifestyle factors (physical activity and dietary habits), patients with RA showed 4 times higher odds of developing abnormal levels of depression compared to patients without RA (OR 4.16, *P*-value = .04). There is emerging evidence about the association of anxiety and depression with RA. A Turkish study conducted on 82 patients with RA and 41 healthy controls, showed a linear relationship between anxiety, depression, and RA.[31] Similarly, a cross-sectional study of 68 patients in Ireland (47 women and 21 men) showed an association between RA, depression, and anxiety.[32] However, these studies had small sample sizes where the association could be underestimated.

Our findings showed that the relationship between exposure to NCDs is significantly associated with several social and lifestyle determinants. Social determinants of health have risen to the forefront as essential intervention targets, due to the shift of health care toward a greater emphasis on population health outcomes and value-based care. Social determinants of NCD are an important domain to address in the prevention of anxiety and depression.[33]

Our finding that aging and differences between the sexes are associated with higher odds of developing T2D, and hypertension is consistent with several previous studies.[1,18,34] It subsequently aggravates the development of anxiety and depression, as aging is characterized by critical biological, psychological, and social changes. It is possible that changes that occur in later life (retirement, increased isolation, the death of loved ones, multiple medical problems, and other cultural differences) could contribute to the increased odds of developing anxiety and depression.[35] For example, in China, a higher prevalence of depression was reported among the elderly,

due to being isolated and lonely with no family support (due to the 1-child policy), retirement, and subsequently a lower income.[18]

In our study, RA showed significant associations with several social determinants. While women had lower odds of developing hypertension and T2D (OR 0.42, 95% CI 0.25, 0.70), they had higher odds of developing RA (OR 4.98, 95% CI 2.88, 8.62) compared to men. Other social determinants including marital status, occupation, income, and smoking status were significantly associated with RA; the odds of developing RA were higher in divorced and unemployed women with lower incomes. These factors are considered as stressors affecting the development of NCDs as well as anxiety and depression.[36] Stress is a well-known trigger for inflammatory diseases, including RA.[37] Although smoking has been linked to the development and severity of RA,[38] we found that smokers had lower odds of having RA than patients who did not smoke. This could be underestimated as self-reports of smoking could lead to self-report bias[39]; the majority of participants (91.5%) self-reported that they are nonsmokers.

Our findings are similar to previous literature regarding other lifestyle factors[1,40]; for example, consuming sugar 1 to 3 times a week, physical inactivity, and sitting for more hours per day increased the likelihood for NCDs and the subsequent development of anxiety and depression. Therefore, differences in lifestyle, dietary habits, living environment, and the prevalence of chronic diseases could be strong attributes to anxiety and depression.

The strength of this study is that the participants were selected from the primary care clinics at the KKUH, which is one of the largest tertiary hospitals in Saudi Arabia that accepts referrals for all age groups across Saudi Arabia and provides medical access to all patients with suspected chronic diseases. This is the first study to investigate the associations of social determinants and inequalities in the prevalence of NCDs and their relationship with the development of anxiety and depression. However, our study has some limitations. This is a cross-sectional study; therefore, we cannot have a causal conclusion. We suggest that further studies are conducted to examine the influence of chronic diseases on the development of depression and anxiety over time. We had to exclude 188 responses from the eligible participants, as they developed deviations from the inclusion criteria (including recent diagnoses of clinical depression and or anxiety) over the course of the study, despite these participants completing the questionnaire. The study was conducted during the COVID-19 pandemic when respondent fatigue from overexposure to surveys was highly expected; this phenomenon is challenging as it negatively affects the response rate.[41]

Conclusions

Anxiety and depression were significantly associated with T2D and RA, respectively. Social determinants and lifestyle factors play a major role in the development of common chronic diseases in Saudi Arabia. Primary care physicians should consider the psychological and sociodemographic status and lifestyle risks during the management of chronic diseases. Findings from this study can help policy makers develop prevention programs and identify individuals at a higher risk of NCDs, anxiety, and depression, for early intervention. A large population-based study is needed to elucidate the nature of these NCDs, including anxiety and depression and the causal relationship with their social determinants.

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Author Contributions

LRB worked on planning and execution of overarching research goals and aims; she was responsible for designing the study, methodology, study materials, computing process, critically revising the manuscript's drafts, comprehensive editing of the manuscript, read, and approved the final draft. MKA was primarily responsible for data analysis, interpreting the data, writing the first draft of manuscript, read, and approved the final draft. FHA significantly reviewed/edited the manuscript, interpreted the data, involved in data analyses, and read and approved the final draft. KBA collected the information, participated in data interpretation, read, and approved the final draft. AAA and FFA involved in collection of the data, read, and approved the final draft.

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Supplemental Material

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