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The association between screen time and depression symptoms severity among adults with diabetes: A cross-sectional study

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ABSTRACT

Objective: To investigate the association between time spent on screen-based sedentary behavior (SBSB) and depression symptom severity (DSS) among adults with type 2 diabetes.
Methods: A cross-sectional study employing secondary data collected by Qatar Biobank (QBB) on 2386 adults with type 2 diabetes aged ≥ 18 years. Self-reported data on DSS measured using the Patient Health Quationnaire-9 and daily time spent on SBSB per week was used.
Results: After adjusting for covariates, including physical activity and sleep duration, subjects who spent 2–4 h or > 4 h a day on SBSB watching TV or other devices other than computers during weekdays had increased odds of higher DSS than subjects who spent < 1 h by 44% (95% Confidence interval (CI) 13–83%) and 52% (95% CI 17–96%), respectively. Subjects who spent > 4 h a day on SBSB using computers during weekdays had increased odds of higher DSS by 115% (95% CI 56–196%) than subjects who spent < 1 h. Similar associations were observed between time spent on SBSB using the mentioned devices during weekends and DSS.
Conclusion: Increase in time spent on SBSB is independently associated with increased DSS among adults with type 2 diabetes regardless of the equipment used or timing of the week.

1. Introduction

Depression is a common mental disorder affecting around 246 million people worldwide, mostly women and younger people [1]. In the Global Burden of Disease Study 2019, depressive disorders were ranked as the second leading cause of years lived with disability [2]. Globally, the incidence of depression has increased by approximately 50% between the year 1990 and 2017, with the highest increase observed in Qatar [3]. More recently, about 53 million additional cases of major depressive disorder globally were attributed to the COVID-19 pandemic [1]. The exact causes for depression are not clearly understood, but a complex interaction between diverse risk factors such as genetic, biological, socioeconomic, and psychological factors appear to contribute to depression [4]. Depression is associated with poor quality of life, increased risk of suicide, and is more prevalent among patients suffering from chronic physical conditions [5–8].

The global prevalence of diabetes in 2019 was 7.5% (374 million), which is projected to increase to 8.0% (454 million) and 8.6% (548 million) by 2030 and 2045, respectively [9]. Research evidence shows that depression is a common comorbid condition in patients with diabetes. A systematic review with meta-analysis including 248 studies showed that 28% of patients with type 2 diabetes experienced depression [10]. Similarly, in another systematic review, the prevalence of depression in individuals with type 1 diabetes and type 2 diabetes were higher by 9% and 8% as compared to individuals without diabetes, respectively [11].

"Sedentary behavior refers to activities that do not increase energy expenditure substantially above the resting level and includes activities such as sleeping, sitting, lying down, and watching television, and other forms of screen-based entertainment" [12]. There is compelling evidence that sedentary behavior, independent of physical activity, is associated with increased risk of cardiovascular disease, cancer, and mortality [13,14]. Additionally, the increased risk of all-cause mortality attributed to sedentary behavior is greater among individuals with high body mass index (BMI), hypertension, and diabetes [14]. Two recent systematic reviews reported a positive association between time spent

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on screen-based sedentary behavior (SBSB) and depression [15,16]. For example, a meta-analysis of 18 cohort studies, with a total of 241,398 participants, reported that increased time spent on SBSB was associated with increased depression risk by 10% (95% confidence interval, 5–14%) [16]. The exact mechanisms underlying the association between time spent on SBSB and depression independent of physical activity are not clear.

There is some evidence that daily time spent on SBSB and depression is more prevalent among individuals diagnosed with diabetes compared to those without diabetes [17,18]. However, research evaluating the relationship between time spent on SBSB according to type of SBSB and depression among individuals with diabetes is limited. The aim of this study is to examine the association between time spent on SBSB and depression symptoms severity (DSS) among individuals with type 2 diabetes in Qatar, a country with an estimated prevalence of diabetes and depression at 13% [19] and 18% [20], respectively.

2. Methods

2.1. Study design, setting and population

This was a cross-sectional study using secondary data on adults with type 2 diabetes collected by Qatar Biobank (QBB). QBB is a population-based study of Qatari nationals and long-term residents (living in Qatar for ≥15 years) aged ≥ 18 years [21]. Since 2012, QBB has been collecting intensive baseline data including physical, clinical, and behavioral characteristics from QBB population which reached 38,213 individuals in 2023 [22]. Through self-administered questionnaires, data on socioeconomic status, general health, diet, and lifestyle factors were collected. A nurse interview was conducted to collect data such as occupation, family history of diseases, current disease status, and medication use [21]. The Institutional Review Board of Hamad Medical Corporation Ethics Committee approved the study protocols of QBB (Ex-2023- QF-QBB-RES-ACC-00172-0246). All subjects provided written consent prior to enrollment in QBB population-based study. The current study was approved by QBB IRB for secondary data analysis (QF-QBB-RES-ACC-00116).

2.2. Data collection

Detailed information on measurements and data collection methods used by QBB are reported elsewhere [21].

2.3. Outcome variable

The outcome variable was DSS measured using the Patient Health Questionnaire-9 (PHQ-9). The PHQ-9 is a reliable and validated self-administered questionnaire for screening and monitoring of DSS, with a PHQ-9 score of ≥ 10 demonstrating 88% sensitivity and 88% specificity for detecting major depression [23]. The PHQ-9 assesses the extent to which the questionnaire's respondent has been bothered by nine problems over the last two weeks measured on a 4-point Likert Scale ranging from "not at all" (scored 0) to "nearly every day" (scored 3). Total PHQ-9 scores of 0–4, 5–9, 10–14, 15–19, and 20–27 represent cutoff points for none-minimal, mild, moderate, moderately severe, and severe depression symptoms, respectively [23].

2.4. Exposure variable

The main exposure variable was SBSB defined as "time spent using a screen-based device (e.g., smartphone, tablet, computer, television) while being sedentary in any context (e.g., school, work, recreational)" [24]. QBB collected self-reported daily hours spent on SBSB stratified by type of equipment and time during a typical week by asking the participants the following questions: "Please tell us about the time you have spent sitting per day during a typical week watching TV, DVDs, mobile phone, iPad etc."; "Please tell us about the time you have spent sitting per day during weekends: watching TV, DVDs, mobile phone, iPad etc."; "Please tell us about the time spent sitting per day using computer"; "Please tell us about the time spent sitting per day during weekends using computer". Each question had the following answer options: none, < 1 h per day, between 1 h and < 2 h per day, between 2 and 4 h per day, and > 4 h per day. These questions were used by QBB to augment the International Physical Activity Questionnaire, which were pilot tested and adapted according to participant's age, sex, and marital status.[21].

2.5. Covariates

To control for potential confounding variables, the covariates included sociodemographic factors (age, gender, education level, income and employment), clinical characteristics (obesity, diabetes duration and treatment type, Hemoglobin A1c (HbA1c) percentage, and medical comorbidity), and behavioral factors (sleeping and napping duration, diet modification, snacking and fast food consumption patterns, smoking, and leisure-time physical activity) previously associated with depression among patients with diabetes and more likely to be related to sedentary behavior [25–28]. The covariates were collected through QBB self-administered health and lifestyle questionnaires and blood tests as follows: age (years); gender (female, male); current smoking status (no, yes, ex-smoker); monthly income in Qatari Riyal (<10,000, 10,000–20,000, 20,001–50,000, >50,000); employment status (employed, retired, other); job involves working during the night (no/not applicable, 2 nights or less/month, 3 nights or more/month). Education level was classified as "low" (primary and secondary school), "medium" (technical or professional school), and "high" (university and postgraduate degree). BMI (kg/m^2) was classified using the WHO BMI cut-off points into the following categories: underweight (<18.5), normal range (18.5–24.9), overweight (25–29.9), and obese (>30) [29]. Other covariates included high blood cholesterol diagnosis (yes, no); high blood pressure diagnosis (yes, no); diabetes duration (≤10 years, >10 years); HbA1c%; treatment type for diabetes (diet, tablets, insulin, tablets, and insulin). Self-reported dietary covariates were diet modifications status during last year (yes, no); frequency of fast food consumption from home-delivery, take-away, and fast food restaurants during a typical week in the last year (never/rarely, once, twice, 3–5 times, every day or almost every day); frequency of snacks consumed between meals during a typical week in the last year (never/rarely, once or twice, 3–5 times, 6–7 times, >7 times). In addition, number of hours of sleep per day (<5, 5-<7, 7-<8, ≥8) including naps and frequency of naps per day (never/rarely, sometimes, frequently, always) in a typical week during the last year were included. Finally, leisure-time physical activity quantified as metabolic equivalent (MET) (minutes/week) measured using the international physical activity questionnaire was included [30].

2.6. Statistical analysis

Descriptive statistics were used to summarize the characteristics of participants, with mean and standard deviation (SD) for continuous variables and frequency with percentage for categorical variables. Bivariable and multivariable ordinal regression analyses were used to evaluate the association between time spent on SBSB and DSS. Separate analyses were performed to evaluate the relationship between each of the four exposure variables and DSS: (1) daily time spent on SBSB watching TV, DVD, tablet, and phone during weekdays; (2) daily time spent on SBSB watching TV, DVD, tablet, and phone during weekends; (3) daily time spent on SBSB using computer during weekdays; (4) daily time spent on SBSB using computer during weekends. Odds ratio (OR) and 95% confidence interval (CI) was used as a measure of association. Data analysis was performed using STATA 17 [31].

3. Results

3.1. Subject characteristics

Data on 2386 subjects with type 2 diabetes and aged ≥ 18 years was retrieved from QBB and included in the present study. The sample characteristics are summarized in Table 1. The mean age of the sample was 51.6 years (SD= 11.8), and it included 1418 females (59.4%). Most subjects were non-smokers (74.2%), 41.1% had low education level, 48.0% employed, 60.8% obese, 65.1% reported sleeping for < 7 h per day (including naps), 54.9% treated with tablets for diabetes, and 62.5% and 42.5% of subjects were diagnosed with high blood cholesterol and high blood pressure, respectively. The mean leisure-time physical activity was 883.5 MET min/week (SD= 2297.1). The highest percentage of subjects (58.2%) had minimal DSS, followed by mild (26.5%), moderate (10.8%), moderately severe (2.9%), and severe depression symptoms (1.7%).

3.2. Association between SBSB and DSS

Crude and adjusted associations between all predictor variables and DSS are presented in supplemental Table 1–4. Adjusted associations between daily time spent on SBSB and DSS are presented in Table 2. After adjusting for all covariates included in the study, subjects who spent 2–4 h or > 4 h a day on SBSB watching TV or using digital devices other than computers during weekdays had statistically significant increased odds of having higher DSS than subjects who spent < 1 h by 44% (95% CI 13–83%) and 52% (95% CI 17–96%), respectively. Similarly, subjects who spent 2–4 h or > 4 h a day on SBSB watching TV or devices other than computers during weekdays or weekends had increased odds of reporting higher DSS by 39% (95% CI 10–75%) and 59% (95% CI 24–102%) than those who spent < 1 h. No statistically significant associations between daily time spent on SBSB and DSS in subjects who spent 1 to < 2 h watching TV or other devices other than computers during weekdays or weekends compared to those who spent < 1 h.

Subjects who spent > 4 h a day on SBSB using computers during weekdays had increased odds of having higher DSS by 115% (95% CI 56–196%) than subjects who spent < 1 h. Moreover, subjects who spent 1-< 2 h or > 4 h on SBSB using computers during weekends had increased odds of reporting higher DSS compared to those spent < 1 h by 77% (95% CI 30–142%) and 136% (95% CI 67–236%), respectively. No statistically significant associations between SBSB and DSS among subjects who spent 1 to < 2 or 2–4 h a day using computers during weekdays, or 2–4 h a day during weekends in comparison with those who spent < 1 h a day during weekdays or weekends (Table 2).

4. Discussion

To our knowledge, this is the first study to examine the association between time spent on specific types of SBSB during weekdays and weekend and DSS among a large sample of individuals with type 2 diabetes. Our study showed that spending 2 h or more a day on SBSB devices other than computers during weekdays or weekends was associated with more DSS. Moreover, spending more than 4 h a day during weekdays, 1 to less than 2 h or more than 4 h a day at weekends, was also associated with higher odds of DSS. These associations were independent of leisure-time physical activity and other demographic, socioeconomic, sleep and dietary patterns, and physical health-related characteristics, which may influence DSS among patients with diabetes.

Our findings accord with the results of a cross-sectional study which assessed factors associated with prevalence of DSS among 118 Australian adults with diabetes and reported that increase in time spent on SBSB by 1-hour a day was associated with a relatively small increase in DSS score by 0.11 (95% CI 0.07, 0.16) [18]. Our findings are consistent also with systematic reviews of cross-sectional and cohort studies

Table 1
Sample characteristics.

Variable	Frequency (%)[c]
Age (Years)[a]	51.6 (11.8)
Gender	
Female	1418 (59.4)
Male	968 (40.6)
Smoking	
No	1770 (74.2)
Yes	289 (12.1)
Ex-smoker	327 (13.7)
Education level	
Low	957 (40.1)
Medium	649 (27.2)
High	780 (32.7)
Monthly income (Qatari Riyal)	
<10,000	646 (27.1)
10,000–20,000	511 (21.4)
20,001–50,000	699 (29.3)
>50,000	530 (22.2)
Employment status	
Employed	1144 (48.0)
Retired	443 (18.6)
Other	799 (33.5)
BMI (kg/m^2)[a]	32.1 (6.0)
BMI category[b]	
Normal	204 (8.6)
Overweight	731 (30.6)
Obese	1451 (60.8)
Treatment for diabetes	
Diet	474 (19.9)
Tablets	1310 (54.9)
Insulin	248 (10.4)
Tablets and Insulin	354 (14.8)
Diabetes duration	
≤10 years	930 (39.0)
>10 years	883 (37.0)
Do not know	573 (24.0)
HbA1C%[a]	7.4 (1.8)
Diagnosed with high blood cholesterol	
No	894 (37.5)
Yes	1492 (62.5)
Diagnosed with high blood pressure	
No	1373 (57.5)
Yes	1013 (42.5)
Depression symptoms severity	
Minimal	1389 (58.2)
Mild	631 (26.5)
Moderate	257 (10.8)
Moderately severe	68 (2.9)
Severe	41 (1.7)
Number of sleep hours per day	
<5	395 (16.6)
5-<7	1158 (48.5)
7-<8	603 (25.3)
≥8	230 (9.6)
Number of naps per day	
Never/rarely	465 (19.5)
Sometimes	1006 (42.2)
Frequently	463 (19.4)
Always	452 (18.9)
Diet modifications during last year	
No	1451 (60.8)
Yes	935 (39.2)
Fast food consumption per week	
Never/rarely	1121 (47.0)
Once	547 (22.9)
Twice	466 (19.5)
3–5 times	192 (8.1)
Almost every day/every day	59 (2.5)
Snacks consumption between meals per week	
Never/rarely	575 (24.1)
Once or twice	614 (25.7)
3–5	490 (20.5)
6–7	389 (16.3)
>7	318 (13.3)
Leisure-time physical activity (MET min/week)[a]	883.5 (2297.1)

(*continued on next page*)

Table 1 (*continued*)

Variable	Frequency (%)[c]
Job involves working during the night	
No/not applicable	1978 (82.9)
2 nights or less/month	128 (5.4)
3 nights or more/month	280 (11.7)

[a] mean (SD);
[b] two individuals had a BMI < 18.5 and were included in the normal range category;
[c] some reported percentages may not add up to 100% due to rounding; HbA1c %; Hemoglobin A1c%., BMI, Body Mass Index; MET, Metabolic equivalent.

demonstrating that increase in time spent on SBSB is associated with higher risk of depression in the general population [15,16]. For example, a cross-sectional study among Chinese adults reported that computer use for 3 or more hours a day at weekends was associated with increased odds of DSS by 1.33 (95% CI 1.05, 1.68) [32]. Another cross-sectional study among US adults found that individuals spending more than 6 h a day watching TV and using computers had higher odds of moderate to severe depression symptoms by 2.3 (95% CI 1.60–3.44) [33].

The exact mechanisms underlying the relationship between time spent on SBSB and DSS independent of sleep duration, leisure-time physical activity and other important characteristics among individuals with type 2 diabetes are unknown. However, several factors have been hypothesized to influence or mediate this relationship. Direct social withdrawal or isolation due to increased time spent on SBSB has been linked to DSS [34]. SBSB was found to be associated with low sleep quality and sleep disturbances, which in turn can increase susceptibility to depression [35,36]. Moreover, there is some evidence that the relationship between SBSB and DSS is mediated through exposure to screen time content involving upward social comparisons [37]. Upward social comparisons refer to the tendency of comparing oneself with others of more positive social characteristics, which has been linked to low self-esteem [38]. In addition, exposure to radiofrequency electromagnetic fields associated with screen-based equipment was found to be associated with increased risk of depression [39].

The findings of the present study highlight the need for more longitudinal and qualitative research to identify exact factors influencing and mediating the relationship between SBSB and DSS among people with diabetes, including identifying specific SBSB duration and content that are detrimental for mental health. This information has important clinical implications for increasing awareness among clinicians and patients about the negative impact of prolonged time spent on SBSB on mental health. Moreover, such information is needed for testing interventions and providing clinical guidance on appropriate strategies to

Table 2
The relationship between daily time spent on screen-based sedentary behavior and depression symptoms severity.

Variable	Depression symptoms severity					Crude association		Adjusted association	
	Minimal N (%)	Mild N (%)	Moderate N (%)	Moderately severe N (%)	Severe N (%)	OR (95% CI)	p-value	OR (95% CI)[a]	p-value
Number of hours spent sitting per day watching TV, DVD, tablet, and phone during weekdays								Ref	
< 1	399 (28.7)	146 (23.1)	55 (21.4)	12 (17.7)	11 (26.8)	Ref	0.613	1.00 (0.79, 1.27)	0.989
1 to ≤ 2	413 (29.7)	163 (25.8)	65 (25.3)	10 (14.7)	10 (24.4)	1.06 (0.85, 1.32)	< 0.001	1.44 (1.13, 1.83)	0.003
2–4	305 (22.0)	194 (30.7)	77 (30.0)	18 (26.5)	6 (14.6)	1.63 (1.31, 2.03)	< 0.001	1.52 (1.17, 1.96)	0.001
> 4	272 (19.6)	128 (20.3)	60 (23.4)	28 (41.2)	14 (34.2)	1.60 (1.27, 2.02)			
Number of hours spent sitting per day watching TV, DVD, tablet, and phone during weekends									
< 1	506 (36.4)	176 (27.9)	68 (26.5)	12 (17.7)	20 (48.8)	Ref	0.311	Ref	0.630
1 to ≤ 2	364 (26.2)	149 (23.6)	65 (25.3)	11 (16.2)	3 (7.32)	1.12 (0.90, 1.39)	< 0.001	1.06 (0.84, 1.33)	0.006
2–4	278 (20.0)	174 (27.6)	60 (23.4)	19 (27.9)	6 (14.6)	1.59 (1.29, 1.98)	< 0.001	1.39 (1.10, 1.75)	< 0.001
> 4	241 (17.4)	132 (20.9)	64 (24.9)	26 (38.2)	12 (29.3)	1.83 (1.46 – 2.29)		1.59 (1.24, 2.02)	
Number of hours spent sitting per day using computer during weekdays									
<1	1154 (83.0)	460 (72.9)	166 (64.6)	37 (54.4)	26 (63.4)	Ref	0.002	Ref	0.070
1 to ≤2	96 (6.9)	64 (10.1)	22 (8.6)	7 (10.3)	2 (4.9)	1.57 (1.19, 2.08)	< 0.001	1.34 (0.98, 1.84)	0.076
2–4	89 (6.4)	55 (8.7)	29 (11.3)	11 (16.2)	7 (17.1)	2.07 (1.56, 2.75)	< 0.001	1.34 (0.97, 1.84)	< 0.001
>4	50 (3.6)	52 (8.2)	40 (15.6)	13 (19.1)	6 (14.6)	3.83 (2.85, 5.16)		2.15 (1.56, 2.96)	
Number of hours spent sitting per day using computer during weekends									
<1	1204 (86.7)	493 (78.1)	176 (68.5)	42 (61.8)	28 (68.3)	Ref	< 0.001	Ref	< 0.001
1 to ≤2	74 (5.3)	58 (9.2)	32 (12.5)	6 (8.8)	5 (12.2)	2.20 (1.65, 2.93)	0.001	1.77 (1.30, 2.42)	0.210
2–4	72 (5.2)	37 (5.9)	21 (8.2)	9 (13.2)	3 (7.3)	1.73 (1.25, 2.40)	< 0.001	1.26 (0.88, 1.82)	< 0.001
>4	39 (2.8)	43 (6.8)	28 (10.9)	11 (16.2)	5 (12.2)	3.65 (2.62, 5.07)		2.36 (1.67, 3.36)	

[a] Adjusted for age, gender, smoking, education level, monthly income, employment status, Body Mass Index category, treatment type for diabetes, diabetes duration, HbA1C%, high blood cholesterol diagnosis, high blood pressure diagnosis, sleep hours per day, naps frequency per day, diet modification status, fast food consumption, snacks consumption, leisure-time physical activity, and working during the night. N, frequency; OR, odds ratio; CI, confidence interval.

prevent or lessen the negative impact of SBSB on mental health.

The present study has a few strengths. *First*, our study included a large national sample of patients with type 2 diabetes. *Second,* the observed association between time spent on SBSB and DSS was independent of a relatively large number of variables which may influence DSS among patients with type 2 diabetes, such as leisure-time physical activity, sleep patterns and duration, physical health-related characteristics, and demographic and socioeconomic characteristics.

Our study also has some limitations that should be considered when interpreting the findings. *First,* this was a cross-sectional study, and therefore, the direction of observed association between time spent on SBSB and DSS remains unclear because time spent on SBSB could be caused by DSS. For example, individuals with mental health conditions such as depression and anxiety were more likely to spend more time on SBSB than controls without mental health conditions [17,40]. However, the findings of the current study are consistent with the findings of cohort studies demonstrating a relationship between SBSB and DSS in the general population [16]. *Second,* time spent on SBSB was self-reported by participants, which is subject recall and measurement bias. *Third*, DSS was measured using the PHQ-9, which may be associated with misclassification errors in DSS compared diagnostic structured clinical interviews, which are considered the gold standard for diagnosis of mental health conditions [41]. However, the magnitude and direction of the mentioned potential biases on the observed association between SBSB and DSS remains unknow. *Fourth,* the secondary data used in this study did not include information on history of depression diagnosis or current treatment for depression, which may underestimate the observed association between SBSB and DSS.

5. Conclusion

In sum, increase in time spent on screen-based sedentary behavior is associated with increased depression symptoms severity among individuals with type 2 diabetes regardless of the type of equipment or time of the week. This association is independent of leisure-time physical activity and other demographic, socioeconomic, sleep and dietary patterns, and physical health-related characteristics. Further longitudinal and qualitative research is needed to confirm the observed association and identify exact factors underlying and mediating this association.

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Declaration of Competing Interest

None.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.pcd.2023.09.006.

References

[1] COVID-19 Mental Disorders Collaborators, Global prevalence and burden of depressive and anxiety disorders in 204 countries and territories in 2020 due to the COVID-19 pandemic, Lancet 398 (2021) 1700–1712.
[2] GBD 2019 Mental Disorders Collaborators, Global, regional, and national burden of 12 mental disorders in 204 countries and territories, 1990-2019: a systematic analysis for the Global Burden of Disease Study 2019, Lancet Psychiatry 9 (2022) 137–150.
[3] Q. Liu, H. He, J. Yang, X. Feng, F. Zhao, J. Lyu, Changes in the global burden of depression from 1990 to 2017: findings from the global burden of disease study, J. Psychiatr. Res 126 (2020) 134–140.
[4] D.S. Hasin, A.L. Sarvet, J.L. Meyers, T.D. Saha, W.J. Ruan, M. Stohl, B.F. Grant, Epidemiology of adult DSM-5 major depressive disorder and its specifiers in the United States, JAMA Psychiatry 75 (2018) 336–346.
[5] F. Cardin, F. Ambrosio, P. Amodio, L. Minazzato, G. Bombonato, S. Schiff, K. Finotti, D. Giuliani, T. Bianco, C. Terranova, C. Militello, C. Ori, Quality of life and depression in a cohort of female patients with chronic disease, BMC Surg. 12 (Suppl 1) (2012) S10.
[6] Y. Ma, Q. Xiang, C. Yan, H. Liao, J. Wang, Relationship between chronic diseases and depression: the mediating effect of pain, BMC Psychiatry 21 (2021) 436.
[7] J.K. Hohls, H.H. König, E. Quirke, A. Hajek, Anxiety, depression and quality of life-a systematic review of evidence from longitudinal observational studies, Int. J. Environ. Res. Public Health 18 (2021).
[8] H. Cai, X.M. Xie, Q. Zhang, X. Cui, J.X. Lin, K. Sim, G.S. Ungvari, L. Zhang, Y. T. Xiang, Prevalence of suicidality in major depressive disorder: a systematic review and meta-analysis of comparative studies, Front Psychiatry 12 (2021), 690130.
[9] P. Saeedi, I. Petersohn, P. Salpea, B. Malanda, S. Karuranga, N. Unwin, S. Colagiuri, L. Guariguata, A.A. Motala, K. Ogurtsova, J.E. Shaw, D. Bright, R. Williams, Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: results from the International Diabetes Federation Diabetes Atlas, 9(th) edition, Diabetes Res. Clin. Pr. 157 (2019), 107843.
[10] M. Khaledi, F. Haghighatdoost, A. Feizi, A. Aminorroaya, The prevalence of comorbid depression in patients with type 2 diabetes: an updated systematic review and meta-analysis on huge number of observational studies, Acta Diabetol. 56 (2019) 631–650.
[11] A. Farooqi, C. Gillies, H. Sathanapally, S. Abner, S. Seidu, M.J. Davies, W. H. Polonsky, K. Khunti, A systematic review and meta-analysis to compare the prevalence of depression between people with and without Type 1 and Type 2 diabetes, Prim. Care Diabetes 16 (2022) 1–10.
[12] R.R. Pate, J.R. O'Neill, F. Lobelo, The evolving definition of "sedentary, Exerc Sport Sci. Rev. 36 (2008) 173–178.
[13] R. Patterson, E. McNamara, M. Tainio, T.H. de Sá, A.D. Smith, S.J. Sharp, P. Edwards, J. Woodcock, S. Brage, K. Wijndaele, Sedentary behaviour and risk of all-cause, cardiovascular and cancer mortality, and incident type 2 diabetes: a systematic review and dose response meta-analysis, Eur. J. Epidemiol. 33 (2018) 811–829.
[14] R. Zhao, W. Bu, Y. Chen, X. Chen, The dose-response associations of sedentary time with chronic diseases and the risk for all-cause mortality affected by different health status: a systematic review and meta-analysis, J. Nutr. Health Aging 24 (2020) 63–70.
[15] X. Wang, Y. Li, H. Fan, The associations between screen time-based sedentary behavior and depression: a systematic review and meta-analysis, BMC Public Health 19 (2019) 1524.
[16] L. Li, Q. Zhang, L. Zhu, G. Zeng, H. Huang, J. Zhuge, X. Kuang, S. Yang, D. Yang, Z. Chen, Y. Gan, Z. Lu, C. Wu, Screen time and depression risk: a meta-analysis of cohort studies, Front Psychiatry 13 (2022) 1058572.
[17] R. An, Y. Yang, Diabetes diagnosis and screen-based sedentary behavior among US adults, Am. J. Lifestyle Med. 12 (2018) 252–262.
[18] S. Taylor, R. McDermott, F. Thompson, K. Usher, Depression and diabetes in the remote Torres Strait Islands, Health Promot J. Austr. 28 (2017) 59–66.
[19] World Health Organization, Diabetes Qatar 2016 country profile, in, WHO, 2016.
[20] A. Bener, M.T. Abou-Saleh, E.E. Dafeeah, D. Bhugra, The prevalence and burden of psychiatric disorders in primary health care visits in qatar: too little time? J. Fam. Med Prim. Care 4 (2015) 89–95.
[21] H. Al Kuwari, A. Al Thani, A. Al Marri, A. Al Kaabi, H. Abderrahim, N. Afifi, F. Qafoud, Q. Chan, I. Tzoulaki, P. Downey, H. Ward, N. Murphy, E. Riboli, P. Elliott, The Qatar biobank: background and methods, BMC Public Health 15 (2015) 1208.
[22] Qatar Biobank, Key Figures, Qatar Biobank, 2023.
[23] K. Kroenke, R.L. Spitzer, J.B. Williams, The PHQ-9: validity of a brief depression severity measure, J. Gen. Intern Med. 16 (2001) 606–613.
[24] M.S. Tremblay, S. Aubert, J.D. Barnes, T.J. Saunders, V. Carson, A.E. Latimer-Cheung, S.F.M. Chastin, T.M. Altenburg, M.J.M. Chinapaw, Sedentary behavior research network (SBRN) - terminology consensus project process and outcome, Int. J. Behav. Nutr. Phys. Act. 14 (2017) 75.
[25] W. Katon, M. von Korff, P. Ciechanowski, J. Russo, E. Lin, G. Simon, E. Ludman, E. Walker, T. Bush, B. Young, Behavioral and clinical factors associated with depression among individuals with diabetes, Diabetes Care 27 (2004) 914–920.
[26] B. Stubbs, D. Vancampfort, J. Firth, F.B. Schuch, M. Hallgren, L. Smith, B. Gardner, K.G. Kahl, N. Veronese, M. Solmi, A.F. Carvalho, A. Koyanagi, Relationship between sedentary behavior and depression: a mediation analysis of influential factors across the lifespan among 42,469 people in low- and middle-income countries, J. Affect Disord. 229 (2018) 231–238.
[27] A. Azmiardi, B. Murti, R.P. Febrinasari, D.G. Tamtomo, Low social support and risk for depression in people with type 2 diabetes mellitus: a systematic review and meta-analysis, J. Prev. Med. Public Health 55 (2022) 37–48.
[28] B. Huang, Z. Huang, J. Tan, H. Xu, K. Deng, J. Cheng, Z. Ren, X. Gong, Y. Gao, The mediating and interacting role of physical activity and sedentary behavior between diabetes and depression in people with obesity in United States, J. Diabetes Complicat. 35 (2021), 107764.

[29] WHO Expert Consultation, Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies, Lancet 363 (2004) 157–163.
[30] C.L. Craig, A.L. Marshall, M. Sjöström, A.E. Bauman, M.L. Booth, B.E. Ainsworth, M. Pratt, U. Ekelund, A. Yngve, J.F. Sallis, P. Oja, International physical activity questionnaire: 12-country reliability and validity, Med Sci. Sports Exerc 35 (2003) 1381–1395.
[31] StataCorp, Stata Statistical Software: Release 17, StataCorp LLC, College Station, TX, 2021.
[32] Y. Zhang, Q. Li, W. Hu, N. Zhan, J. Zou, J. Wang, F. Geng, The relationships between screen time and mental health problems among Chinese adults, J. Psychiatr. Res. 146 (2022) 279–285.
[33] K.C. Madhav, S.P. Sherchand, S. Sherchan, Association between screen time and depression among US adults, Prev. Med Rep. 8 (2017) 67–71.
[34] R. Kraut, M. Patterson, V. Lundmark, S. Kiesler, T. Mukopadhyay, W. Scherlis, Internet paradox. A social technology that reduces social involvement and psychological well-being? Am. Psychol. 53 (1998) 1017–1031.
[35] M. Lucas, R. Mekary, A. Pan, F. Mirzaei, E.J. O'Reilly, W.C. Willett, K. Koenen, O. I. Okereke, A. Ascherio, Relation between clinical depression risk and physical activity and time spent watching television in older women: a 10-year prospective follow-up study, Am. J. Epidemiol. 174 (2011) 1017–1027.
[36] L. Sun, K. Li, L. Zhang, Y. Zhang, Distinguishing the associations between evening screen time and sleep quality among different age groups: a population-based cross-sectional study, Front Psychiatry 13 (2022), 865688.
[37] E. Boers, M.H. Afzali, N. Newton, P. Conrod, Association of screen time and depression in adolescence, JAMA Pedia 173 (2019) 853–859.
[38] E.A. Vogel, J.P. Rose, L.R. Roberts, K. Eckles, Social comparison, social media, and self-esteem, Psychol. Pop. Media Cult. 3 (2014) 206–222.
[39] M. Redmayne, E. Smith, M.J. Abramson, The relationship between adolescents' well-being and their wireless phone use: a cross-sectional study, Environ. Health 12 (2013) 90.
[40] L. de Wit, A. van Straten, F. Lamers, P. Cuijpers, B. Penninx, Are sedentary television watching and computer use behaviors associated with anxiety and depressive disorders? Psychiatry Res. 186 (2011) 239–243.
[41] F. Li, H. He, Assessing the accuracy of diagnostic tests, Shanghai Arch. Psychiatry 30 (2018) 207–212.