ORIGINAL ARTICLE

Is Obesity a Risk Factor for Depression?
A Multi-institutional Study Done at an Urban Setting in South India

Nitin Joseph*, Sumangala Nangia**

Abstract

Objective: To study the association between obesity and depression after controlling the effects of other confounders prevalent in an urban setting.

Methodology: This cross-sectional study was conducted among patients and their attenders visiting two tertiary care hospitals in Mangalore city. Data were collected using a self-administered questionnaire. The Center for Epidemiologic Studies Depression (CES-D-20) scale was used to screen participants for depression. Weight and height of participants were recorded using standard procedures.

Results: Mean age of the 298 participants was 40.7 ± 14.9 years. Overweight or obesity was observed among 168 (56.4%) participants. As many as 147 (49.3%) participants were at risk of depression.

In univariate analysis, female participants aged ≤ 40 years with overweight or obesity (p = 0.008), widow/widowers (p = 0.0046), those with a current history of alcohol consumption (p = 0.0472), presence of hypertension (p = 0.0426), presence of any co-morbidities (p = 0.002) and those with a family history of mental health problems (p = 0.0097) were associated with risk of depression. In multivariable analysis, family history of mental health problems among participants was associated with the risk of depression.

Conclusion: Obesity and depression were quite prevalent among participants in this study but were not associated. However, family history of mental health problems was independently associated with risk of depression among participants. Thus, familial and genetic factors need to be further analysed to control depression at this setting.

Key words: Obesity, risk of depression, association, multi-institutional study, urban setting.

Introduction

Obesity is one of the most prevalent morbidity. It affects more than 609 million adults worldwide[1]. In India, there are more than 135 million people with obesity. Even then it is a neglected health problem in India[2]. Its prevalence is particularly high in the Southern states of India[2]. In urban areas of Karnataka, the prevalence rate of obesity (BMI ≥ 25) is 39.4% and 37.1% among males and females, respectively[3].

The proportion of Indians who suffer from various depressive disorders is estimated to be 45·7 million[4]. The prevalence is on the rise, particularly in the southern states of India[5]. Based on the above observations, it was essential to find out whether there was any relationship between obesity and depression. This would help to frame suitable preventive strategies to address both morbidities in a clinical setting.

Prior studies have given contradictory findings of an association between these parameters. Some studies reported that an association exists[6,7] while others reported

no association[8,9]. Therefore, the present study was done to assess the association between obesity and depression after controlling the effects of various confounders prevalent in an urban setting in South India.

Materials and methods

This cross-sectional study was done at a government and a private tertiary care hospital affiliated to a private medical college in Mangalore city. The study was conducted in January 2021 after obtaining ethics clearance from the Institutional Ethics Committee. The medical superintendents at these hospitals gave permission to conduct this study. People visiting these hospitals either as out-patients or accompanying them were enrolled in this study using the convenience sampling method. The investigators approached them in the waiting area at the out-patient department. Written informed consent was taken from the participants after informing them of the nature and purpose of this study. All consenting participants aged 18 years and above were included in this study. Pregnant and lactating mothers, illiterates, and patients

*Associate Professor, **MBBS Student, Department of Community Medicine, Kasturba Medical College, Mangalore, Manipal Academy of Higher Education, Manipal - 576 104, Karnataka.
Corresponding Author: Dr Nitin Joseph, Associate Professor, Department of Community Medicine, Kastura Medical College, Mangalore, Manipal Academy of Higher Education, Manipal - 576 104, Karnataka. Tel: 9448732896, E-mail: drnitinjoseph@gmail.com.

diagnosed with pre-existing mental disorders were excluded from this study. Participants were screened for pre-existing mental disorders based on history and the diagnosis stated in the treatment records.

The sample size was calculated using the formula $Z_{\acute{a}}^2PQ/d^2$. An Asian study reported that 15.4% of participants with obesity had depression after being screened with the CES-D-20 scale[10]. Based on this proportion, at 95% confidence intervals and 5% absolute precision, the minimum sample size was calculated as 200. Adding a non-response rate of 10%, the final sample size was rounded off to 220 participants.

Data was collected using a self-administered questionnaire. It was a semi-structured anonymous questionnaire. Section A of the questionnaire recorded the demographic details (gender, age, marital status, occupational status, educational status, number of family members, type of family, total monthly family income, and place of residence), history of current usage of substances of abuse (tobacco, alcohol, and drugs), presence of co-morbidities and family history of co-morbidities (including a family history of mental health problems) among the participants.

Section B of the questionnaire was the Center for Epidemiologic Studies Depression (CES-D-20) screening scale[11]. This is a 20 item scale to assess various symptoms suggestive of depression over the past one week. The participant was considered to be at risk of depression if he/she scored $\geq$ 16 points. Sensitivity and specificity of this scale were observed to be 95.1% and 85% respectively[12].

The questionnaire was prepared in the local language Kannada. It was both language and content validated with the help of experts before its use in this study. The investigator was present close by to clarify any doubts among participants while filling the questionnaire.

The Cronbach's alpha value of internal consistency for the Kannada version of the CES-D-20 scale used in this study was 0.875.

In this study, current users of substances of abuse were defined as those using tobacco (in smoked or smokeless form) or alcohol within the recent one month[13].

Socio-economic status (SES) of the participants was assessed using Modified B G Prasad Classification of 2020[14].

The weight and height of the participants were measured using standard procedures. Weight was recorded to the nearest 0.1 kilograms using a digital weighing machine, and height was recorded to the nearest 0.1 cm using a stadiometer. Body mass index (BMI) was calculated as kilograms per square meter. Overweight and obesity were defined as those with BMI $\geq$ 23 and $\geq$ 25, respectively based on Asia-Pacific guidelines[15].

Considering the ongoing COVID-19 pandemic, precautionary steps like hand sanitation, both before handing out the form and after receiving the filled-in form was, practiced by the investigator.

Participants identified as at risk of depression were advised consultation at the Psychiatry department at the respective hospitals.

Data entry and analysis were done using IBM SPSS for Windows version 25.0, Armonk, New York. Unpaired t-test, Chi-square test, and Fisher's Exact test were used to test association. All mutually exclusive variables identified among participants associated with the risk of depression at p value 0.3 or less in the univariate analysis were introduced into the binary logistic regression model. Then backward stepwise logistic regression process was applied. All p values were two-tailed, and a value less than 0.05 was taken as the cut-off to decide significant association.

Results

The mean age of the 298 participants was 40.7 $\pm$ 14.9 years. Majority were males [158 (53%)], were married [192 (64.4%)], were graduates [104 (34.9%)], were professionals [73 (24.5%)] and were from urban areas [224 (75.2%)]. All of them belonged to nuclear families.

SES could be assessed among 40 participants. Thirty seven (92.5%) of them belonged to class I, and the rest belonged to class II status (Table I).

Out of the total participants, underweight, normal weight, overweight and obesity were observed among 12 (4.0%), 118 (39.6%), 83 (27.9%), and 85 (28.5%) participants respectively. Substance abuse in the form of smoking, tobacco chewing, and alcohol consumption were reported respectively by 49 (16.4%), 20 (6.7%), and 61 (20.5%) participants each, out of the total participants. 193 (64.8%) participants had no history of substance abuse.

Co-morbidities were present among 100 (33.6%) participants. These morbidities were identified from the treatment records. The various co-morbidities reported among participants were: Hypertension among 57, diabetes mellitus among 48, asthma among 10, hyperthyroidism among 2, cataract among 2, disc prolapse in 1, osteoporosis in 1, and gastro-oesophageal reflux disease in 1.

Family history of co-morbidities was present among 146 (49.0%) of participants. Family history of mental illness was present among 16 (5.4%) participants.

The responses of participants to the CES-D-20 screening scale have been presented in Table II.

Table I: Socio-demographic distribution of the participants.

Socio-demographic variables	Number	Percentages
Age group (years)		
≤ 20	11	3.7
21 - 30	82	27.5
31 - 40	63	21.1
41 - 50	66	22.1
51 - 60	48	16.1
61 - 70	17	5.7
71 - 80	7	2.3
81 - 90	4	1.3
Gender		
Males	158	53.0
Females	140	47.0
Marital status		
Unmarried	89	29.9
Married	192	64.4
Widow/Widower	17	5.7
Educational status		
Post-graduate	40	13.4
Graduate	104	34.9
Intermediate/ Post-high school diploma	75	25.2
High school	61	20.5
Primary school	18	6.0
Occupational status		
Professional	73	24.5
Semi-professional	31	10.4
Clerk/Shop owner/Farm owner	13	4.4
Skilled worker	39	13.1
Semi-skilled worker	21	7.0
Unskilled worker	18	6.0
Housewives	38	12.8
Students	32	10.7
Unemployed	8	2.7
Retired	25	8.4
Socio-economic status (n = 40)		
Class I	37	92.5
Class II	3	7.5
Type of family		
Nuclear family	298	100.0
Place of residence		
Urban	224	75.2
Semi-urban	65	21.8
Rural	9	3.0
Total	298	100.0

Table II: Distribution of CES-D-20 depression scale parameters among participants (n = 298).

Items	Rarely or none of the time (< 1 day) No. (%)	Some or a little of the time (1 - 2 days) No. (%)	Occasionally or a moderate amount of time (3 - 4 days) No. (%)	Most or all of the time (5 - 7 days) No. (%)
I was bothered by things that usually don't bother me	144 (48.3)	81 (27.2)	54 (18.1)	19 (6.4)
I did not feel like eating; my appetite was poor	149 (50.0)	72 (24.2)	52 (17.4)	25 (8.4)
I felt that I could not shake off the blues even with help from my family or friends	156 (52.4)	77 (25.8)	50 (16.8)	15 (5.0)
I felt I was just as good as other people	56 (18.8)	61 (20.5)	69 (23.1)	112 (37.6)
I had trouble keeping my mind on what I was doing	122 (40.9)	73 (24.5)	71 (23.8)	32 (10.8)
I felt depressed	168 (56.4)	65 (21.8)	51 (17.1)	14 (4.7)
I felt that everything I did was an effort	109 (36.6)	78 (26.2)	68 (22.8)	43 (14.4)
I felt hopeful about the future	60 (20.1)	100 (33.6)	74 (24.8)	64 (21.5)
I thought my life had been a failure	187 (62.7)	58 (19.5)	36 (12.1)	17 (5.7)
I felt fearful	133 (44.6)	71 (23.8)	67 (22.5)	27 (9.1)
My sleep was restless	102 (34.2)	72 (24.2)	71 (23.8)	53 (17.8)
I was happy	57 (19.1)	110 (36.9)	91 (30.6)	40 (13.4)
I talked less than usual	151 (50.7)	77 (25.8)	45 (15.1)	25 (8.4)
I felt lonely	174 (58.4)	55 (18.5)	55 (18.5)	14 (4.6)
People were unfriendly	147 (49.3)	88 (29.5)	41 (13.8)	22 (7.4)
I enjoyed life	68 (22.8)	89 (29.9)	93 (31.2)	48 (16.1)
I had crying spells	171 (57.4)	66 (22.1)	49 (16.5)	12 (4.0)
I felt sad	120 (40.3)	95 (31.9)	62 (20.8)	21 (7.0)
I felt that people dislike me	171 (57.4)	78 (26.2)	39 (13.1)	10 (3.3)
I could not get going	147 (49.3)	80 (26.9)	48 (16.1)	23 (7.7)

Out of the total participants, 147 (49.3%) were found to be at risk of depression.

There was no association between overweight or obese status with risk of depression among participants. However, out of the 49 participants, aged ≤ 40 years with overweight or obese status, 29 (59.2%) were at risk of depression. In comparison, out of the 44 participants, aged ≤ 40 years with underweight or normal status, 13 (29.5%) were at risk

of depression. These differences in proportion were found to be significant ($X^2 = 8.223$, p = 0.004).

Out of the 21 female participants, aged ≤ 40 years with overweight or obesity, 15 (71.4%) were at risk of depression. Out of 32 female participants, aged ≤ 40 years with underweight or normal weight status, 11 (34.4%) were at risk of depression. These differences in proportion were found to be significant ($X^2 = 6.966$, p = 0.008).

Variables associated with the risk of depression among participants in univariate analysis at p value ≤ 0.3 are shown in Table III.

	Depression status		Total
	At risk mean ± SD	Not at risk mean ± SD	
Age (years)	42.4 ± 16.2	39.1 ± 13.4	
		t = 1.915, p = 0.056	
	At risk No. (%)	Not at risk No. (%)	
Gender			
Males	73 (46.2)	85 (53.8)	158
Females	74 (52.9)	66 (47.1)	140
		$X^2 = 1.315$, p = 0.251	
Body mass index			
Underweight	7 (58.3)	5 (41.7)	12
Normal weight	51 (43.2)	67 (56.8)	118
Overweight or obese	89 (53.0)	79 (47.0)	168
		$X^2 = 3.045$, p = 0.218	
Educational status			
Professional/Post-graduate	21 (52.5)	19 (47.5)	40
Graduate	42 (40.4)	62 (59.6)	104
Intermediate/ Post-high school diploma	43 (57.3)	32 (42.7)	75
High school	30 (49.2)	31 (50.8)	61
Primary school	11 (61.1)	7 (38.9)	18
		$X^2 = 6.412$, p = 0.17	
Marital status			
Unmarried	46 (51.7)	43 (48.3)	89
Married	88 (45.8)	104 (54.2)	192
Widow/widower	13 (76.5)	4 (23.5)	17
		$X^2 = 6.147$, p = 0.046	
History of current alcohol usage			
Yes	37 (60.7)	24 (39.3)	61
No	110 (46.4)	127 (53.6)	237
		$X^2 = 3.937$, p = 0.0472	
History of current usage of any substance abuse			
Yes	57 (54.3)	48 (45.7)	105
No	90 (46.6)	103 (53.4)	193
		$X^2 = 1.594$, p = 0.2068	

Diabetes mellitus			
Present	27 (56.3)	21 (43.7)	48
		$X^2 = 1.097$, p = 0.295	
Hypertension			
Present	35 (61.4)	22 (38.6)	57
		$X^2 = 4.111$, p = 0.0426	
Asthma			
Present	7 (70)	3 (30)	10
		p = 0.2134	
Any co-morbidities			
Present	62 (62.0)	38 (38.0)	100
		$X^2 = 9.668$, p = 0.002	
Family history of mental health problems			
Present	13 (81.3)	3 (18.7)	16
Absent	134 (47.5)	148 (52.5)	282
		p=0.0097	
Total	147	151	298

These variables therefore qualified entry into the multivariable model. Hosmer and Lemeshow test p value was found to 0.579, indicating that this model was a good fit. The independent variables in the model could explain 72.5% of the variability of the dependent variable.

In multivariable analysis, family history of mental health problems among participants was associated with the risk of depression among the participants (Table IV).

Table IV: Multivariable analysis of determinants associated with increased risk of depression among participants (n=298).

Characteristics	Unadjusted OR 95% CI	p value	Adjusted OR 95% CI	p value
Marital status				
Married	1		1	
Unmarried	0.7916 (0.4769 - 1.312)	0.3648	2.897 (0.862 - 9.74)	0.086
Widow/widower	0.2619 (0.07133 - 0.8009)	0.01716	1.932 (0.523 - 7.129)	0.323
Educational status				
Professional/Post-graduate	1		1	
Graduate	1.626 (0.7764 - 3.425)	0.1975	1.662 (0.334 - 8.27)	0.535
Intermediate/ Post-high school diploma	0.8239 (0.3779 - 1.797)	0.6251	2.77 (0.607 - 12.645)	0.188
High school	1.141 (0.5097 - 2.561)	0.7495	1.27 (0.269 - 6.005)	0.763
Primary school	0.8864 (0.1865 - 4.005)	0.8805	1.492 (0.315 - 7.069)	0.614
History of current alcohol usage				
Yes	1.78 (1.003 - 3.159)	0.0472	1.726 (0.943 - 3.162)	0.077
No	1		1	
Family history of mental health problems				
Present	4.786 (1.335 - 17.161)	0.0097	4.991 (1.333 - 18.683)	0.017
Absent	1		1	

Discussion

In this study, overweight or obesity status among the participants was not associated with risk of depression among them. However, presence of high BMI among participants aged ≤ 40 years and among them, female participants in particular were at risk of depression. The World Mental Health surveys have identified that the period ranging from middle to late adolescence till early 40 years was the peak risk period for the onset of major depressive episodes worldwide[16]. Moreover, as much as two-third of risk factors of depression are found to be environmental and the rest being inherited[17]. Hence, people aged 40 years and below with extrinsic risk factors like overweight or obesity form a risk group of developing depression. These high-risk groups therefore need to be periodically screened for depression.

The other socio-demographic variable associated with the risk of depression in this study was widow/widower status. Therefore, the social welfare agencies and the local government need to offer appropriate services for their welfare.

No other socio-demographic variables were associated with the risk of depression among the participants in the present study.

In the present study, the current history of alcohol consumption was associated with the risk of depression among participants, which was similar to the observations of Kuria *et al*[18]. Depression is identified as the most common psychiatric disorder among those with alcohol use disorders[19]. A period of 3 to 4 weeks of abstinence was significantly found to relieve depression among patients[20]. The association between alcohol use disorders and depression appears to be due to common genetic, behavioural, and environmental factors[18,21-23].

However, there was no association between current usage of other substances of abuse like tobacco smoking or chewing with risk of depression among participants in this study.

The presence of any co-morbidities was associated with the risk of depression among participants in this study. The social and economic implications of diseases apart from the known medical reasons could be the reason behind this observation.

Hypertensive patients in this study were associated with the risk of depression. In previous studies, hypertension was independently associated with depression[24,25]. Hypertension is known to cause microvascular changes in the brain, leading to structural and cognitive deficits resulting in vascular depression[26].

There was no association of the presence of diabetes mellitus or asthma with risk of depression among participants in the present study, which was contrary to the findings of other studies[27-30].

Family history of mental health problems was independently associated with the risk of depression among participants in this study. This could probably be due to the familial and genetic factors involved in mental disorders like depression.

Hence treatment of depression among participants in the current setting requires a multidisciplinary approach to address familial and genetic factors involved in its occurrence. The role of these factors needs to be further explored to control depression.

The association between SES and depression among the majority of the participants could not be analysed due to the non-disclosure of this information. The association between care-giver burden with depression among persons accompanying patients and of central obesity with depression among all the participants could not be done as the data collection tool did not capture these information.

Conclusion

Obesity and depression are quite prevalent among participants in this study but were not associated. However, family history of mental health problems was independently associated with risk of depression among participants. Thus, familial and genetic factors need to be further analysed to control depression at this setting.

Limitations

The Self-administered questionnaire process was used for data collection. Hence, there is a possibility that the participants filling out the questionnaire may not have completely understood the questionnaire.

Patients and their caregivers were both included in this study. However, the data collection tool did not specify the question whether the respondent filling the form was a patient or a caregiver. Hence, sub-analysis of depression in outpatients versus depression in caregivers could not be performed. There is a possibility that caregivers of even stable patients might also experience substantial caregiver burden, which may present as depressive symptoms. Therefore the confounding effect of the inclusion criteria of enrolling out-patients and their caregivers could be a major limitation in this study.

The non-disclosure of information required to assess socio-economic condition, namely total monthly family income and the number of family members by the majority of the participants (258 out of 298), is another major limitation in

this study, considering the role of SES in the occurrence of depression among the participants.

Anthropometric measurements like waist and hip circumference (to assess central obesity), although non-invasive and measurable on minimal clothing in OPD setting, were not done as it was not included in the questionnaire considering the prevailing conditions.

References

1. Chooi YC, Ding C, Magkos F. The epidemiology of obesity. *Metabolism* 2019; 92: 6-10.

2. Ahirwar R, Mondal PR. Prevalence of obesity in India: A systematic review. *Diabetes Metab Syndr* 2019; 13: 318-21.

3. National Family Health Survey (NFHS-5). Ministry of Health and Family Welfare, Government of India, Key Indicators 2019-20. Available from: http://rchiips.org/NFHS/NFHS-5_FCTS/NFHS-5%20State%20Factsheet%20Compendium_Phase-I.pdf

4. India State-Level Disease Burden Initiative Mental Disorders Collaborators. The burden of mental disorders across the states of India: the Global Burden of Disease Study 1990-2017. *Lancet Psychiatry* 2020; 7: 148-61.

5. Mental disorder cases doubled in less than 3 decades, anxiety and depression most common condition. *The Economic Times [Internet]* 2019; Dec 24 [last accessed 2021 Jan 2] Available from: https://economictimes.indiatimes.com/magazines/panache/mental-disorder-cases-doubled-in-less-than-3-decades-anxiety-and-depression-most-common-condition/articleshow/72950200.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst.

6. Tyrrell J, Mulugeta A, Wood AR *et al*. Using genetics to understand the causal influence of higher BMI on depression. *Int J Epidemiol* 2019; 48: 834-48.

7. Gibson-Smith D, Bot M, Snijder M *et al*. The relation between obesity and depressed mood in a multi-ethnic population. The HELIUS study. *Soc Psychiatry Psychiatr Epidemiol* 2018; 53: 629-38.

8. Cui J, Sun X, Li X *et al*. Association Between Different Indicators of Obesity and Depression in Adults in Qingdao, China: A Cross-Sectional Study. *Front Endocrinol (Lausanne)* 2018; 9: 549.

9. Han SY, Shim KW, Lee HS *et al*. The Relationship between Body Mass Index, Depression and Body Image of Adult Population in Korea. *Korean J Fam Pract* 2018; 8: 348-53.

10. Kim JY, Chang HM, Cho JJ *et al*. Relationship between obesity and depression in the Korean working population. *J Korean Med Sci* 2010; 25: 1560-7.

11. American Psychological Association. Center for Epidemiologic Studies Depression Scale (CES-D), NIMH. Available from: http://www.chcr.brown.edu/pcoc/cesdscale.pdf.

12. Wada K, Tanaka K, Theriault G *et al*. Validity of the Center for Epidemiologic Studies Depression Scale as a screening instrument of major depressive disorder among Japanese workers. *Am J Ind Med* 2007; 50: 8-12.

13. Chen J, Li S, Zheng K *et al*. Impact of Smoking Status on Stroke Recurrence. *J Am Heart Assoc* 2019; 8: e011696.

14. Mathiyalagen P, Davis P, Sarasveni M. Updated BG Prasad Socio-Economic Classification: The 2020 Update. *Indian J Pediatr* 2021; 88: 76-7.

15. Lim JU, Lee JH, Kim JS *et al*. Comparison of World Health Organisation and Asia-Pacific body mass index classifications in COPD patients. *Int J Chron Obstruct Pulmon Dis* 2017; 12: 2465-75.

16. Kessler RC, Bromet EJ. The epidemiology of depression across cultures. *Annu Rev Public Health* 2013; 34: 119-38.

17. Sullivan PF, Neale MC, Kendler KS. Genetic epidemiology of major depression: review and meta-analysis. *Am J Psychiatry* 2000; 157: 1552-62.

18. Kuria MW, Ndetei DM, Obot IS *et al*. The Association between Alcohol Dependence and Depression before and after Treatment for Alcohol Dependence. *ISRN Psychiatry* 2012; 2012: 482802.

19. Grant BF, Stinson FS, Dawson DA *et al*. Prevalence and co-occurrence of substance use disorders and independent mood and anxiety disorders: Results from the National Epidemiologic Survey on Alcohol and Related Conditions. *Arch Gen Psychiatry* 2004; 61: 807-16.

20. Liappas J, Paparrigopoulos T, Tzavellas E. Impact of alcohol detoxification on anxiety and depressive symptoms. *Drug Alcohol Depend* 2002; 68: 215-20.

21. McHugh RK, Weiss RD. Alcohol Use Disorder and Depressive Disorders. *Alcohol Res* 2019; 40: arcr.v40.1.01.

22. Andersen AM, Pietrzak RH, Kranzler HR *et al*. Polygenic scores for major depressive disorder and risk of alcohol dependence. *JAMA Psychiatry* 2017; 74: 1153-60.

23. Zhou H, Polimanti R, Yang BZ *et al*. Genetic risk variants associated with co-morbid alcohol dependence and major depression. *JAMA Psychiatry* 2017; 74: 1234-41.

24. García-Fabela L, Melano-Carranza E, Aguilar-Navarro S *et al*. Hypertension as a risk factor for developing depressive symptoms among community-dwelling elders. *Rev Invest Clin* 2009; 61: 274-80.

25. Wang L, Li N, Heizhati M *et al*. Association of Depression with Uncontrolled Hypertension in Primary Care Setting: A Cross-Sectional Study in Less-Developed Northwest China. *Int J Hypertens* 2021; 2021: 6652228.

26. Alexopoulos GS, Meyers BS, Young RC *et al*. 'Vascular depression' hypothesis. *Arch Gen Psychiatry* 1997; 54: 915-22.

27. Akula M, Kulikova A, Khan DA. The relationship between asthma and depression in a community-based sample. *J Asthma* 2018; 55: 1271-7.

28. Trzciñska H, Przybylski G, Koz³owski B. Analysis of the relation between level of asthma control and depression and anxiety. *Med Sci Monit* 2012; 18: CR190-4.

29. Choi HG, Kim JH, Park JY *et al*. Association Between Asthma and Depression: A National Cohort Study. *J Allergy Clin Immunol Pract* 2019; 7: 1239-1245.e1.

30. Meurs M, Roest AM, Wolffenbuttel BH *et al*. Association of Depressive and Anxiety Disorders With Diagnosed Versus Undiagnosed Diabetes: An Epidemiological Study of 90,686 Participants. *Psychosom Med* 2016; 78: 233-41.