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Original Article

A Correlative Assessment of Indian Diabetic Risk Scores with Anxiety States Among Healthy Adults

M.V. Shobha[1], P.N. Ravindra*[2] and A. Deepali[3]

[1] Department of Physiology,
Sri Devaraj Urs Medical College, Kolar
[2] Department of Physiology,
Gadag Institute of Medical Sciences, Gadag
[3] Department of Physiology,
Sri Siddhartha Medical College, Tumkur

Abstract

Introduction: Diabetes, a major public health problem, whose global prevalence is increasing, with India heading to be diabetic capital of World by 2030. Among many factors that increase the risk of becoming diabetes, the psychological factors share major concern. **Aim:** Present study attempts to decipher the relationship between anxiety states and the diabetes risk among normal healthy adult volunteers. **Material & Methods**: This is a cross-sectional study conducted in 216 subjects which includes both gender in the age group of 20-45 yrs. Demographic profiles, anthropometric parameters were assessed. Indian Diabetes Risk Score (IDRS) was calculated and subjects were categorized into low risk (group1), medium risk (group 2) and high risk (group 3) based on IDRS scores. Anxiety was assessed using Spielberg's state and trait anxiety score (STAI); sleep quality was assessed by Pittsburg sleep quality index, morningness and eveningness was assessed using standard questionnaire. **Statistics:** Data was subjected to ANOVA and Pearson correlation. **Results:** The risk of developing type 2 diabetes mellitus (T2DM) increased with age. The prevalence of participants at high risk was 24%, moderate risk 56% and low risk was 16%. Anthropometric parameters was higher (p=0.00) in group 3 compared to other two groups. Trait anxiety score was significantly high (p=0.001) in group 3 compared to group 1 and group 2. Pearson correlation showed weaker association with IDRS and STAI, but, there was a positive correlation of waist circumference with STAI. There was no significant differences sleep quality. **Conclusion:** Present study showed a positive correlation between trait anxiety status i.e anxiety proneness and markers of abdominal obesity in high risk group. Therefore, it could be hypothesized that high anxiety states could drive towards excess eating, a reward seeking behavior, to alleviate the experience of anxiety. Thus, assessment of anxiety and steps to overcome the same could be considered as initial steps towards preventing risk of developing diabetes.

***Corresponding author :**

Dr. Ravindra P.N., Professor and Head, Gadag Institute of Medical Sciences, Gadag, Mallasamudr, Karnataka – 582 103, Ph.: 9448934488; Email.id:ravindrapinna@gmail.com

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Introduction

The prevalence of type 2 diabetes mellitus (T2DM) is increasing worldwide. It is estimated that the number of diabetic subjects will rise to 366 million by year 2030, of which the large proportion of burden will be from developing countries, and an estimated of 79.4 million diabetics will be from India (1). Increased prevalence of diabetes is observed across all the age groups, but, higher incidences are observed in the age group between 20-40 years (1). Higher incidence of T2DM during most productive years of life and the fact that more than 50% of Indian diabetics remain unaware of the disease condition, contributes to a large extent towards socio economic and health burden of the country. Therefore, identification of high risk individual is a very important initial step towards preventive strategies of diabetes. Thus, Indian Diabetes Risk Score (IDRS) was formulated for screening the risk group. The components of IDRS score includes two modifiable risk factors like physical activity and waist circumference and two non-modifiable risk factors like age and family history of diabetes. Based on IDRS scores risk assessment individuals are categorized as low, medium and high risk to develop diabetes (2).

The comorbididty of mental illness in the chronic disease conditions seems to be undiagnosed or neglected in the medical practice. There are reproducible evidences demonstrating that diabetic patients suffer from anxiety and depression twice as that of general population and odds ratio for anxiety among diabetics is higher than other affective disorders (3, 4, 5). Further, in contrast to other affective disorders, the significant relationship between anxiety and diabetes remained even after controlling for other factors like socio-economic and demographic characteristic (6, 7, 8). But, more than 45% of diabetic patients are not screened for the presence of these psychological distresses (9). Thus, the presence of undiagnosed affective disorders among diabetics seems to be one of the great concerns in the poor clinical outcome (7). Therefore, assessment of psychological states among diabetics seems to be one of the important step towards preventive and disease management strategies.

A complex relationship with casual role is being observed between anxiety states, dietary pattern and markers of obesity like body mass index (BMI), waist circumference (WC) (10). Dietary pattern and anxiety states reinforce each other i.e high consumption of free fatty acids known to induce anxiety states (11, 12); further, behavior of excess food consumption is cultivated as a gratification behavior to overcome anxiety state (13), thus, a positive correlation is reported between dietary pattern and anxiety states is established (14) which acts as a vicious cycle. Therefore, it could be hypothesized that obesity, as a result of inappropriate dietary pattern, which is a risk factor to develop diabetes should bear a relationship with anxiety states. There are no evidences to the best of the knowledge of the authors that has documented the relationship between categories of diabetes risk and anxiety status. Therefore, in the present study, anxiety states (state and trait) as measured with Spielberg's state and trait anxiety scales is assessed among apparently healthy individuals who were at varying degree of risk becoming diabetics as measured by IDRS. Further, add on assessment of subjective sleep quality by Pittsburg sleep quality index, and sleep pattern is also assessed with the premise that altered sleep quality is the first symptom to be developed during anxious state.

Material and Methods

This is a cross sectional, individually administered questioner survey carried out among 216 subjects of either gender from the age group 20-45 year over a period of six months in an educational institution campus. Considering the prevalence diabetes about young adult in India about 7.3% (1) and maximal acceptable difference to be 5%; the minimal sample size for the cohort of 1500 was about 146. In the present study we have surveyed 216 subjects well more than minimal needed with simple random sampling of the cohort.

The experimental protocol was approved by the Institutional Ethical Committee. The methodology was explained and written informed consent was obtained from the participants. History of Clinical and treatment history was assessed. Subjects with any

congenital issues, hypertension, diabetes, coronary heart disease, treatment on thyroid supplements, corticosteroid and oral contraceptives were excluded from the study. General information was obtained with regard to age, gender, educational qualification, socio economic status, tobacco consumption/ smoking and alcohol intake. A detailed family history of diabetes was obtained by putting pedigree chart. With routine clinical assessment and history, participants who were apparently healthy and non-diabetic were included for the assessment.

Selected subjects were requested to be in the laboratory between 9 am to 12 noon of their convenience. After 10 minutes of rest, supine resting radial pulse rate is counted for one full minute; Blood Pressure was measured by using the standard mercury sphygmomanometer. Anthropometric measurements were carried out with minimal clothing without shoes. Weight in kilograms was measured using standard calibrated balance scale with sensitivity to the nearest 0.1 kg. Height in centimeters was measured against a non-stretchable tape fixed to a vertical wall, with the participant standing on a level surface and it was measured to the nearest 0.5 cm and BMI was calculated using formula weight in kg/height in meter square. Waist circumference (WC) was measured with a non-stretchable tape to the nearest 0 .1 cm at the midpoint between the lowest rib and the iliac crest after normal expiration in standing position with feet together and arms by the side of the body. Hip circumference (HC) was measured with a non-stretchable tape to the nearest 0.1 cm at the widest part of the hips usually this corresponds to the groin level for women and about 2-3 inches below the navel in men. Waist to hip ratio (WHR) was calculated by dividing waist circumference by hip circumference. Waist to height ratio (WHtR) was calculated by dividing waist circumference by height.

Standardized questioners were personally administered with regard to their levels of routine physical activity, anxiety levels, Pittsburgh sleep quality index, Morning and Eveningness. Physical activity of the subjects was assessed through the questionnaire which has two sections. The first section asses moderate and the second section the severe the degree of physical activity that is carried atleast for 10 minutes without a break for past one week (15).

The Spielberger State Trait Anxiety Inventory (STAI) is a well-established and validated self-report measure with a separate subset of questions for state anxiety and trait anxiety assessment. The STAI distinguishes between state anxiety which implies the level of anxiety experienced in a specific condition and trait anxiety which assess the general tendency of an individual to perceive anxiety irrespective of situation i.e ‘anxiety proneness’. Each subset has 20 questions and subject need to score for every question from scoring from 1 (not at all) to 4 (very much so) for state and 1 (almost never) to 4 (almost always) for trait subset. Total score in each subset may range from 20 to 80. Scores of state anxiety more than 39-40 implies the individual experiences high state anxiety levels (16).

The Pittsburg sleep quality index (PSQI) questionnaire was administered to measures the subjective sleep pattern and quality. It is a self-rating questionnaire that measures seven domains viz., sleep quality, sleep latency, sleep duration, and sleep efficiency, use of medication, sleep disturbances and daytime dysfunction. The score in each domain ranges from 0-3 scale, where, highest score indicates negative extreme on Likert scale. The PSQI yields the global score that is the sum score of seven domains; PSQI of 5 and more is considered poor sleep quality (17).

Morningness and Eveningness Questionnaire is a self-assessment questionnaire developed to evaluate circadian sleep rhythm. The questioner has 19 questions; the scores range from 16-86. Score of 41 and less indicate ‘eveningness, score 59 and above indicate morningness and scores between 42-58 indicate intermediate type (18).

Indian Diabetic Risk Score was assessed based on the basic data obtained which compromises of two modifiable (Waist circumference and Physical activity) and two non-modifiable risk factors (age and family history of T2DM). Waist circumference <80 cm for female and <90 cm for male scored as 0, WC >80-89 for females and >90-99 cm for male score is

10 and WC >90 cm for female and >100 cm for male scored as 20. The type of physical activity carried by subject is categorized and scored as vigorous exercise/strenuous (score=0), moderate exercise work/home (score=10), no exercise and sedentary work (scored=30). Scoring for different age groups is as follows, age < 30 years, 35-49 years and more than 50 years is scored as 0, 20 and 30 respectively. Family history of T2DM scoring includes viz with no family history=0, positive family history in either parent=10 and both parent=10. Sum of all the scores gives IDRS which categorizes the risk for T2DM as follows i.e.<30 is low risk, 35-50-moderate risk and IDRS >60 is high risk (18). The subjects were categorized into three risk groups based on T2DM risk as per IDRS score. The data was compared between these three groups.

Statistics

Statistical analysis was carried by SPSS ver 18. Mean and SD was estimated for descriptive statistics. Test of normality was performed using Levens test. Chi squared test (χ^2) was performed to estimate the prevalence of all the variables studied among three groups as per IDRS classification. ANOVA with Bonferroni posthoc analysis was carried out for comparison of parameters across three groups. Pearson's correlation was carried to evaluate the relationship between IDRS score and those variables showed significant differences with ANOVA. p value < 0.05 considered as significant level.

Results

The present study is a cross sectional study among healthy subjects (n=216) who were at various degrees of risk for becoming diabetic as scored by Indian diabetic risk score viz., group 1 (n=36,) - low risk (IDRS < 30), group 2 (n=126) - moderate risk (IDRS 35-50) and group 3 (n=54) - high risk (IDRS > 60) accounting for 16%, 56% and 24% respectively among the total subjects studied. Normality of distribution of subjects into three groups was confirmed by Levens test [(2,213) = 0.303].

Age of the participants belonging to group 1 and group 2 were comparable, whereas, group 3 subjects were significantly (p=0.00) older than the other two groups [group 1 = 21.88±3.75 years, group 2 = 23.44±5,54 years, group 3 = 34.38 ±10.59 years, F (2,213)=54.12, p=0.00]. The IDRS scores respectively were - group 1 - 14.72±8.1, group 2 - 37.53±7.96 and group 3 - 64.81±10.04 and the scores increased linearly from group 1 to group 3 and was significantly different (p=0.00), [F (2,213)=389.23, p=0.00]. Accordingly, group 1 were low risk, group 2 moderate risk and group 3 high risk category as per IDRS classification (2).

The mean and standard deviation of anthropometric measure of all the three groups is provided in Table I. The high risk group weighed significantly (p=0.00) more than other two groups, however, the height of the all the three groups was comparable.

TABLE I: Comparison of Anthropometric parameters between three groups.

Variables	*Group 1 (n=36)*	*Group 2 (n=126)*	*Group 3 (n=54)*	*F value*	*P value*
Weight (kgs)	54.66±12.19	56.99±12.50	71.46±11.90#	2,213=31.69	0.00
Height (cm)	163.13±9.40	162.36±9.05	165.00±10.43	2,213=1.46	0.23
BMI (kg/m^2)	20.44±3.24	28.24±3.7*	37.24±6.0#	2,213=27.72	0.048
Waist Circumference (cm)	76.15±7.80	78.24±10.03	92.89±8.56#	2,213=53.65	0.00
Hip Circumference (cm)	92.65±6.28	94.90±7.75	102.54±8.74#	2,213=23.05	0.00
Waist hip ratio	0.82±0.04	0.82±0.06	0.90±0.08#	2,213=24.7	0.04
Waist height ratio	0.47±0.05	0.48±0.06	0.51±0.05#	2,213=32.38	0.00

Values are depicted in mean and SD, ANOVA with bonferroni post hoc test for multiple comparisons was applied. P < 0.05 is significant level.
*comparison between group 1 and group 2,
#comparison between group 2 and group 3.

Correspondingly, BMI also varied significantly across the three groups, wherein, the high risk group having significantly (p=0.02) higher index compared to other two groups. Similarly, waist circumference and hip circumference was significantly (p=0.00) more in the high risk group when compared to other two groups. Therefore, Waist hip ratio and waist height ratio were also significantly (p=0.00) more in high risk group when compared to other groups.

The Spielberg's state anxiety scores did not showed significant difference across three groups. [Group 1 (37.58±10.43), group 2 (37.95±9.50) and group 3 (38.04±8.84), F = (2,213) =1.77, p=0.17]. Score more than 39-40 is considered as presence of state anxiety levels in adults. Trait anxiety scores were comparable between low (41.25±9.57) and moderate risk (42.34±9.12) groups, but, the score was significantly (p=0.00) more in high risk (48.40±9.50) group when compared to other two [F = (2,213) = 3.42, p=0.034] Fig. 1. Trait anxiety scores showed significant positive association with IDRS scores [χ^2 9.22, p=0.010]. Pearson's correlation showed a weak positive relationship with IDRS and state (r=0.18, p=0.008) trait (r=0.17, p=0.008) anxiety scores. Pearson's correlation with anthropometric variables showed a significant positive relation with both state and trait scores, however, the association with WC (state r=0.21, p=0.002, trait r=0.27, p=0.00) Fig. 2 was more stronger than the other variables like BMI [state r=0.19, p=0.005, trait r=0.26, p=0.00], and HC [state r=0.12, p=0.07, trait r=0.18, p=0.006].

Subjects across all the three groups belong to intermediate type as far as their morningness and eveningness is concerned. Their scores were [group 1- 54.66±9.42, group 2 -53.32±8.05 and group 3 - 55.68±7.30] comparable with each other [F = (2,213) =0.17, p=0.54]. PSQI more than 5 indicates of poor sleep quality. Following are the percentage distribution of subjects scoring poor sleep quality- low risk 25%, moderate risk 69.8% and high risk 74.1%. However, the ANOVA demonstrated the comparable mean value of PSQI across the three groups [group 1-3.52±1.85, group 2- 3.74±2.65, group 3-3.38±2.07, F= (2,213) =0.45, p=0.63].

The basic cardiovascular parameters, heart rate and blood pressure showed significant variations only in the values of systolic blood pressure (Table II). Heart rate [group 1 -75.72±9.03, group 2 -76.19±6.63, group 3 - 77.47±6.80, F = (2,213)=0.77, p=0.46] was comparable across all the three groups and diastolic blood pressure [group 1-72.61±8.20, group 2 - 73.40±6.84, group 3- 75.88±7.26. F = (2,213) = 2.89, p=0.057] showed a trend of increase from low to

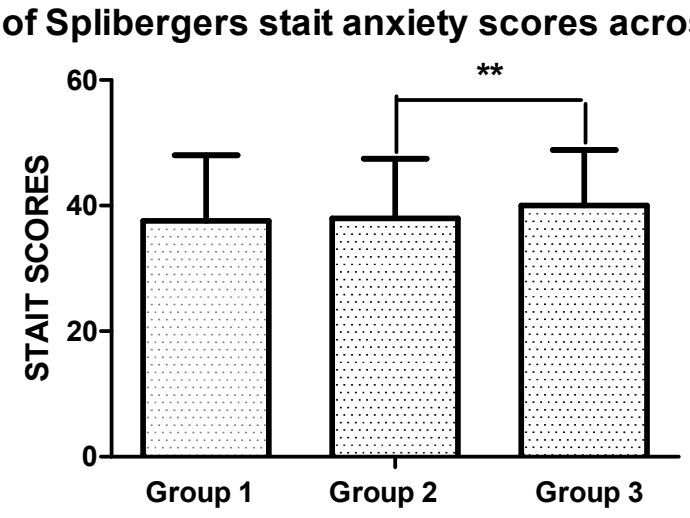

Fig. 1: Compariosn of Spielberg's Trait anxiety scores across three groups. Values are depicted in mean and SD, One way ANOVA with Banferroni post hoc multiple comparisons was applied. Spielberg's trait anxiety scores was comparable between group 1 and group 2, but, it was significantly more in group 3 when compared to other groups. **p=0.00.

TABLE II: Comparison of Cardiovascular parameters between three groups.

Variables	*Group 1*	*Group 2*	*Group 3*	*F value*	*P value*
Heart Rate (b/min)	75.72±9.03	76.19±6.63	77.47±6.80#	F=(2,213)=0.77	0.46
Diastolic Blood Pressure (DBP) mmhg	72.61±8.20	73.40±6.84	75.88±7.26#	F=(2,213)=2.89	0.057
SystolicBlood Pressure (SBP) mmhg	110.16±10.98	108.56±10.16	113.66±11.1#	F=(2,213)=4.25	0.001

Values are depicted in mean and SD, ANOVA with bonferroni post hoc test for multiple comparisons was applied. P < 0.05 is significant level.
*comparison between group 1 and group 2
#comparison between group 2 and group 3.

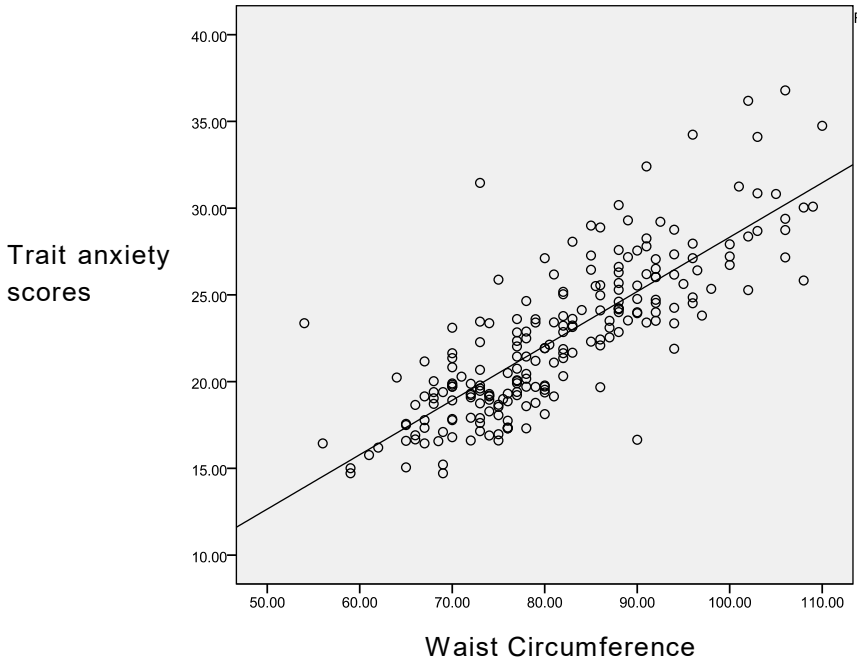

Fig. 2: Pearsons correlation between trait anxiety scores and waist circumference. Pearson's correlation between trait anxiety scores and waist circumference depicts direct correlation between these two variables with r=0.26, p=0.00.

high risk but did not reached statistical significant level. Whereas, the systolic blood pressure, was significantly (p=0.00) higher in high risk group when compared to other two groups [group 1 -110.16±10.98, group 2 - 108.56±10.16, group 3 - 113.66±11.11, F= (2,213=4.25, p=0.01)] however, the values were within normal limits.

Thus, in summary, trait anxiety scores increased with scores of IDRS and showed a positive correlation with anthropometric variables. WC showed a stronger association with trait scores than BMI.

Discussion

The present cross sectional study has demonstrated that a trait anxiety state is positively correlated with high risk group of IDRS. Markers of obesity i.e. waist circumference and BMI, that are the components of IDRS score, showed a positive correlation with state and trait anxiety scores, with stronger association with waist circumference.

Indian diabetic risk score is the screening tool widely used to assess the risk of diabetes among general

population. It is 72.5% sensitive and 60.1% specific in predicting diabetes (2, 20). In the cohort of the present study, 56% had moderate risk (IDRS 30-60) and 24% were in high risk (IDRS > 60) category and the percentage of risk distribution in the present sample fits in statistics from large population reported elsewhere (21). Age and anthropometric measurements showed a significant linear increase with IDRS scores. This observation is quite logical as age and anthropometric measurements are important components for IDRS scoring. We have reported that the change in anthropometric variables precedes the changes in lipid among risk group who are healthy, non-diabetic (22) and the same trend was reported earlier linking modifiable risk factors like obesity and physical inactivity as risk for developing diabetes in the span of five years (23). Thus, efforts towards reducing weight with intense physical activity formed one of the most important strategies towards preventing the development of diabetes. However, in addition to the anthropometric factors, psychological variables also contributes either as a causative role in developing obesity and/ or as a major hindering factor towards effective implementation of life style modification strategies. High prevalence of anxiety and depression is reported in diabetics and also in high risk group (6, 7, 5, 24, 25). In contrast, few have reported that anxiety is less in diabetics and risk group when compared to depression (26). This discrepancy is due to the tools that have been used to assess the psychological profile. Most of the studies have used Hospital anxiety depression scores (HADS), short version of depression, anxiety and stress scales (DASS21) that assess the clinically overt anxiety and depression states among patient population. Further, the above mentioned tools which are used quite often, don't distinguish between state and trait anxiety levels. Evaluation these two distinct anxiety behaviors is important considering the relationship between dietary pattern, anxiety states and obesity (27). Hence, in the present study, state and trait anxiety levels was assessed along with sleep quality among healthy individuals with low, moderate and high risk of becoming diabetic.

State and Trait anxiety scores have shown to be predict future occurrence of anxiety disorders and is known to be highly prevalent among diabetics of younger age group between 18-48 years (26). State anxiety provides the information about transitory anxiety states on how the individual feel in particular circumstances; the values 39-40 and above is considered to be clinically prevalent anxious state (16). In the present study, 50% of high risk group showed scores more than 39-40 in the group studied, but, the average values of state anxiety scores across all the three groups were comparable. Thus, demonstrating the absence of clinical anxiety states based on the average values of the scores in the group studied. However, the state anxiety scores are very informative about affective state in specific clinical conditions. Since, the subjects of the present study were healthy and normal individuals state anxiety scores did not vary significantly across the group.

Trait anxiety intends to assess the 'anxiety proneness' which is a longstanding characteristic and is less responsive to immediate short term change when compared to state anxiety. The test-retest reliability of trait anxiety scores higher than state scores and is also used as a reliable tool to predict the occurrence of anxiety (28). Our results have demonstrated significant positive association with trait anxiety and IDRS scores. Markers of obesity i.e WC and BMI showed a positive but weak correlation with trait anxiety scores. When compared to both markers of obesity; waist circumference showed a stronger association than BMI. The fact waist circumference demonstrating stronger association with trait scores depicts that the dietary pattern could be common factor associated with both increase in waist circumference and trait anxiety state.

Consumption of processed food is known to induce anxiety like states (29). Animal studies have also demonstrated that feeding high fat diet induces anxious behavior in adult mice and is known to increase the risk of developing anxiety disorders in later stages of life and also attenuates cognitive capacity (30, 31). Thus, demonstrating the consistent effect of dietary pattern on inducing anxiety states. Similar results are also demonstrated in sedentary adults with age range between 25-45 years (32).

Participants in the present study were also in the same range as above and the Pearson correlation showed stronger relation with waist circumference with anxiety scores. Eventhough, we have not evaluated the dietary pattern in the study, still with the large evidences in the literature, it could be inferred that faulty dietary pattern and sedentary life style has led to obesity. Further, repeated comfort food intake is one of the coping behavior that is easily cultivated to overcome the anxiety states, which in turn increases risk of obesity and anxiety (14). Hence, the vicious circle initiating with high fat intake leading to obesity and anxiety; anxiety states in turn drives the reward seeking in terms of food intake is developed. Therefore, managing anxiety looks like key to break this vicious cycle in effective implementation of preventive strategy from developing diabetes.

Sleep quality, as measured in terms of Pittsburgh sleep quality index showed comparable average value across the three groups. However, the percentage of subjects with PSQI more than 5 indicating poor sleep quality increased with increasing diabetes risk. Studies has shown increased prevalence of snoring in high risk group which is the major reason for poor sleep quality (33). In the present study, sleep quality was comparable across the groups, thus, demonstrating that development of trait anxiety along with risk anthropometric variables could be the preclinical physical and psychological manifestation among high risk group as assessed by IDRS scores. However, on follow up of the high risk group there could be chances of developing anxiety could impair sleep quality. Therefore, the study, provides the data that development of trait anxiety could be early psychological marker in high risk group that needs to be addressed Vitals like pulse rate and blood pressure were within normal limits, eventhough, systolic blood pressure showed a significant differences across the groups.

In conclusion, the present study has shown a positive correlation between anxiety states and markers of obesity in the high risk group intend to develop diabetes. Hence, as a strategy in the diabetes preventive programs, along with physical activity, management of anxiety seems to be the critical point towards effective implementation of healthy dietary style. In this regard, the mechanism involved in the role of Yoga and meditation practices as a strategy in diabetes prevention needs to be evaluated. To substantiate our observations assessment in population of larger sample and among various age groups with assessment of anxiety related hormones are called for, which forms limitation of the present study to provide comprehensive explanation.

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