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A descriptive study to determine an association between knowledge regarding diabetes and pattern of exercises & yoga and sleep among adults with diabetes from both rural and urban communities of Uttarakhand, India.

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Introduction

Diabetes mellitus (DM) is a chronic metabolic illness characterized by high blood glucose levels (hyperglycemia) due to disturbances in carbohydrate, protein, and fat metabolism, often linked to insulin deficiency or resistance. As the prevalence of diabetes in India is projected to rise from 74.2 million in 2021 to 124.9 million by 2045, it represents a significant public health emergency. The etiology of DM is multifactorial, including genetic predisposition, obesity, dyslipidemia, and hypertension. Both non-modifiable (genetics, age, family history) and modifiable risk factors (sedentary lifestyle, poor diet, smoking, alcohol, stress, and lack of sleep) contribute to its development [1-8]. Engaging in physical exercise is a crucial non-pharmacological approach to managing blood sugar levels. [9]

DM encompasses several types: Type 1 (autoimmune destruction of pancreatic beta cells), Type 2 (insulin resistance and deficiency), gestational diabetes (during pregnancy), and other forms caused by medication, pancreatic diseases, or genetic factors [10-12]. Managing DM focuses on maintaining near-normal blood glucose levels to prevent complications [13]. DM is a metabolic illness that can be avoided with nutrition, weight loss, and lifestyle changes. Management ought to be customised to raise DM patients' quality of life. [14] Exercise, nutrition & medical therapy together form the keystone of diabetes. The American Diabetes Association emphasizes lifestyle changes, including at least 150 minutes of moderate-to-vigorous aerobic activity and resistance training weekly, as key interventions. Regular exercise has been associated with several risk factors for the formation of diabetes mellitus, including decreasing blood pressure, avoiding and minimising weight gain, enhancing insulin sensitivity and glucose control, and optimising lipoprotein profile [15-16].

Adequate sleep is essential for overall health and well-being, and poor sleep quality is associated with various health issues and reduced productivity. Research highlights the impact of behavioral and pathological factors on

sleep patterns, underscoring the importance of good sleep hygiene and management of underlying health conditions [17].

Diabetes mellitus (DM) is a rapidly growing health concern in India, with the number of affected individuals expected to rise significantly. Although there were many literatures from Indian scenario found online on diabetes knowledge. Despite the known benefits of lifestyle modifications, including regular exercise and adequate sleep, there was scarcity of literature in North-Indian, specifically Sub-Himalayan hilly region on how knowledge about diabetes influences these behaviors-exercise, sleep and yoga, particularly in diverse settings like rural and urban communities of Uttarakhand. Therefore, we conducted this study to determine an association between knowledge regarding diabetes and pattern of exercises & yoga and sleep among adults with diabetes from both rural and urban communities of Uttarakhand, India.

Methods and Statistics

Research approach: Quantitative research approach was used in the study.

Research design: A descriptive cross-sectional study design was adopted in this study.

Research setting: Rural and urban community areas of Uttarakhand, Sub-Himalayan hilly region, India.

Sample: Adults with diabetes residents of rural and urban community areas of Uttarakhand, Sub-Himalayan Hilly region, India.

Sample size: A total of 100 sample size were calculated for this study.

The sample size was estimated using the Winpepi® program (http:// www.brixtonhealth.com/pepi4windows.html. To estimate a proportion Confidence level 95%, Acceptable difference 0.06, Assumed proportion 0.09, expected loss of subjects 10%. Required sample size = 98 if the proportion is 0.09.

Eligibility criteria: The participants enrolled in the who had fasting blood sugar (FBS) levels greater than 200 mg/dL, belonged to rural and urban community areas of Sub-Himalayan hilly region, Uttarakhand, provided consent to participate in the study and understanding either Hindi or English language.

Sampling Technique: Purposive sampling technique utilized in the study.

Variables/Outcomes: 1) Knowledge regarding diabetes, 2) patterns of exercise & yoga and sleep and 3) association between knowledge regarding with pattern of exercise & yoga and sleep.

Data collection tools and procedure: -

The data collection tools were self-structured questionnaires, consists of three sections. **Section I-** consists of socio-demographic variables of participants. **Section II-** consists of knowledge regarding diabetes questionnaire and the responses in form of yes/no and questions used such as when did you last test your blood sugar levels? Has your healthcare provider ever informed you about elevated blood sugar levels or a diabetes mellitus diagnosis? Are you currently taking insulin? Have you been taking any antidiabetic medications in the past two weeks? Are you following any dietary restrictions for diabetes? Are you using any home remedies or Ayurvedic treatments for diabetes mellitus? If so, have these home remedies or Ayurvedic treatments helped in decreasing your blood sugar levels? Finally, has your healthcare provider ever mentioned any kidney problems due to diabetes? **Section III**- consists of questions related to pattern of exercise & sleep and the answer having multiple responses such as how much physical activity is required for you to get to your workplace? How physically active

are you at your workplace? How physically active are you during your free time? Do you exercise regularly? Do you practice yoga regularly? How is your sleep pattern at night? Each participants took around 5 - 10 min per participant to fill the questionnaire. The research tools were validated by 5 experts from the fields of medicine, community Family Medicine & nursing and the reliability scores were 0.80.

Ethical clearance

The current study was ethically approved by the Institutional Ethical Committee (IEC/IM/RC69/2015/07), AIIMS, Rishikesh, India. A written informed consent was obtained from each participant before data collection. The study ensured confidentiality and anonymity of the subjects by safeguarding participant details such as names, initials, or hospital numbers. All ethical standards outlined by the Institutional Ethics Committee (IEC), Declaration of Helsinki, Indian Council of Medical Research (ICMR), and good clinical practices were adhered to throughout the study.

Statistical analysis

Data analysis was performed using IBM® SPSS® software version 23.0. The sociodemographic variables, knowledge regarding diabetes, pattern of exercise & yoga and sleep of diabetic participants were assessed and denoted as frequency (%) in this study. The association between knowledge of diabetes with pattern of exercise & sleep were analysed by using Chi-Square $(x)^2$ test/Fisher exact test accordingly (where cell value less than 5) at p value ≤ 0.05 considered as significant in this study.

Results

For 100 participants the data was coded and entered MS Excel sheet then transfer to SPSS software file and analysed further. Table.1 showed that out of 100 participants, the mean age (in years) of the participants was 53.3 ± 12.22, with their mean family income of INR- 20,200± 17,725 and mean number of family members as 5.38±2.33 respectively. Majority of them were females (55%), residing in rural areas (61%) and most of them were illiterate (29%) and home maker (37%) respectively.

Outcome-1: Knowledge regarding diabetes

Table.2, out of the 100 participants, majority of them were doing test for blood sugar level (77%), get informed by their health care provider about diabetes (58%), not taking insulin (85%), not taking any diabetic medication in the past 2 weeks (51%), but following diet restriction for diabetes (54%), not taking any ayurvedic/home remedies (81%), don't know whether home remedies will reduce blood sugar levels (83%) and lastly, majority of them were not get mentioned about kidney problems due to diabetes (86%). So, it can be interpreted that although majority of participants belonged to rural areas but still, they had good knowledge regarding diabetes mellitus disease condition.

Outcome-2 : Pattern of exercise and sleep

Table.3 out of 100 participants, majority of them were using a motor vehicle to go to workplace or has no work (56%), doing mildly physically active at their workplace (59%), performing light/mild hard work during free time (76%), not doing any regular exercise (65%), as well as yoga on regular basis (73%), and lastly, most of them were having an okay- okay or not good quality sleep at night (41%). So, it can be interpretated that majority of the participants belongs to rural areas were not performing exercise, yoga on regular basis and having okay-okay

sleep or not good quality sleep at night which can lead to sedentary lifestyle and diabetes mellitus condition among them.

Outcome-3 : Association of knowledge with exercise and sleep variables

Table.4 showed the significant association found between knowledge regarding diabetes questions which includes testing blood sugar level with pattern of exercise needed to get to work at $p \leq 0.05$; get informed about elevated blood sugar with physical activity at workplace at $p \leq 0.05$; get informed about diabetes-related kidney issues with exercise needed to get to work, $p \leq 0.005$ & physical activity at workplace, $p \leq 0.004$ respectively. No association found between other variables of pattern of exercise & sleep that's why not mentioned in this table. So, it can be interpreted as that good knowledge regarding diabetes was found to be significantly associated with less regular exercise/physical activities at workplace among the participants residing in rural areas of Uttarakhand predominantly.

Discussion

In this study, most of the participants were female, from rural community areas, illiterate, and homemakers. The participants' knowledge regarding diabetes was found to be good. Most of the participants did not engage in regular exercise or yoga at workplace. Their sleep patterns were okay okay or not of good quality in nighttime. Despite of having good knowledge regarding diabetes, it was associated with less regular exercise/yoga at the workplace, which led to elevated blood sugar levels and diabetes mellitus among these participants belongs to rural areas of Uttarakhand.

A previous study by **Sami W, et al** study revealed that dietary habits and sedentary lifestyle are the major factors for rapidly rising incidence of DM among developing countries. Better control of the disease results from increased information about the problems of diabetes and the ensuing improvements in dietary practices, attitudes, and knowledge.[18] This study findings were in line with our study findings which revealed that knowledge regarding diabetes helps in the better control of blood sugar level.

A recent study by **Simó R, et al** study revealed that the calorie content of the diet should be adjusted in each individual in accordance with the body mass index and regular physical activity. As far as the nutrient proportions of the diet, it is recommended that proteins should constitute 10%-20% of calorie intake and fats less than 30%, with less than 10% saturated fats. With regard to carbohydrates, emphasis should be placed on total intake rather than on their origin, although rapidly absorbed carbohydrates should be avoided.[19]

A study by **Ross et al** analysed the effect of exercise-induced weight loss via a 500-700 kcal/day deficit during a 12-week intervention and showed an average weight loss of 7.6kg (8% initial body weight). Their findings also showed that exercise-induced weight loss decreases total fat percentage with increases in cardiovascular fitness to a greater degree than similar diet-induced weight loss. This degree of weight loss is uncommon in exercise interventional studies without simultaneous calorie restriction, so diet and exercise interventions should be administered simultaneously for maximal benefit to prevent non-communicable diseases. [20] These findings align with the present study, which showed that a lack of regular exercise, yoga, and good quality sleep at the workplace can be a causative factor for elevated blood sugar levels and diabetes mellitus.

A previous study by **Latif et al.,** discovered that combined exercises—that is, aerobic and strength training—provide superior blood glucose-lowering effects. In the future, coordinated exercise regimens may be employed

to control and prevent blood sugar levels in diabetic patients. [21, 22] Different research findings also support the current study's conclusions, suggesting that improved knowledge about diabetes will lead to increased awareness about exercise, yoga, and good quality sleep. This, in turn, will help lower blood sugar levels and reduce the severity of diabetes mellitus.

Strength and Limitations of the study: This study was one of own its kind study in Sub-Himalayan hilly region which collected both rural and urban communities of Uttarakhand state which increase its generalizability. Sample size was enough for increasing its generalizability. All possible statistics to find association was used in this study.

Although, it's a descriptive cross-sectional study not a randomized controlled trial to get a control over confounders. Last one is this data is self-reported which impact risk of bias status of the study.

Conclusion

Preliminary study findings showed that the participants from community areas of Uttarakhand state had good knowledge about diabetes but lacked regular exercise & yoga and good quality sleep at nighttime. It further suggests an association found between higher knowledge regarding diabetes with lack of regular exercise/yoga at the workplace from rural communities, which ultimately helped improve their elevated blood sugar levels.

These insights highlight the need for tailored diabetes education programs in Uttarakhand's rural and urban areas, helping policymakers understand and address the unique challenges faced by each group. The study results provide importance for targeted educational interventions, health disparities between rural & urban areas, provides cultural relevance of this region, and lastly the preventive strategies for diabetes. This meticulous research sheds light on crucial lifestyle factors that often go unnoticed in conventional treatment approaches. By incorporating both rural and urban perspectives of hilly region, we have enriched the study's relevance and applicability, ensuring a broader impact on diabetes care.

The study emphasizes that educational interventions can enhance diabetes awareness, leading to healthier behaviours and better disease outcomes. This study results provide ground data to conduct further randomized controlled trials with larger sample sizes in this area.

Conflict of intertest: All authors declare that there is no conflict of interest in this manuscript.

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Table.1 showing socio-demographic variables of the participants. (N=100)

S.N	Variable	Category	Frequency (%)
1	Age (in years)	mean ± SD	53.33±12.22
2	Family income (INR)	mean ± SD	20,200±17,725
3	Number of family members	mean ± SD	5.38±2.33
4	Gender	Male	45 (45%)
		Female	55 (55%)
5	Residency	Urban	39 (39%)
		Rural	61 (61%)
6	Educational status	Post-graduate	09 (9%)
		Graduate	13 (13%)
		Intermediate	11 (11%)
		High school	13 (13%)
		Upto 8th standard	17 (17%)
		Primary school	8 (8%)
		Illiterate	29 (29%)
7	Occupational status	Job	16 (16%)
		Unemployed	11 (11%)
		Retired	15 (15%)
		Homemaker	37 (37%)
		Self-employed	15 (15%)
		Labour	06 (6%)

Table.2 showing the knowledge regarding diabetes of the participants. (N=100)

S. N	Variable	Category	Frequency (%)
1	When did you last test your blood sugar levels?	Yes	77 (77%)
		No	23(23%)
2	Has your healthcare provider ever informed you about elevated blood sugar levels or a diabetes mellitus diagnosis?	Yes	58 (58%)
		No	42 (42%)
3	Are you currently taking insulin?	Yes	15 (15%)
		No	85 (85%)
4	Have you been taking any antidiabetic medications in the past two weeks?	Yes	49 (49%)
		No	51 (51%)
5	Are you following any dietary restrictions for diabetes?	Yes	54 (54%)
		No	46 (46%)
6	Are you using any home remedies or Ayurvedic treatments for diabetes mellitus?	Yes	19 (19%)
		No	81 (81%)
7	If so, have these home remedies or Ayurvedic treatments helped in decreasing your blood sugar levels?	Sugar decreases	12 (12%)
		No effect	03 (3%)
		Health is deteriorated	02 (2%)
		Don't know	83 (83%)
8	Has your healthcare provider ever mentioned any kidney problems due to diabetes?	Yes	14 (14%)
		No	86 (86%)

Table 3 showing the pattern of exercises and sleep of the participants. (N=100)			
S. No	**Variable**	**Category**	**Frequency (%)**
1	How much physical activity is required for you to get to your workplace?	By using motor vehicle or has no work	56 (56%)
		>1 minutes' walk or by bicycle	21(21%)
		1 -29-minute walk or by bicycle	15 (15%)
		>30 minutes' walk or by bicycle	08 (8%)
2	How physically active are you at your workplace?	Mild hard work	59 (59%)
		Moderate hard work	38 (38%)
		Very hard work	03 (3%)
3	How physically active are you during your free time?	Light/mild hard work	76 (76%)
		Moderate hard work	21(21%)
		Very hard work	03 (3%)
4	Do you exercise regularly?	>5 days in a week or more	16 (16%)
		3-4 days in a week	13 (13%)
		2 days in a week or less	06 (6%)
		Not doing any exercise	65 (65%)
5	Do you practice yoga regularly?	>5 days in a week or more	08 (8%)
		3-4 days in a week	13 (13%)
		2 days in a week or less	06 (6%)
		Not doing any yoga	73 (73%)
6	How is your sleep pattern at night?	Very good	13 (13%)
		Good only	38 (38%)
		Okay-okay only	41 (41%)
		Very bad	08 (8%)

Table.4 showing the association between knowledge of diabetes and pattern of exercises & sleep of the participants. (N=100)			
Knowledge regarding diabetes variables	**Pattern of exercise variables**	**Chi square**	***p* value**
Last blood sugar test?	Exercise Needed to Get to Work	7.47	0.05*
	Physical activity at workplace	1.16	0.55
Informed about elevated blood sugar levels?	Exercise Needed to Get to Work	6.63	0.08
	Physical activity at workplace	5.91	0.05*
Current intake of insulin.	Exercise Needed to Get to Work	11.29	0.08
	Physical activity at workplace	7.80	0.09
Intake of antidiabetic medications in the past two weeks?	Exercise Needed to Get to Work	9.38	0.15
	Physical activity at workplace	7.27	0.12
Following any dietary restrictions for diabetes?	Exercise Needed to Get to Work	9.08	0.16
	Physical activity at workplace	6.38	0.17

Following any home remedies or Ayurvedic treatments for diabetes?	Exercise Needed to Get to Work	9.69	0.13
	Physical activity at workplace	6.01	0.19
If yes, are these home remedies effective?	Exercise Needed to Get to Work	18.55	0.10
	Physical activity at workplace	12.82	0.11
Informed about diabetes-related Kidney Issues?	Exercise Needed to Get to Work	12.70	0.005*
	Physical activity at workplace	11.03	0.004*

*(*p value considers as significant 0.05)*