Original Article

Determination of SRPA and adiposity measures and its association with glycemic status in type 2 diabetics having high mean HbA1c in a private clinic of a city in west India

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Abstract

Introduction: Indian type 2 diabetics (T2D) is known for poor disease control on which self-reported physical activity (SRPA) and optimum body composition have positive impact. We determined prevalence of SRPA and general/visceral obesity and its impact on HbA1c-based glycemia. **Methodology:** By a cross-sectional study conducted on 200 T2Ds in a private clinic, HbA1c-based glycemic status, WHO questionnaire-based SRPA, BMI-based general obesity, and bipolar bioelectrical impedance-based visceral obesity were evaluated. SRPA and obesity were compared and associated with glycaemic status keeping mean HbA1c as cutoff. **Result:** Mean age, male%, mean duration of T2D, mean BMI, mean HbA1c, and SRPA prevalence were 54 years, 42.5%, 4.82 years, 25.49, 8.69%, and 61.5%, respectively. Comparison of groups based on either SRPA or BMI (cutoff 25) showed better HbA1c with the presence of SRPA and BMI <25. Physical inactivity imposed odds risk of 3.44 for visceral fat (VF) ≥10% and odds risk of 2.6 for more than mean HbA1c with statistical significances. VF ≥10% imposed odds risk of 4 for higher than mean HbA1c. Physical inactivity and visceral obesity together imposed ⅓rd prevalence of better glycaemic value, while physical activity and controlled visceral obesity yielded ¾th prevalence of good glycaemic value. **Conclusion:** In T2D with poor glycaemic status and moderately prevalent physical activity, we found strongly significant association of SRPA and controlled body adiposity with HbA1c-based glycaemic status. It reaffirms physical activity and control of central obesity as forerunners of better glycaemic status and calls for further studies having vertical follow-up.

Keywords: Adiposity, HbA1c, physical activity, type 2 diabetes mellitus, visceral obesity

Introduction

Type 2 diabetes has been a global endemic with threatening future projection.[1] Indian diabetics are known to have substandard glycaemic status, which is not measured in accordance with the gold standard of HbA1c.[2] There is poor health literacy in our diabetic population and lack of awareness about health benefits of physical activity.[3] Obesity is both the forerunner and aftermath of diabetes[4] with negative association with disease control. Obesity itself is associated negatively with physical activity,[5] as reported elsewhere. However, such associations are not studied in our population more so from a private set up. Considering this, we studied the association of

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SRPA and adiposity with glycaemic status in undertreatment type 2 diabetics.

Methodology

Study setup

A cross-sectional field study was carried out under the guidance of the medicine and physiology departments of a tertiary care hospital affiliated with a government medical college. All participants were chronic diabetics being treated as outdoor patients in a private clinic.

Study population

Study proposal was approved by both the departments and the IRB committee of the institution. Permission was taken from the treating physician, and written informed consent was obtained from the participants, who were also explained about the aim of the study.

Sample size was calculated by Rao soft sample size calculator software that yielded a sample size of 200 adequate for 95% confidence interval, 5% margin of error, and 9.6% prevalence of type 2 DM for the population size of the city, i. e., 10 lakhs. Study population was selected from a single private clinic of a physician by convenient sampling. We included participants with type 2 diabetics aged less than 75 years, of either sex, known to be diabetics since a minimum period of 1 year, treated as outdoor patients, adherent to treatment (as per case file), having current HbA1c report, and ready to give written informed consent. We excluded dehydrated participants, pregnant and lactating females, trained athletes, current smokers, and current alcoholics.

Approval was taken for this study prospectively from IRB committee of the institution numbered 1281/2023, department number: 107/2023, dated 09/08/2023.

Participant assessment

Each participant was personally interviewed to record personal details, disease history, treatment, and current glycaemic status report. HbA1c report, conducted within the last one month by using high-performance liquid chromatography at an ISO 9000 certified pathology laboratory, was used for the evaluation of glycaemic control. Each participant was evaluated for SRPA using the GPAQ questionnaire of WHO.[6]

Adiposity assessment

General adiposity was measured by body mass index, standard height was taken using a stadiometer wherein the participant was asked to stand barefoot looking forward, and height was measured using a sensitivity of 0.5 cm. Weight was measured through a standard instrument (Omron Karada).

For visceral adiposity, body composition analysis was performed by Omron Karada scan using the bipolar bioelectrical impedance analysis method.[7] Having entered the age, gender, and height, the participant stands on an instrument so that a low strength of 500 μA electric current at 500 kHz is passed through the lower limb into the body in a bipolar circuit. It yields parameters of total and regional body composition by scanning the body for fat-free mass and fat. Instrument was self-calibrated before each measurement, and in case of dehydration, participants were excluded as instrument reports measuring errors.

Study parameters and norms

Our exposure variables were self-reported physical activity (SRPA Score), general obesity (BMI—quantitative and qualitative), and visceral obesity (total body fat, skeletal muscle mass, visceral fat—quantitative and qualitative). Outcome variable was HbA1c-based current glycaemic status (both quantitative and qualitative). Confounding variables were age, gender, and duration of DM. HbA1c norms were defined as per ADA guidelines: <5.7%—normal, 5.7-6.4—prediabetes, and >6.4—diabetics. SRPA was defined as regular physical activity for more than or equal to 30 minutes for at least 5 days a week for most of the weeks in a year (GPAQ, WHO). BMI categories were defined according to the WHO criteria: 18-24.9—normal and ≥25—obese.[7] Visceral fat cutoff was 10% with visceral fat ≥10% taken as visceral obesity.[7]

Statistical analysis

Data from case record files were entered, compiled, and sorted by Microsoft Office Excel spreadsheets. Quantitative data were expressed as mean ± SD, and qualitative data were expressed as number (frequency). For each data, the normality test was ran to check for parametric distribution before applying a statistical test. GraphPad QuickCalcs software (demo version free software of GraphPad Software, Inc. California, USA) was used for statistical analysis. Comparison between 2 groups was performed by an unpaired *t*-test or Mann-Whitney *U* test. Contingency tables were assessed by the Chi-square test to check association between prevalent qualitative variables. Major study outcome parameters were assessed by multiple linear regressions to find out significant predictors. For all the tests, the significance value was $P < 0.05$.

Results

Comparison of gender-based subgroups revealed that both groups were comparable for age, duration of diabetes mellitus, HbA1c, SRPA, BMI, and visceral fat, but females have

Table 1: Distribution of study parameters among study participants (male, female, and all)

	Male (*n*=85)	Female (*n*=115)	*P*	Total (*n*=200)
Age (years)	54.98±11.12	53.28±9.71	0.25	54±10.32
Height (cm)	165.14±6.29	155.75±4.49	0.0001	159.74±7.05
Duration of DM (years)	5.05±4.53	4.65±5.09	0.57	4.82±4.84
HbA1c (%)	8.60±1.19	8.75±1.47	0.52	8.69±1.36
SRPA (Yes/No)	53/32	69/46	0.74	122/78
BMI (kg/m^2)	24.94±4.54	25.90±6.17	0.23	25.49±5.54
Total body fat (%)	27.30±7.81	35.10±8.22	0.0001	31.88±8.89
Visceral fat (%)	11.12±6.24	9.76±7.08	0.16	10.33±6.72
Skeletal muscle mass (%)	28.56±3.73	24.34±3.46	0.0001	26.13±4.13

significantly shorter height, more total body fat, and less skeletal muscle mass compared to males [Table 1].

Group with SRPA was significantly younger, with more female participants, shorter duration of diabetes, and better HbA1c than those without SRPA. Diabetics with SRPA has statistically significantly lower BMI, total body fat, visceral fat, and higher skeletal muscle mass [Table 2].

Using BMI cutoff of 25, we found that groups were comparable for age, gender, and duration of diabetes, and there was no significant difference between HbA1c and SRPA [Table 3].

Groups were stratified by visceral fat (cutoff 10%) which were comparable for age and duration of diabetes but not for gender distribution. As compared to visceral fat >10%, the group with visceral fat <10% had better mean HbA1c with more prevalence of SRPA [Table 4].

Table 2: Comparison of study parameters between type 2 diabetics with or without SRPA

	SRPA + (*n*=123)	SRPA - (*n*=77)	*P*
Age (years)	51.49±9.38	58.01±10.59	0.0001
Gender (M/F)	54/69	31/46	0.61
Height (cm)	160.78±6.10	158.07±8.15	0.0081
Duration of DM (years)	3.90±3.88	6.29±5.81	0.0006
HbA1c (%)	8.45±1.16	9.08±1.55	0.0014
Weight (kg)	62.69±11.81	68.77±17.10	0.0040
BMI (kg/m^2)	24.20±4.25	27.55±6.67	0.0001
Total body fat (%)	33.58±7.48	29.15±10.30	0.0005
Visceral fat (%)	8.72±5.40	12.90±7.83	0.0001
Skeletal muscle mass (%)	26.97±3.83	24.80±4.24	0.0003

Table 3: Comparison of study parameters between type 2 diabetics stratified by a BMI cutoff of 25

	BMI ≥25 (*n*=106)	BMI <25 (*n*=94)	*P*
Age (years)	53.25±10.36	54.84±10.31	0.28
Gender (M/F)	42/64	43/51	0.38
Duration of DM (years)	4.86±4.07	4.77±5.62	0.90
HbA1c (%)	8.87±1.35	8.49±1.36	0.05
HbA1c >mean (Yes/No)	36/70	63/31	<0.0001
SRPA (Yes/No)	51/55	71/23	<0.0001

Table 4: Comparison of study parameters between type 2 diabetics stratified by a VF cutoff of 10%

	VF ≥10% (*n*=104)	VF <10% (*n*=96)	*P*
Age (years)	54.05±10.20	53.95±10.54	0.95
Gender (M/F)	54/53	34/62	0.04
Duration of DM (years)	5.16±4.26	4.44±5.41	0.30
HbA1c (%)	8.92±1.30	8.43±1.38	0.0107
HbA1c >mean (Yes/No)	35/69	64/32	<0.0001
SRPA (Yes/No)	50/54	72/24	<0.0001

We correlated the presence and/or absence of SRPA with controlled and/or uncontrolled visceral obesity with glycaemic status taking mean HbA1c as a cutoff value. Subgroup with either SRPA or visceral fat <10% had better glycaemic status than the third group without both. Highest prevalent HbA1c > mean was shown by the 4th group with both SRPA and VF <10%. This increasing trend of better glycaemic status was statistically significant [Table 5].

Discussion

Diabesity is a highly prevalent NCD taking a heavy toll on urban populations with sedentary lifestyles.[8] In 2013, obesity has been declared as an official disease by the USA, but there is a lack of awareness about the same in the Indian population. After incident diabetes, disease control is substandard, which is measured not in terms of HbA1c.[9] Physical activity, be it occupational or leisure time, is not explored by diabetics who later on take treatment irregularly.[10] Obesity is measured in terms of BMI which does not give a true picture of visceral adiposity,[11] and glycaemic status is limited to plasma glucose only. Most studies reported are from nonprivate setups. With this background, we evaluated SRPA by standard questionnaire and general and visceral adiposity to test their association with HbA1c-based long-term glycaemic control in undertreatment type 2 diabetics from a private setup of an urban area in India.

Among study participants, female participants had comparatively shorter height, more body fat, and lesser skeletal muscle mass in line with the previous literature.[12] However, gender did not prove to be a confounding factor for other study outcomes, mainly SRPA and glycaemic status. SRPA was assessed by WHO questionnaire, and it was mainly in the form of leisure time physical activity (LTPA) with a prevalence of 61.5%. Contrastingly, HbA1c-based glycaemic status was evident in 3%. Among type 2 diabetics, 53% exhibited general obesity based on BMI cutoff of ≥25 and 52% had visceral obesity based on visceral obesity cutoff of >10%. Such high prevalence of obesity[13] and poor glycaemic status[14] is the hallmark of our diabetics as reported previously that can jeopardise disease control after incident diabetes, which is neglected to this extent ever in diabetic patients from a private setup. Among our population contrastingly to previously reported,[2,14] prevalent plasma glucose-based glycaemic status is reported to be better (30% and 40%) than HbA1c-based glycaemic status (3%) of the current study. However, HbA1c gives a better picture of long-term disease control than plasma glucose. The current study had participants from a private set up, yet such poor disease control may underscore the high prevalence of complications of type 2 diabetes in our population. Contrasting to glycaemic control, we found a 61.5% prevalence of SRPA which was mainly in the form of LTPA. This is higher than the previously reported study[15] from a private setup (19%) among type 2 diabetics not receiving any antihypertensives and that can be due to participants being from the private clinic having better literacy and socioeconomic status. Despite such high prevailing SRPA, study participants exhibited only 3% HbA1c control suggestive of many other factors responsible like diet.[16]

Table 5: Odds risk for various outcomes for given exposures using SRPA, visceral fat (cutoff 10%), and HbA1c (cutoff mean)

Parameter	SRPA -	SRPA +	Statistic
Visceral fat ≥10%	54	50	χ^2=16.44
Visceral fat <10%	23	73	*P*=0.0001
			OR=3.43 (95% CI-1.87-6.29)
Absence of SRPA was associated with 3.44 times OR with statistical significance for abnormally high VF.			
Parameter	**SRPA -**	**SRPA +**	**Statistic**
HbA1c >mean	47	46	χ^2=10.63
HbA1c <mean	30	77	*P*=0.0011
			OR=2.62 (95% CI-1.46,4.71)
Absence of SRPA was associated with 2.6 times OR with statistical significance for poor glycaemic control.			
Parameter	**Visceral fat ≥10%**	**Visceral fat <10%**	**Statistic**
HbA1c >mean	65	28	χ^2=22.29
HbA1c <mean	39	68	*P*=0.0001
			OR=4.03 (95% CI-2.24,7.32)
Poor glycaemic control was associated with 4.03 times OR with statistical significance for abnormally high VF			

Parameter	SRPA - VF ≥10	SRPA + VF ≥10	SRPA - VF <10	SRPA + VF <10	Statistic
HbA1c >mean	18	21	12	56	χ^2=27.31
HbA1c <mean	36	29	11	17	*P*=0.00001

SRPA was quantified by standard questionnaire, while rather than general, visceral obesity was quantified by a body fat analyser. SRPA was associated with lesser prevalence of visceral obesity in line with other studies.[17-19] Though the high prevalent SRPA was only leisure time physical activity (LTPA), there was 3.44 times lesser risk of prevalent visceral obesity in those by SRPA. So LTPA is suggested as a positive modifier that can affect body composition which has multiple health benefits.

HbA1c showed a mean high value, and only 6 out of 200 showed that it controlled indicating the real picture of uncontrolled diabetes in our population. Due to this, we could not compare groups as good or poor glycemics, but they were stratified by the HbA1c mean value. Likewise, SRPA associated with relatively better glycaemic status as those with physical inactivity among our study group exhibited 2.6 times odd's risk for HbA1c < mean. This reinforcing health behaviour can bring better glycaemic status, though the mean HbA1c in our population was 8.6% and all but few had HbA1c beyond targeted cutoff. This is a cross-sectional study, so exact causality cannot be established but definitely be hinted. Diabetes makes a duo with obesity,[1] but unfortunately, the latter is neglected in patient care. In most studies, general adiposity is inferred in terms of BMI, but as reported previously, visceral adiposity is better in this regard. Visceral fat <10% was associated with 4.03 times lesser risk of abnormal glycemia in overt diabetics. Though either BMI or VF was related to glycaemic status, the association of HbA1c was stronger for general obesity than visceral obesity. It further reaffirms the superiority of central or visceral obesity than general obesity, though both were predictors of better glycemia.

Though SRPA or VF <10% was independently associated with better glycaemic status, there was an additive effect. Those with neither SRPA nor VF <10% exhibited ⅓rd prevalence of better glycaemic status. Contrastingly, type 2 diabetics with both SRPA and VF <10% showed ¾th prevalence of better glycaemic status. This indicates that both physical activity even LTPA like our study group and visceral obesity under control have profound effect on long-term glycaemic status, so both must be insinuated in chronic diabetes to ensure good glycemia with benefits on overall prognosis as well. This can be achieved by better health literacy with lifestyle modifications incorporated as nonpharmacological treatment in patients' management. We also suggest that to establish an exact cause effect relationship study with vertical follow up is needed in newly diagnosed patients.

Glycemic control, treatment adherence, physical activity, health literacy, monitoring for obesity, and screening for complication are all domains that even a primary care level physician handle. A recent analysis revealed that primary care was better than tertiary care in terms of persons with diabetes's regularity of clinic visits and waiting time for care.[20] The poor glycemic control and obesity control can be better insinuated by family physicians, and there is scope to rectify the same in Indian scenario.[21] There is a severe breech in glycemic control and physical activity after COVID pandemic and that has taken a heavy toll on diabetics in India.[22] As a physician, a health care worker can insinuate the health literacy and better life style modifications as lacking in most of our diabetics.[23] The better association of the absence of obesity and physical activity with HbA1c also reiterates the role of nonpharmacological measures that are felt need to bring HbA1c under 6.5 mg% cutoff that is lacking[24] in most. This also calls for the indispensible role of a primary care family physician as a guide whom the diabetic patient trusts as a physician of first contact.

The use of HbA1c for glycaemic status, visceral fat for adiposity assessment, and standard SRPA questionnaire was the strength of the study. However, we had a few limitations like lack of vertical follow-up, high mean HbA1c of participants, no baseline data, and not too large sample size.

Conclusion

In type 2 diabetics with poor glycaemic status and moderately prevalent physical activity, we found strong and significant association of SRPA and controlled body adiposity (visceral > general) with HbA1c-based glycaemic status. It reaffirms physical activity and control of central obesity as forerunners of better glycaemic status, and it also calls for further studies having vertical follow-up.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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