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Association of Physical Activity and Sedentary Behaviour with Obesity, Hypertension, and Glycaemic Status Among Middle-Aged Adults: A Community-Based Observational Study.

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Abstract

Background: Physical inactivity and prolonged sedentary behaviour are modifiable determinants of cardiometabolic disease, yet community-level evidence linking both behaviours with multiple metabolic outcomes among middle-aged Indian adults remains limited. ***Objectives:*** To assess physical activity and sedentary behaviour and examine their associations with obesity, hypertension and glycaemic status among middle-aged adults. ***Methods:*** This community-based cross-sectional observational study included 100 adults aged 40–59 years from the field practice areas of MNR Medical College, Sangareddy, Telangana, India, between March and May 2026. Physical activity was classified as low, moderate or high, and daily sedentary duration was grouped as <6, 6–8 or >8 hours. Anthropometry, blood pressure and fasting blood glucose were assessed using standard procedures. Associations were tested using the chi-square test and multivariable logistic regression. ***Results:*** The mean age was 49.6 ± 5.7 years; 52.0% were males. Overweight, obesity, hypertension and dysglycaemia were present in 37.0%, 34.0%, 39.0% and 42.0%, respectively. Low physical activity was reported by 42.0%, while 29.0% had sedentary behaviour exceeding 8 hours/day. Obesity, hypertension and dysglycaemia were significantly more frequent among participants with low physical activity and among those sedentary for >8 hours/day. After adjustment, low physical activity was associated with obesity, hypertension and dysglycaemia, with adjusted odds ratios of 3.42, 2.61 and 2.47, respectively. Sedentary behaviour >8 hours/day was independently associated with the same outcomes. ***Conclusion:*** Low physical activity and prolonged sedentary behaviour were independently associated with adverse cardiometabolic profiles. Community screening and interventions that promote movement while reducing sitting time should be incorporated into middle-age non-communicable disease prevention strategies.

Keywords: Physical activity; sedentary behaviour; obesity; hypertension; dysglycaemia; middle-aged adults.

INTRODUCTION

Non-communicable diseases have become a dominant public health challenge in India, with obesity, hypertension and diabetes contributing substantially to premature cardiovascular morbidity, disability and healthcare expenditure. The ICMR-INDIAB national survey documented a high burden of metabolic disorders across urban and rural populations, confirming that cardiometabolic risk is no longer restricted to metropolitan settings.

1 Middle age is a particularly important period because cumulative exposure to unhealthy behaviours begins to manifest as central adiposity, elevated blood pressure and impaired glucose regulation, while preventive modification can still alter subsequent disease trajectories.

Physical activity represents movement generated by skeletal muscles that increases energy expenditure above resting levels. Regular moderate-to-vigorous activity improves energy balance, insulin sensitivity, vascular function and autonomic regulation. Nevertheless, population data from the ICMR-INDIAB study showed widespread inactivity in India, with marked variation by sex, place of residence and socioeconomic characteristics.2 The Indian cardiometabolic phenotype also deserves specific attention. Asian Indians develop visceral adiposity, insulin resistance and diabetes at lower body

mass index and waist circumference values than many Western populations, supporting the use of population-specific anthropometric thresholds.3

Earlier evidence from the Chennai Urban Population Study demonstrated that decreasing physical activity was accompanied by progressively higher frequencies of obesity, abdominal obesity, hypertension, diabetes and metabolic syndrome.4 Community surveys from southern India have similarly reported clustering of behavioural and biological risk factors within the same adult population.5

Sedentary behaviour is distinct from insufficient physical activity. It refers to waking activities performed while sitting, reclining or lying with very low energy expenditure. An individual can satisfy recommended activity targets yet still spend much of the day seated. Meta-analytic evidence has linked greater sedentary exposure with metabolic syndrome,6 while accelerometer-based studies have shown adverse associations with waist circumference, insulin sensitivity and other cardiometabolic biomarkers.7

These concerns are highly relevant to South Asian adults, among whom prolonged sitting has been associated with diabetes, higher body mass index, larger waist circumference, elevated blood pressure and abnormal glucose measures.8 A recent systematic review further demonstrated positive associations of sedentary behaviour and physical inactivity with general and abdominal obesity.9

Physical activity and sedentary behaviour therefore require simultaneous assessment rather than being treated as opposite ends of a single continuum. Higher activity has been associated with lower risks of cardiovascular disease and diabetes,10 incident hypertension,11 and type 2 diabetes in dose-response analyses.12 However, local community-level studies evaluating both behaviours against obesity, hypertension and glycaemic status within one middle-aged population remain limited.

The present study aimed to determine the distribution of physical activity and sedentary behaviour among adults aged 40–59 years and to examine their independent associations with obesity, hypertension and dysglycaemia in the community field practice areas of MNR Medical College, Sangareddy, Telangana, India.

METHODOLOGY

Study design and setting: This community-based cross-sectional observational study was conducted in the urban and semi-urban field practice areas attached to MNR Medical College, Sangareddy, Telangana, India, from March 2026 to May 2026. Community screening sessions were organised with local health workers, and potentially eligible residents were approached consecutively.

Study population and sample size: Adults aged 40–59 years who had resided in the selected community for at least six months and provided written informed consent were eligible. Individuals who were pregnant, acutely ill, unable to stand for anthropometric measurement, receiving long-term corticosteroid therapy, or lacking complete activity, blood pressure or biochemical information were excluded.

The minimum sample size was estimated using the single-proportion formula, assuming 50% prevalence, 95% confidence and 10% absolute precision. The calculated sample of 96 was rounded to 100. Of 108 adults screened, 100 completed assessment.

Data collection and behavioural assessment: Trained investigators recorded age, sex, tobacco use, family history, known hypertension, diabetes and medication details using a pretested schedule. Physical activity during the preceding seven days was assessed using the International Physical Activity Questionnaire-Short Form, which has established reliability for population surveillance.13

Activity was expressed in metabolic equivalent-minutes per week and categorised as low, moderate or high according to standard scoring criteria. As self-reported instruments can overestimate activity, uniform interviewer instructions were used.14 Daily sitting time was recorded and grouped as <6, 6–8 or >8 hours/day.

Anthropometric and clinical measurements: Height was measured without footwear to the nearest 0.1 cm, and weight was recorded in light clothing to the nearest 0.1 kg. Body mass index was calculated as kg/m². Asian Indian criteria classified BMI <18.5 kg/m² as underweight, 18.5–22.9 kg/m² as normal, 23.0–24.9 kg/m² as overweight and ≥25.0 kg/m² as obese.3

Waist circumference was measured midway between the lowest rib and iliac crest; central obesity was defined as ≥90 cm in males and ≥80 cm in females. Blood pressure was measured after five minutes of seated rest. The mean of two readings taken five minutes apart was used. Hypertension was defined as systolic pressure ≥140 mmHg, diastolic pressure ≥90 mmHg, previous diagnosis or current treatment.

Biochemical assessment and outcome definitions: Following an overnight fast of at least eight hours, venous blood was collected and fasting plasma glucose was measured enzymatically. Glycaemic status was classified as normal (<100 mg/dL), prediabetes (100–125 mg/dL) or diabetes (≥126 mg/dL, previous diagnosis or glucose-lowering treatment). Dysglycaemia comprised prediabetes and diabetes.

Statistical analysis and ethics: Data were analysed using IBM SPSS Statistics version 26.0. Continuous variables were presented as mean ± standard deviation and categorical variables as frequency and percentage. One-way analysis of variance, chi-square testing and multivariable logistic regression were applied as appropriate. Adjusted odds ratios with 95% confidence intervals were calculated for obesity, hypertension and dysglycaemia. Statistical significance was set at $p<0.05$. Necessary Permissions were obtained before starting the study. Confidentiality was preserved.

RESULTS

Participant recruitment and baseline characteristics: A total of 108 middle-aged adults were screened during the study period. Eight individuals were excluded: five did not satisfy the eligibility criteria and three had incomplete physical activity or biochemical data. The remaining 100 participants were included in the final analysis, with complete information available for all study variables.

The mean age of the participants was 49.6 ± 5.7 years, ranging from 40 to 59 years. Fifty-two (52.0%) participants were males and 48 (48.0%) were females. The mean body mass index was 26.8 ± 4.2 kg/m², while the mean waist circumference was 91.6 ± 11.2 cm. Thirty-seven (37.0%) participants were overweight and 34 (34.0%) were obese. Central obesity was identified in 46 (46.0%) participants. The mean systolic and diastolic blood pressures were 132.8 ± 17.4 mmHg and 83.6 ± 10.1 mmHg, respectively. Hypertension was present in 39 (39.0%) participants, including 18 previously diagnosed and 21 newly identified cases. Normal glycaemic status was observed in 58 (58.0%) participants, whereas 27 (27.0%) had prediabetes and 15 (15.0%) had diabetes mellitus. The overall prevalence of dysglycaemia was 42.0% (Table 1).

Table 1. Demographic, behavioural and clinical characteristics of the participants

Characteristic	Frequency or mean ± SD	Percentage
Age, years	49.6 ± 5.7	—
Age 40–49 years	51	51.0
Age 50–59 years	49	49.0
Male sex	52	52.0
Female sex	48	48.0
Body mass index, kg/m²	26.8 ± 4.2	—
Normal or underweight	29	29.0
Overweight	37	37.0
Obese	34	34.0
Waist circumference, cm	91.6 ± 11.2	—
Central obesity	46	46.0
Systolic blood pressure, mmHg	132.8 ± 17.4	—
Diastolic blood pressure, mmHg	83.6 ± 10.1	—
Hypertension	39	39.0
Fasting blood glucose, mg/dL	106.7 ± 24.6	—
Normal glycaemic status	58	58.0
Prediabetes	27	27.0
Diabetes mellitus	15	15.0
Family history of diabetes	28	28.0
Family history of hypertension	35	35.0
Current tobacco use	18	18.0

Physical activity and sedentary behaviour: Based on the physical activity assessment, 42 (42.0%) participants had low physical activity, 36 (36.0%) had moderate physical activity and 22 (22.0%) had high physical activity. The mean daily sedentary duration was 7.1 ± 2.2 hours. Thirty (30.0%) participants reported <6 sedentary hours/day, 41 (41.0%) reported 6–8 hours and 29 (29.0%) reported >8 hours/day.

Participants with low physical activity had a higher mean body mass index than those with moderate or high activity (29.1 ± 4.1, 25.8 ± 3.5 and 24.1 ± 3.0 kg/m², respectively; p<0.001). Mean systolic blood pressure decreased across the low-, moderate- and high-activity categories (139.8 ± 17.6, 128.8 ± 15.2 and 125.8 ± 12.7 mmHg, respectively; p=0.001). Mean fasting blood glucose followed a comparable pattern (115.4 ± 28.6, 102.4 ± 18.9 and 96.7 ± 13.4 mg/dL, respectively; p=0.004).

Association of physical activity with cardiometabolic outcomes: Obesity was present in 22 (52.4%) participants with low physical activity, compared with 9 (25.0%) with moderate activity and 3 (13.6%) with high activity. Hypertension was identified in 23 (54.8%), 11 (30.6%) and 5 (22.7%) participants across the same activity groups. Dysglycaemia occurred in 24 (57.1%) participants with low activity, 13 (36.1%) with moderate activity and 5 (22.7%) with high activity. All three associations were statistically significant (Table 2).

Table 2. Association between physical activity level and cardiometabolic outcomes

Outcome	Low activity n=42	Moderate activity n=36	High activity n=22	χ^2	p-value
Obesity	22 (52.4)	9 (25.0)	3 (13.6)	11.69	0.003
Hypertension	23 (54.8)	11 (30.6)	5 (22.7)	7.91	0.019
Dysglycaemia	24 (57.1)	13 (36.1)	5 (22.7)	7.82	0.020

Values are presented as frequency (percentage). Dysglycaemia includes prediabetes and diabetes mellitus.

Association of sedentary behaviour with cardiometabolic outcomes: The prevalence of obesity increased from 16.7% among participants reporting <6 sedentary hours/day to 31.7% among those reporting 6–8 hours and 55.2% among those reporting >8 hours/day. Hypertension was present in 23.3%, 39.0% and 55.2%, respectively, while dysglycaemia was observed in 26.7%, 41.5% and 58.6%. Each association reached statistical significance (Table 3).

Table 3. Association between daily sedentary duration and cardiometabolic outcomes

Outcome	<6 hours n=30	6–8 hours n=41	>8 hours n=29	χ^2	p-value
Obesity	5 (16.7)	13 (31.7)	16 (55.2)	9.91	0.007
Hypertension	7 (23.3)	16 (39.0)	16 (55.2)	6.28	0.043
Dysglycaemia	8 (26.7)	17 (41.5)	17 (58.6)	6.19	0.045

Values are presented as frequency (percentage).

Multivariable logistic regression analysis: After adjustment for selected covariates, low physical activity was associated with higher odds of obesity (adjusted odds ratio [aOR]=3.42; 95% confidence interval [CI]: 1.38–8.47; p=0.008), hypertension (aOR=2.61; 95% CI: 1.08–6.32; p=0.033) and dysglycaemia (aOR=2.47; 95% CI: 1.03–5.94; p=0.043). Sedentary behaviour >8 hours/day remained associated with obesity (aOR=2.91; 95% CI: 1.15–7.38; p=0.024), hypertension (aOR=2.48; 95% CI: 1.01–6.09; p=0.047) and dysglycaemia (aOR=2.36; 95% CI: 1.00–5.59; p=0.050) (Table 4).

Table 4. Adjusted association of physical activity and sedentary behaviour with cardiometabolic outcomes

Predictor and outcome	Adjusted odds ratio	95% CI	p-value
Low physical activity: obesity	3.42	1.38–8.47	0.008
Low physical activity: hypertension	2.61	1.08–6.32	0.033
Low physical activity: dysglycaemia	2.47	1.03–5.94	0.043
Sedentary behaviour >8 hours/day: obesity	2.91	1.15–7.38	0.024
Sedentary behaviour >8 hours/day: hypertension	2.48	1.01–6.09	0.047
Sedentary behaviour >8 hours/day: dysglycaemia	2.36	1.00–5.59	0.050

Models were adjusted for age, sex, tobacco use, relevant family history, physical activity level and sedentary duration, as appropriate.

DISCUSSION

The present community-based study identified a substantial concentration of modifiable cardiometabolic risk among middle-aged adults. More than two-thirds of participants were overweight or obese, 39% had hypertension and 42% had dysglycaemia. Low physical activity affected 42%, and almost one-third reported more than eight sedentary hours daily. Both behaviours showed graded relationships with obesity, hypertension and abnormal glycaemic status, and the associations persisted after adjustment for selected demographic, behavioural and familial factors.

The observed clustering is consistent with national evidence showing that metabolic disorders are widely distributed across India and frequently coexist within individuals.1 The proportion with low activity was lower than that reported in some large Indian surveys, although differences in age structure, occupation, residence and assessment instruments limit direct comparison.2

The high prevalence of overweight and obesity is clinically important because Asian Indians experience cardiometabolic complications at comparatively lower BMI values.3 Our findings also resemble the Chennai Urban Population Study, where declining activity was associated with higher frequencies of obesity, abdominal obesity, hypertension and diabetes.4 Comparable community evidence from Tamil Nadu has demonstrated the simultaneous presence of behavioural and biochemical risk factors in both rural and urban adults.5

Obesity showed the strongest adjusted relationship with low physical activity. Participants in the low-activity category had more than threefold higher odds of obesity than those with moderate or high activity. This pattern agrees with a systematic review and meta-analysis reporting positive associations of physical inactivity and sedentary behaviour with general and abdominal obesity.9

Reduced energy expenditure contributes to positive energy balance, while diminished skeletal-muscle activity can adversely affect lipid oxidation and insulin-mediated glucose disposal. However, reverse direction remains possible in a cross-sectional study because obesity can also restrict movement through fatigue, pain or reduced exercise tolerance.

Hypertension and dysglycaemia were also more frequent among inactive participants. Prospective evidence supports an inverse association between recreational activity and incident hypertension,11 while dose-response analyses have linked increasing physical activity with lower risk of type 2 diabetes.12 Physical activity can improve endothelial function, arterial compliance, autonomic balance, insulin sensitivity and body composition, providing biologically plausible pathways for the observed associations. The adjusted relationships remained significant even after considering age, sex, tobacco use and family history, suggesting that activity contributes information beyond inherited and demographic risk.

Long sedentary duration displayed an independent adverse pattern. Participants sitting for more than eight hours daily had higher odds of all three outcomes. Meta-analytic evidence has connected sedentary exposure with metabolic syndrome,6 and objectively measured sedentary time has been associated with poorer insulin sensitivity and adverse anthropometric markers.7

Evidence focused on South Asian adults likewise shows links with diabetes, BMI, waist circumference, blood pressure and glucose.8 These findings indicate that increasing exercise alone is incomplete; community programmes should also encourage standing, brief walking breaks and replacement of prolonged sitting with routine movement. Because the study was community based and included previously undiagnosed hypertension, integrated screening linked to practical activity counselling could support earlier risk recognition.

LIMITATIONS

The cross-sectional design prevents determination of temporal sequence or causality. Physical activity and sedentary duration were self-reported and remain vulnerable to recall and social-desirability bias. Recruitment from selected field practice areas and the modest sample restrict wider generalisability. Dietary intake, lipid profile, occupational activity patterns and objectively measured movement were not evaluated. Residual confounding and limited statistical power for multivariable subgroup estimates should also be considered.

CONCLUSION

Low physical activity and prolonged sedentary behaviour were common among middle-aged adults and were significantly associated with obesity, hypertension and dysglycaemia. Participants reporting low activity or more than eight sedentary hours daily had unfavourable anthropometric, blood pressure and fasting glucose profiles.

These associations remained evident after adjustment for demographic, behavioural and familial variables. Community-based non-communicable disease prevention should therefore address insufficient activity and excessive sitting. Periodic

screening, culturally acceptable walking programmes, workplace and household movement breaks, and counselling focused on sustainable daily routines could improve early risk detection and support healthier cardiometabolic profiles. Larger prospective studies using objective activity monitoring are required to confirm temporal relationships and evaluate feasible interventions.

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