Original Article

Is Physical Activity Related to Depression and Anxiety among Adults? Observations from a Noncommunicable Disease Screening Clinic in North India

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Abstract

Background: Physical activity (PA) offers innumerable benefits and is a promising intervention against common mental disorders, such as depression and anxiety. We examined the association between PA and depression or anxiety in adults. **Materials and Methods:** A study was conducted between March 2021 and August 2022 using a cross-sectional study design. We recruited 334 participants >40 years of age from the noncommunicable disease (NCD) screening clinic of a tertiary care institute in North India. Health-enhancing PA (HEPA) was estimated using the International Physical Activity Questionnaire (IPAQ), while depression and anxiety were screened using the 9-item Patient Health Questionnaire (PHQ-9) and 7-item Generalized Anxiety Disorder scales. Bivariate and univariate analyses were performed using Statistical Package for the Social Sciences (SPSS) version 21 to depict our results. **Results:** Engagement in HEPA was 23.4%. The HEPA depicted significant socioeconomic disparities. The mean total cholesterol and triglyceride levels were considerably higher in the HEPA active group, despite having lower GAD-7 and PHQ-9 scale scores. The prevalence of depressive and anxiety symptoms was 59.0% and 13.4%. PA depicted better odds against depression but not against anxiety symptoms. **Conclusions:** Low HEPA engagement in adults is a matter of concern, and it is high time we look beyond NCDs toward the risk factors. It is essential to incorporate PA counseling universally and not be restricted to a particular clinical department to realize its full potential in restraining the growing NCD burden.

Keywords: Cardiovascular diseases, common mental disorders, geriatrics, physical activity

Introduction

Depression and anxiety are prevalent common mental health disorders (CMDs) that can markedly affect an individual's quality of life and are witnessing an increasing burden due to the aging population worldwide, including India.[1] While medication and therapeutic approaches are continuously evolving to be more effective than ever, there is a need for alternative interventions that are accessible, affordable, and have fewer side effects. Physical activity (PA) is a promising intervention for reducing the symptoms of CMD.[2] Previous literature has indicated that regular PA reduces the likelihood of morbidity conditions, such as obesity, diabetes, and cardiovascular disorders (CVDs), and can also positively affect mental health, including reducing the symptoms of depression and anxiety.[3] Observational studies have demonstrated that those who regularly exercise have lower rates of CMD than those who do not.[4] Further research into the possible therapeutic benefits of exercise for people with CMD, either on its own or in conjunction with other forms of treatment, has been conducted through randomized controlled trials.[5]

While the evidence supporting the favorable consequences of PA on CMD is compelling, the mechanisms underlying these effects are not entirely understood. The physiological basis of PA affecting CMD is complex.[6] Several theories have been proposed to explain the relationship, including the release of endorphins, the reduction in inflammation, and the

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promotion of neuroplasticity.[7] Research has also found that a range of other factors, including genetics, age, gender, and socioeconomic status (SES), can modulate the physiological effects of PA on CMD.[8] While the physiological basis of the positive effects of PA on mental health is not fully understood, there is strong evidence to suggest that PA can be an effective intervention for reducing symptoms of CMD, especially depression and anxiety.[9,10] This highlights the merits of incorporating PA into mental health treatment and prevention programs and the need for further research to better understand the relationship between PA and mental health.[11] Within this background, this study aimed to contribute to the growing literature investigating the association between PA and CMD (specifically depression and anxiety) in adults. We also examined whether the association between PA and depression or anxiety is moderated by demographic characteristics, such as age, gender, and SES. The findings may have implications for developing public health interventions that promote PA to reduce the burden of mental illness. They may also inform the development of PA programs tailored to individuals with depression and anxiety.

Methodology

Study design and duration: We used a cross-sectional design for this study, which was conducted between March 2021 and August 2022.

Study setting: The study was conducted in the northern Indian state of Punjab's Malwa region. The state has a high burden of noncommunicable diseases (NCDs) and associated risk factors.

Specific study setting: A single-center study was conducted at the NCD screening clinic under the Department of Community and Family Medicine in collaboration with the Internal Medicine Department of a tertiary care institute that offers a variety of preventive, promotive, and curative services, with an average daily footfall of around 2000 patients. The NCD screening clinic offers screening and lifestyle counseling services to adults referred from different clinical departments.

Study population: We included adults more than 40 years of age. This was based on the World Health Organization (WHO) member nations' commitment to reducing the burden of CVD globally by 2025 by offering counseling and medication treatments to at least half of the eligible individuals (aged 40 and at increased risk of CVD).[12]

Sample size and sampling technique: Following estimates from the National Mental Health Survey 2015–2016 that the prevalence of common mental disorders in Punjab is approximately 13%, with a 95% confidence interval (CI), a margin of error of 5%, and a design effect of 1.8, a sample size of 313 adults was calculated using the single population proportion formula.[13] We ultimately included 334 adults in the study analysis. Online statistical software, "OpenEpi (version 3.01)," was used to calculate the sample size. Samples were collected using a multistage systematic random sampling process. Firstly, two days per week were randomly chosen for sample collection. Then, a systematic random sampling approach was implemented to approach the eligible participants, and every fifth visitor to the NCD clinic was offered participation in our research. The participants were duly informed about the purpose of the study and were assured of data confidentiality. Those who concorded to participate were requested to fill up the consent performa. In case they were illiterate, the participant information sheet was read to them, and consent was taken in the presence of a witness. Following this, data were collected to assess the study objectives through face-to-face interviews. Trained nursing officers were sensitized about the topic and, given the necessary training, conducted the interviews.

Study variables

Dependent variables: Our main dependent variable was the symptoms suggestive of anxiety or depression, which were assessed using the validated 9-item Patient Health Questionnaire scale and the 7-item Generalized Anxiety Disorder (GAD-7) scale. There are nine components in the PHQ-9 scale, a depression screening tool. The patients are asked to rank the severity of each symptom over the past two weeks. There are four options: never (0), a few days, more than half the days, and nearly every day (3). Scores of 5, 10, and 15 on the general scale, which ranges from 0 to 27, indicate mild, moderate, and severe degrees of depression, respectively.[14] The validated Hindi scale version was used for this study.[15,16] The GAD-7 scale, which has seven items with a rating range of 0 to 3 (0 = not at all; 1 = a few days; 2 = more than 50% of days; and 3 = virtually every day), is used to quantify anxiety. A score of 0 to 4 indicates no anxiety, 5 to 9 indicates mild anxiety, 10 to 14 indicates moderate anxiety, and 15 to 21 indicates severe anxiety. We used a cutoff score of ≥10, to label the participant with a provisional diagnosis of GAD.[17] As research has shown that the Hindi version of the GAD-7 has acceptable diagnostic concordance with a clinical diagnosis, it was used for this investigation. In Indian clinics, it has also been used on geriatric patients.[15]

Independent variable: Health-enhancing PA (HEPA) was our primary independent variable. HEPA was evaluated using the shorter version of the International Physical Activity Questionnaire Short Form (IPAQ-SF). Comparing the IPAQ-SF to accelerometers, a multicountry evaluation study revealed that it had satisfactory criterion-related validity and test–retest reliability.[18] By questioning each person how frequently (days/week) and how long (the average time in minutes) they have engaged in vigorous, moderate-intensity activities in addition to walking, the IPAQ analyzes HEPA. An average metabolic equivalent (MET) value is allocated to each intensity. Walking, moderate, and vigorous activities are allotted 3.3, 4.0, and 8.0 MET. The data are assessed using the IPAQ scoring approach, version 2.0 (found at http://www.ipaq.ki.se), with one exception. The most recent guidelines for PA state that every adult should engage in moderate-intensity physical exercise most days of the week, ideally every day,

and should aim to accumulate 30 minutes of PA per day, or 600 MET minutes per week, according to IPAQ standards. The higher group (HEPA) includes people who engage in deliberate PA three or more days per week, accumulate 1500 MET minutes/week, or do it three days per week for 3,000 MET minutes.[19] Participants in this category are believed to be sufficiently active to benefit their overall health.

Covariates: We categorized different covariates as age groups (40–44, 45–49, 50–54, 55–59, 60–64, and > 65 years), gender (male or female), residence (urban or rural), marital status (married, unmarried, or divorced), education (<primary or more than primary school), occupation (nonworking or working), SES as per the BG Prasad scale (upper, upper middle, middle, lower middle, and lower class), CVD risk score as per the WHO CVD risk scores (<5%, 5–10%, 10–20%, and >20%), overweight or obesity–body mass index (BMI) >22.99 kg/m^2 (no or yes), presence of type 2 diabetes mellitus (T2DM) (no or yes), presence of hypertension according to the Joint National Committee (JNC) VII criteria (no or yes), and lipid profile (total serum cholesterol (mg/dl), low-density lipoproteins (mg/dl), high-density lipoproteins (mg/dl), and triglycerides (mg/dl)). The lipid profile and fasting blood glucose were estimated using the fasting blood samples. The thresholds for total cholesterol (200 mg/dl), triglycerides (150 mg/dl), low-density lipoprotein (LDL) (130 mg/dl), and high-density lipoprotein (HDL) (>40 mg/dl for men and >50 mg/dl for women) were considered high. The risk of suffering from cardiovascular events in the next 10 years was predicted using the WHO or International Society of Hypertension (ISH) cardiovascular risk prediction charts designed for the Southeast Asian population.

Data analysis: Extensive data curation was performed using Microsoft (MS) Excel, followed by analysis in Statistical Package for the Social Sciences (SPSS) version 21. The dataset's normality distribution was assessed using the Shapiro–Wilk test. The Chi-square tested the association between the sociodemographic characteristics, and *P* values were used to report results. Continuous variable means and standard deviations were compared using an unpaired Student's *t*-test. To determine the adjusted odds ratio with 95% CI, we further investigated the determinants of depression and anxiety. After determining whether there was multicollinearity, the appropriate variables for the multiple regression model were selected. A *P* value of 0.05 or less was regarded as significant.

Ethical clearance: The study was approved by the institutional ethics committee of the institute, with vast letter number of IEC/AIIMS/BTI/064, dated February 19, 2021, and an IEC no. of IEC-01/2020-012. Informed consent forms were obtained from participants, and the purpose of the study using the participants' information sheet was discussed before data collection. Throughout the trial, participant confidentiality and data anonymity were maintained. Every approach was used as per all the laws and regulations that applied. The study was conducted following Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) principles, and its results were presented.

Results

Less than one-fourth of the study participants (23.4%) reported engagement in HEPA. We categorized and compared the sociodemographic characteristics of the study participants as per the HEPA levels, that is, who met the criteria of being physically active versus physically inactive [Table 1]. The HEPA active groups varied significantly according to age distribution, education levels, occupation, SES, presence or absence of T2DM, anxiety, and depression (*P* value < 0.05). We observed higher HEPA in participants with fewer years of education, working groups, and those from poorer sections of society. While HEPA active levels were higher in people living with T2DM, the reverse pattern was observed in people with symptoms suggestive of anxiety and depression. We then compared the anthropometric and biochemical parameters of the participants with and without HEPA levels on a continuous scale and using an unpaired *t*-test [Table 2]. HEPA group had a lower mean age of participants but a higher mean BMI. The HEPA active group also had significantly higher mean triglyceride levels and total cholesterol but lower scores per the GAD-7 and PHQ-9 scales.

Overall, the prevalence of symptoms suggestive of depression was around 59.0% as per the PHQ-9 Questionnaire. Table 3 depicts the distribution of depression and its predictors across various sociodemographic characteristics. The presence of symptoms was significantly higher in older age groups (>50 years), nonworking participants from lower socioeconomic classes, those having symptoms suggestive of anxiety, and those who were not HEPA active. Binary logistic regression analysis depicted higher odds of having depressive symptoms with increasing age, low SEA, presence of anxiety, and not engaging in HEPA. Similarly, the overall prevalence of symptoms suggestive of generalized anxiety disorders was 13.4% [Table 4]. The prevalence did not show any significant association with sociodemographic characteristics. Logistic regression analysis depicted higher odds of developing symptoms in the upper class compared with the lower middle class and concomitant presence of depressive symptoms. PA did not show any protective effect against anxiety symptoms.

Discussion

Even though the relationship between PA levels and CMD has been long established, further evidence is essential for exploring factors from developing countries where it is common to equate occupational work and HEPA concerning their effects on mental health, which is untrue.[20] We report some exciting findings from the current research. First, the overall prevalence of HEPA levels was low in our study population, and only one-fourth of the participants were engaged in adequate PA. Second, the HEPA levels were significantly associated with specific covariates, such as age, education, and occupation. Third, the

Table 1: Sociodemographic characteristics of the study participants w.r.t to their physical activity status

	Physical activity (HEPA) levels			Chi-square (*P*)
	No Count (row N)	Yes Count (row N)	Total Count (row N)	
Total	256 (76.6)	78 (23.4)	334 (100)	
Age (completed years)				<0.044
40–44	46 (70.8)	19 (29.2)	65 (100)	
45–49	37 (63.8)	21 (36.2)	58 (100)	
50–54	57 (80.3)	14 (19.7)	71 (100)	
55–59	30 (85.7)	5 (14.3)	35 (100)	
60–64	42 (77.8)	12 (22.2)	54 (100)	
>65	44 (86.3)	7 (13.7)	51 (100)	
Gender				0.384
Male	126 (78.8)	34 (21.3)	160 (100)	
Female	130 (74.7)	44 (25.3)	174 (100)	
Residence				0.686
Urban	105 (75.5)	34 (24.5)	139 (100)	
Rural	151 (77.4)	44 (22.6)	195 (100)	
Marital status				0.120
Married	253 (77.1)	75 (22.9)	328 (100)	
Unmarried/divorced	3 (50)	3 (50)	6 (100)	
Education				<0.001
≤ Primary	113 (66.5)	57 (33.5)	170 (100)	
More than primary	143 (87.2)	21 (12.8)	164 (100)	
Occupation				<0.001
Nonworking	130 (94.2)	8 (5.8)	138 (100)	
working	126 (64.3)	70 (35.7)	196 (100)	
Socioeconomic status				0.049
Upper class	48 (75)	16 (25)	64 (100)	
Upper middle	79 (86.8)	12 (13.2)	91 (100)	
Middle	84 (75)	28 (25)	112 (100)	
Lower middle	38 (69.1)	17 (30.9)	55 (100)	
Lower class	7 (58.3)	5 (41.7)	12 (100)	
Overweight/obesity				0.138
No	48 (84.2)	9 (15.8)	57 (100)	
Yes	208 (75.1)	69 (24.9)	277 (100)	
Presence of T2DM				0.032
No	220 (78.9)	59 (21.1)	279 (100)	
Yes	36 (65.5)	19 (34.5)	55 (100)	
Presence of hypertension				0.565
No	99 (75)	33 (25)	132 (100)	
Yes	157 (77.7)	45 (22.3)	202 (100)	
CVD risk score				0.995
<5%	95 (76.6)	29 (23.4)	124 (100)	
5–10%	90 (76.3)	28 (23.7)	118 (100)	
10–20%	63 (76.8)	19 (23.2)	82 (100)	
>20%	8 (80)	2 (20)	10 (100)	
Presence of anxiety				0.037
No	216 (74.7)	73 (25.3)	289 (100)	
Yes	40 (88.9)	5 (11.1)	45 (100)	
Presence of depression				<0.001
No	74 (54.4)	62 (45.6)	136 (100)	
Yes	182 (91.9)	16 (8.1)	198 (100)	

HEPA lifestyle did not offer any benefits concerning CVD risk scores or biochemical and anthropometric characteristics compared with the others. Fourth, while PHQ-9 and GAD-7 scores were lower in the HEPA group, we only observed a significant association between PA and reported symptoms suggestive of depression after adjusting for other covariates.

Table 2: Comparison of the lipid profile, depression, and anxiety scores per the physical activity status

HEPA active	No Mean (std. deviation)	Yes Mean (std. deviation)	*P* (unpaired *t*-test)
Age (completed years)	54.2 (9.4)	51.6 (9.5)	0.030
Body mass index	27.3 (4.9)	28.7 (5.8)	0.027
Total S. cholesterol (mg/dl)	187.8 (47.5)	223.7 (37.2)	<0.001
Low-density lipoproteins (mg/dl)	108.3 (44.5)	110.5 (44.8)	0.695
High-density lipoproteins (mg/dl)	50.8 (27.2)	44.2 (9.7)	0.038
Triglycerides (mg/dl)	151.2 (39.5)	345 (130.8)	<0.001
Anxiety (GAD-7 scores)	3.7 (4.4)	2.5 (4.2)	0.034
Depression (PHQ-9 scores)	6.2 (3.4)	4 (3.5)	<0.001

Physical inactivity and sedentary lifestyles have long been established as risk factors for NCDs, including mental health.[21] However, we observed a low overall prevalence of HEPA levels in our study population, and only one-fourth of the participants were engaged in HEPA. Our results resemble a study from Lebanon, where 22% engage in HEPA,[22] but the estimates are lower than the estimates from the International Prevalence Study executed in 20 countries utilizing a similar study tool as ours.[22] In another study of adults in the European Union among adults, about 13.6% were performing aerobic and muscle-strengthening activities as per the guidelines, but this was all nonwork-related PA.[23] Likewise, a study from India has depicted a high level of physical inactivity with significant geospatial disparities.[24] Restrictions imposed during the coronavirus disease 2019 (COVID-19) pandemic during our study period can also strongly predict decreased PA as there was an overall reduction in mobility.[25]

PA depicted sociodemographic disparities as per age, education, and occupation. These disparities follow a global trend.[26–28] Older people depicted less engagement in HEPA, as a lesser proportion of people aged >50 years met the recommendation compared with the younger groups, similar to results from other studies.[24] A decrease in HEPA among elderly males can be attributed to less engagement in occupational activities. At the same time, extended help with household chores by the younger females can be seen as anecdotal reasons from our study area. The Lebanon study exhibited an inverse association between PA and SES indicators, suggesting a negative influence of urbanization on activity levels.[22] We observed that HEPA was more among our study participants with fewer years of schooling and participants engaged in any occupation. This may be attributed to more engagement of participants in work-related PA. These results are consistent with earlier studies, which showed that those with physically demanding jobs that frequently need manual labor have higher self-reported overall PA levels than those with higher-status jobs that typically do not.[29] Likewise, while we observed more HEPA with less schooling, reports from developed countries suggest that the years of education increase PA. Still, it is primarily leisure-time PA, hours of intensive activity per week, and daily aerobic steps.[29] There is a complex relationship between education and PA and occupation as more years of schooling facilitate better jobs and higher income, thus providing more time for PA. Also, better-educated people are into jobs that demand less PA during working hours. Overall, it can be anticipated that our study participants are more engaged in work-related PA, but work-related PA depicts a weak positive association with an increased risk of heart disease. Highly manual occupations can be detrimental to health overall, which is supported by results from our study as well, as we could not establish any beneficial effect of HEPA on cardiovascular risk scores when we have enough evidence that PA helps decrease cardiovascular risk scores.[30] At the same time, our HEPA participants depicted significantly worse biochemical and anthropometric profiles than others, thus reiterating the fact that the followed patterns of PA did not benefit our study participants. Several studies have shown that a less active lifestyle and physical inactivity are associated with higher cholesterol levels, obesity, and T2DM.[30]

We observed higher odds of developing depressive symptoms with increasing age, lower SES, HEPA, and concomitant anxiety symptoms. A previous study suggested a dose–response relationship as it observed a significant reduction in odds ratio with the highest PA levels.[31] Previous studies have shown different effects of various doses of PA on depression, where a larger treatment dose of exercise might significantly improve depressive symptoms.[32] In contrast, light-intensity PA positively affected depression prevention.[33] A recent systematic review and meta-analysis on this subject revealed that even marginal MET levels of 4.4 hours per week were associated with an 18% lesser risk of depression, and 8.8 MET hour/week led to a 25% reduction of risk of depression and that higher MET levels beyond this level were not much effective in further diminution of risk of depression.[34] Similar findings were reported by Schuch *et al*. and Dishman *et al*. as well.[35,36] Many physiological, biochemical, and psychosocial changes, such as immune system changes by reducing some inflammatory markers, increased release of endorphins, and improved social interactions with better self-worth and self-esteem, are attributed to PA, which is responsible for lower odds of depressive symptoms. Also, the concomitant presence of depressive symptoms and inadequate HEPA has long-term morbidity and mortality implications, in addition to higher inpatient healthcare utilization.[37]

Table 3: Predictors of depression in the presence of physical activity and other sociodemographic variables

	Total counts	Depression count (row %)	*P*	Adjusted OR (95% CI)	*P*
Total	334	198 (59.3)			
Age (completed years)			0.035		
40–44	65	31 (47.7)			
45–49	58	28 (48.3)			
50–54	71	47 (66.2)			
55–59	35	21 (60)			
60–64	54	34 (63)			
>65	51	37 (72.5)			
Mean age		54.80±9.4		1 (1.1-1.1)	0.036
Gender			0.798		
Male	160	96 (60)		Ref	
Female	174	102 (58.6)		0.9 (0.5-1.6)	0.822
Residence			0.094		
Urban	139	75 (54)		Ref	
Rural	195	123 (63.1)		1.1 (0.6-1.9)	0.83
Marital status			0.641		
Married	328	195 (59.5)		Ref	
Unmarried or divorced	6	3 (50)		1.3 (0.2-8.9)	0.785
Education			0.862		
≤ Primary	170	100 (58.8)		Ref	
More than primary	164	98 (59.8)		0.8 (0.5-1.5)	0.568
Occupation			<0.001		
Nonworking	138	100 (72.5)		Ref	
working	196	98 (50)		0.7 (0.4-1.2)	0.212
Socioeconomic status			<0.001		
Upper class	64	21 (32.8)		Ref	
Upper middle	91	61 (67)		4.9 (2.2-10.8)	<0.001
Middle	112	71 (63.4)		5.2 (2.4-11.5)	<0.001
Lower middle	55	38 (69.1)		10.1 (3.8-27.4)	<0.001
Lower class	12	7 (58.3)		5.7 (1.1-29)	0.035
CVD risk score			0.627		
<5%	124	68 (54.8)		Ref	
5–10%	118	72 (61)		1.0 (0.4-2.5)	0.963
10–20%	82	52 (63.4)		0.7 (0.2-3.0)	0.637
>20%	10	6 (60)		0.6 (0.0-5.1)	0.524
Overweight/obesity			0.123		
No	57	39 (68.4)		0.7 (0.3-1.4)	0.309
Yes	277	159 (57.4)			
Presence of T2DM			0.167		
No	279	170 (60.9)		0.9 (0.4-1.8)	0.669
Yes	55	28 (50.9)		Ref	
Presence of hypertension			0.060		
No	132	70 (53)		Ref	
Yes	202	128 (63.4)		1.4 (0.8-2.4)	0.27
Presence of anxiety			<0.001		
No	289	159 (55)		Ref	
Yes	45	39 (86.7)		8 (2.8-23.1)	<0.001
Physical activity level			<0.001		
HEPA active	78	16 (20.5)		0.1 (0-0.2)	
No	256	182 (72.1)		Ref	<0.001

There has been ample research showing that anxiety disorders are common comorbid conditions with depressive disorders and CVDs. Furthermore, this relationship exists otherwise, too, and it has been shown that people with anxiety disorders are also prone to suffer from CVDs.[38] The impact of PA in reducing anxiety symptoms has been studied in the past but with unequivocal results.[39,40] A recent meta-analysis reported that PA significantly reduced anxiety with a moderate effect

Table 4: Predictors of anxiety in the presence of physical activity and other sociodemographic variables

	Total counts	Anxiety count (row %)	*P*	Adjusted OR (95% CI)	*P*
Total	334	45 (13.4)			
Age (completed years)			0.547		
>65	51	7 (13.7)			
40–44	65	11 (16.9)			
45–49	58	8 (13.8)			
50–54	71	12 (16.9)			
55–59	35	2 (5.7)			
60–64	54	5 (9.3)			
Mean	-	52.2±10.0	0.282	0.9 (0.9-1)	0.076
Gender			0.643		
Male	160	23 (14.4)		Ref	
Female	174	22 (12.6)		1.1 (0.5-2.2)	0.872
Residence			0.165		
Urban	139	23 (16.5)		Ref	
Rural	195	22 (11.3)		0.8 (0.4-1.7)	0.54
Marital status			0.817		
Married	328	44 (13.4)		Ref	
Unmarried or divorced	6	1 (16.7)		2 (0.2-22.6)	0.579
Education			0.211		
≤ Primary	170	19 (11.2)		Ref	
More than primary	164	26 (15.9)		1.2 (0.6-2.6)	0.599
Occupation			0.647		
Nonworking	138	20 (14.5)		Ref	
working	196	25 (12.8)		1.1 (0.5-2.2)	0.812
Socioeconomic status			0.308		
Upper class	64	10 (15.6)		Ref	
Upper middle	91	16 (17.6)		0.7 (0.3-1.8)	0.439
Middle	112	14 (12.5)		0.5 (0.2-1.4)	0.199
Lower middle	55	3 (5.5)		0.2 (0-1)	0.043
Lower class	12	2 (16.7)		0.9 (0.1-6.1)	0.948
CVD risk score			0.958		
<5%	124	17 (13.7)		Ref	
5–10%	118	17 (14.4)		1.6 (0.5-4.8)	0.407
10–20%	82	10 (12.2)		2.4 (0.5-13)	0.294
>20%	10	1 (10)		3.4 (0.2-68.3)	0.429
Overweight or obesity			0.574		
No	57	9 (15.8)		0.9 (0.4-2.2)	0.81
Yes	277	36 (13)		Ref	
Presence of T2DM			0.542		
No	279	39 (14)		0.6 (0.2-2)	0.44
Yes	55	6 (10.9)		Ref	
Presence of hypertension			0.559		
No	132	16 (12.1)		Ref	
Yes	202	29 (14.4)		1.1 (0.5-2.3)	0.848
Presence of depression			<0.001		
No	289	6 ()		Ref	
Yes	45	39 ()		7.1 (2.6-19.7)	<0.001
Physical activity level					
No	256	40 (15.6)		Ref	0.831
HEPA active	78	5 (6.4)	0.37	0.9 (0.3-3)	

size.[41] In the index study, the physically active people had lower scores on the GAD-7 scale, but we could not depict decreased odds of having anxiety symptoms in the presence of HEPA. The biological plausibility of explaining the role of HEPA in reducing anxiety is already established in many studies.[42] Potential mechanisms could include PA's role in regulating stress responses through the hypothalamic–pituitary–adrenal (HPA) axis or glucocorticoid circulation.

In addition, PA promotes neurogenesis and angiogenesis and upregulates growth factors, including brain-derived neurotrophic factor (BDNF), all of which are essential for normal brain function. By increasing the activity of brain regions primarily associated with anxiety or stress-related disorders, PA may help reduce anxiety symptoms.[42] The left hippocampal volume may be positively impacted by PA, which is particularly effective at improving hippocampus function.[43,44]

There are a few strengths and limitations of this study. The present study was among the few from our subnational region that has comprehensively assessed PA CMDs and CVD risk scores. The use of IPAQ makes our results comparable to other studies. Opportunistic screening may generate estimates that deviate from actual community-based estimates. However, such a comprehensive assessment could be very logistically challenging in field settings but generate more realistic estimates. We could not segregate the work-related and leisure-time PA in our study. Our results are based on self-reported PA levels considered inferior to accelerometer-based PA measurements. Also, the screening tools for depression and anxiety are only suggestive and need psychiatrist consultation to confirm the diagnosis.

To conclude, while the benefits offered by PA are undeniable, the proportion of people engaging in HEPA regularly is low. We can indirectly anticipate that the engagement is more into work-related PA, which does not offer any benefits against the CVD as seen by the CVD risk scores and biochemical and anthropometric profile. However, PA decreases the chances of depressive symptoms after adjusting for other covariates, but not for anxiety disorders. Future research should explore this aspect deeper after explicitly segregating work and leisure-time PA. While the government of India has released PA guidelines for all age groups, it is essential to look at sociocultural disparities while dealing with them, as these disparities have affected our results.[45] It is high time we look beyond NCDs and curtail the development of risk factors. Designing more interventions that promote PA and increasing adherence to the recommended guidelines can help us realize the actual benefits offered by PA on the control of NCD burden in the coming years.

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The author's contributions

MV was involved in conceptualization, study design, data collection, analysis, and manuscript writing and submitted it for publication. AK, PD, and AU helped in data collection and study implementation; JA and RK were involved in supervision, critical inputs in the manuscript, and reviewing and approving the final version of the manuscript. All the authors approved the final version of the manuscript submitted for publication.

Availability of data and materials

The data collected for the study are available from the corresponding author on reasonable request to protect the anonymity of the participants.

Ethics approval and consent to participate

The study was approved by the institutional ethics committee of the institute, with vast letter number of IEC/AIIMS/BTI/064, dated February 19, 2021, and an IEC no. of IEC-01/2020-012. Informed consent forms were obtained from participants, and the purpose of the study using the participants' information sheet was discussed before data collection. The participants' confidentiality and the data's anonymity were maintained throughout the study. The application of every technique followed all applicable guidelines and regulations. The study followed STROBE principles, and its findings were reported as per protocol. The application of every method followed all applicable rules and regulations.

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Conflicts of interest

There are no conflicts of interest.

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