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# Prevalence of Total and Domain-Specific Physical Activity and Associated Factors Among Nepalese Adults: A Quantile Regression Analysis

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**Aim**: To analyze the data from the World Health Organization Nepal STEPS survey 2013 to determine the prevalence of total and domain-specific physical activity (PA) and associated factors among Nepalese adults. **Methods**: A multistage cluster sampling technique was used to proportionately select participants from the 3 ecological zones (Mountain, Hill, and Terai) in Nepal. The Global PA Questionnaire was used to assess PA. The data were analyzed using quantile and ordinary least square regression. **Results**: Only 4% of the adults did not meet the World Health Organization PA guidelines. Age had a negative monotonic association with total PA and occupational PA, with the highest difference at the upper tails of the PA distribution. Lower total PA and occupational PA were associated with secondary or higher education, being retired or in unpaid employment, living in Terai or urban areas, and nonsmoking. Age, higher education, unpaid employment, and Terai or urban residence were negatively associated, while being currently married was positively associated with transport-related PA. **Conclusion**: Increasing age, higher education, unpaid employment, unemployment or retirement, and urban residence were associated with lower PA, with the stronger association at the upper tails of the distribution. The correlates had dissimilar associations across the quantiles of PA distribution.

**Keywords**: physical activity domains, Nepal, STEPS survey, secondary analysis, sociodemographic correlates

Regular physical activity (PA) has a range of health, social, and economic benefits. It reduces the risk of coronary heart disease, type 2 diabetes, breast and colon cancer, hypertension, and obesity.[1] PA has positive effects on mental health, especially depression and anxiety, mostly from leisure-time and transport-related domains.[2,3] It plays a vital role in healthy aging and forms an essential component of rehabilitation and recovery programs.[4] Despite all these benefits, physical inactivity is emerging as a global pandemic, and 1 in 4 adults worldwide do not meet the World Health Organization (WHO) recommendations of at least 150 minutes of moderate or 75 minutes of vigorous PA per week.[4,5] The economic costs of physical inactivity were estimated to be around 53.8 billion international dollars in 2013. In addition to direct health care costs, physical-inactivity-related deaths caused around $13.7 billion in productivity losses.[6]

Physical activity encompasses a range of activities that can be classified into four key domains: transport, household, occupation, and leisure. Priorities and preferences for the types of activities differ between countries and population groups according to their culture, context, and resources.[4] Occupational and active commuting-related activities are the prevalent PA forms in Nepal, whereas engagement in leisure-time activities is minimal.[7] The Global Action Plan on Physical Activity has highlighted the problem of declining levels of PA in low- and middle-income countries, as people are making greater use of private transport.[4]

Previous studies based on the WHO Noncommunicable Diseases Risk Factors: STEPwise approach to surveillance (STEPS) Survey 2013 have reported that 3.5% of Nepalese adults aged 15–69 years (2%–4% among men and 1%–2% among women) and 6.4% aged 45–69 years do not meet the WHO recommendations for weekly PA.[7,8] Another Nepalese study found that adults living in a peri-urban area had a high prevalence of low PA (43%) and that this was most elevated among urban residents, house-based women, government employees, and self-employed adults.[9] Factors such as changing preferences for motorized transport, increased access to private transport, unreliable public transport, gradual mechanization of household activities, lack of user-friendly parks and public spaces, poor walkability, lack of pedestrian-friendly features, and poor road safety are likely to decrease PA among adults in Nepal.[10–13] Motorcycles are becoming the preferred means of private transport because of traffic congestion and unreliable public transport,[14] and this trend is expected to increase further in the future.

Studies investigating the prevalence and associated factors across total PA (TPA) and different PA domains among Nepalese adults aged 40 years and older are limited. Previous studies that have analyzed the STEPS survey data have mostly focused on TPA and reported that physical inactivity is higher among older adults, men, urban residents, and those living in Mountain and Terai (plains) ecological zones.[8,15] Another study among 640 adults aged 25–59 years has reported that men have higher transport-related PA (TrPA) while women have a higher rate of occupational PA (OPA).[9] However, these studies, while valuable, have used traditional regression analytical approaches; thus, they cannot provide an overall picture of the relationship between exposure variables and PA across the distribution. Furthermore, a focus on the domains of PA has hitherto been limited. Information on the prevalence and associated factors of different PA domains is needed to understand the changing PA patterns better and develop targeted PA promotion and chronic disease prevention interventions. Therefore, this study aimed to examine the prevalence of total and domain-specific PA and

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identify the associated factors at different quantiles of the PA distribution among Nepalese adults aged 40–69 years.

# Methods

## Study Design and Sampling

This is the secondary analysis of the data from the WHO STEPS survey in Nepal, 2013. STEPS is a cross-sectional survey carried out to estimate the population-level prevalence of major noncommunicable disease (NCD) risk factors. A sample size target of 4200 was determined using the prevalence of low fruit and vegetable intake from the 2007 STEPS survey (61.9%), with a 5% absolute margin of error and a design effect of 1.5. Multistage cluster sampling was used to select the study participants. First, 70 out of 921 illakas (administrative units at the subdistrict level) were selected from 3 ecological zones (Mountain, Hill, and Terai); then, from each of these 70 illakas, 3 clusters (individual wards in a municipality or village development committee) were selected. A Microsoft Excel database specially designed for the STEPS survey was used for random selection of both the primary (illaka) and secondary (cluster) sampling units based on probability proportionate to size. From each of these 210 clusters, 20 households were selected using systematic random sampling, and one participant was selected from each of these 4200 households using the Kish method.[16] Those too frail, mentally unfit, with any form of physical disability, or unable to give consent, as well as visitors or those residing in that house for <6 months, were not eligible for inclusion.[7] The survey was approved by the ethical review board of the Nepal Health Research Council. The survey methodology has been presented in detail elsewhere.[7,15]

Out of the 4143 study participants, 48% (2004) were younger than 40 years, while the remaining 52% (2139) were 40 years or older. This study analyzed the data from these 2139 study participants aged 40 years or older to identify the prevalence of total and domain-specific PA and explore the associated factors. The Monash University Human Research Ethics Committee has approved this secondary analysis (16,613).

## Data Collection

The NCD risk factors were assessed in 3 steps, using the WHO NCD STEPS instrument (version 2.2; Geneva, Switzerland).[17] In the first step, a questionnaire was used to collect information on demographic characteristics, tobacco and alcohol use, fruit and vegetable intake, PA, dietary salt, oral health, and history of blood pressure and diabetes. Anthropometric (weight, height, and waist circumference) and blood pressure measurements were taken in the second step, and biochemical measurements of fasting blood glucose and total cholesterol were taken in the final step. Consent was obtained from the study participants for each of these steps. The response rates for each of these steps were 98.6%, 98.2%, and 89.8%, respectively.

The English version of the STEPS questionnaire was translated into Nepali and validated through expert consultation and a pilot study.[7] Field staff with an undergraduate degree in health science (nursing, general medicine, or public health) were trained and mobilized for the data collection. The week-long training covered aspects such as interview techniques, the sampling process, household and respondent selection, electronic data entry, and the collection of anthropometric and biochemical measurements. Field supervisors, the national STEPS team, and representatives from WHO and the Ministry of Health and Population monitored the data collection.

## Outcome Variables

Physical activity was assessed using the Global Physical Activity Questionnaire (GPAQ), which consists of 16 questions to estimate participants' self-reported PA (work, transport, and leisure time) and sedentary behavior (sitting time).[18] GPAQ is considered to be a suitable and acceptable instrument for measuring population-level PA[19,20] and is the most commonly used instrument for PA surveillance in developing countries.[21] Culturally relevant PA show cards were used to assist recall and ensure an accurate classification of activities as moderate or vigorous. At least 10 minutes of engagement in activities that involved hard physical effort and caused a significant increase in heart and breathing rate were considered to be vigorous activities. Moderate activities were defined as those involving at least 30 minutes of engagement in activities that required moderate physical effort and caused a moderate increment in heart and breathing rate. OPA included moderate and vigorous activities carried out as part of paid or unpaid work, studying/training, household chores, seeking employment, and so on. TrPA included walking or cycling for at least 10 minutes continuously to move from one place to another, while leisure-time PA (LtPA) included moderate or vigorous activities carried out during leisure. Sedentary behavior included time spent sitting or reclining at work, at home, during leisure, or during travel.

## Correlates

Age, gender, education, occupation, ethnicity, marital status, place of residence, ecological zone of residence, body mass index (BMI), current smoking, and alcohol intake were the correlates of interest. BMI was calculated using the height and weight measurements and categorized as underweight (<18.5 kg/m$^2$), normal weight (18.5–24.9 kg/m$^2$), overweight (25–29.9 kg/m$^2$), and obese (≥30 kg/m$^2$). The STEPS questionnaire categorizes participants' ethnicity into 6 categories: upper-caste groups (Brahmin/Chhetri), relatively advantaged Janajatis, disadvantaged Janajatis, disadvantaged non-Dalit Terai caste, religious minorities, and Dalits. These groups were further categorized into advantaged and disadvantaged ethnic groups for this analysis, considering the economic and educational differences between them. Advantaged groups included relatively advantaged Janajatis and upper-caste groups, while disadvantaged groups included Dalits, disadvantaged Janajatis, disadvantaged non-Dalit Terai caste, and religious minorities.[22] The ecological zones comprise 3 regions: Mountain, Hill, and Terai. Mountain is the Himalayan region on the northern side of the country, Hill refers to the adjacent region at a lower altitudinal belt, and Terai is the flat land at an altitude of 70 to 700 m above the sea level in the southern region of the country. Alcohol intake refers to whether the participant consumed any amount of alcohol within the last 30 days and is dichotomized as "yes" or "no" for this analysis.

## Statistical Analysis

The metabolic-equivalent-minutes (MET-minutes) per week of PA for each domain were obtained by summing the METs for vigorous and moderate activities that were calculated by multiplying the number of minutes of activity at each intensity by the number of days per week these were undertaken. A MET is the ratio of a person's working and resting metabolic rate, and 1 MET is

defined as the energy cost of sitting quietly, which is equivalent to a calorie consumption of 1 kcal/kg/h.[23] Vigorous activity in the work and leisure domain contributed 8 METs, while moderate activities in these domains and transport-related activities contributed 4 METs.[23] The MET-minutes per week of the 3 PA domains (work, transport, and leisure) were combined to obtain a TPA score. This score was categorized as low (<600 MET-min/wk), moderate (600–3000 MET-min/wk), and high (>3000 MET-min/wk) for descriptive analysis.

Descriptive characteristics for categorical variables are reported as frequency and percentages. For continuous variables, normality was examined by histogram and boxplot, and measures of skewness and kurtosis and the median and interquartile range are reported, as the variables had skewed distribution. The weighted percentage was calculated by adjusting the analysis for the complex sampling design used in the survey. Wards were considered to be clusters, and ecological zones were considered to be strata. There were no missing values in the correlates, as the completed questionnaires were cross-checked at the field level and any missing information was collected during subsequent visits. The descriptive analysis was carried out using Stata SE 14 (StataCorp, College Station, TX).

Quantile regression (QR) was used to examine the potential heterogeneous associations between correlates and different quantiles of PA.[24] QR allows the modeling of any quantile of a continuous endpoint as a linear combination of the covariates, rather than only at the mean. QR makes no assumptions about the distribution of the error and is considered more robust in handling outliers, compared with the traditional linear regression analysis.[25,26] QR coefficients indicate the differences in the dependent variable at the modeled percentile for each unit change in the corresponding correlates.

Estimates for PA variables were derived from both QR and ordinary least square (OLS) regression analysis. We used R (version 3.6.1; The R Foundation for Statistical Computing) to conduct both regression analyses. The sampling design used in the STEPS survey was accommodated using the methodology proposed by Geraci[27] for complex surveys. This approach allows the analysis to be weighted using the sampling weights, while taking into account clustering (ie, wards) and stratification (ie, ecological belts). The estimates were generated for 5 different quantiles (0.1, 0.25, 0.5, 0.75, and 0.9), and 1000 bootstrap replications were performed to generate standard errors (SEs) and 95% confidence intervals of both regression analyses. A $P$ value <.05 was considered statistically significant. Running a QR for LtPA was not possible, as the MET-minutes per week at all quantiles other than the 90th percentile clustered around zero.

## Results

The mean age of the study participants was 51.8 (8.7) years. Approximately 63% of the participants were female. More than half (58%) did not have formal education, 59% were involved in unpaid employment, 89% were currently married, and 53% belonged to advantaged ethnic groups. The geographic distribution of the study participants in the sample was consistent with that of the national population, with 48% living in the Terai, 44% in the Hills, and 7% in the Mountains. Overall, about 81% lived in rural areas. Around 26% were current smokers, while 18% had consumed alcohol within the last 30 days. Nearly 12% of the sample was underweight, while 22% and 6% were overweight and obese, respectively. Almost 80% engaged in high TPA, while 4% did not meet the recommended MET-minutes per week. The average sitting time was 160 (105) minutes per day. Table 1 presents the descriptive characteristics of the study sample.

The study participants engaged in 6720 median MET-minutes per week of TPA. The males, younger age groups, those with primary education, those on paid employment, rural or Mountain residents, and healthy weight individuals accumulated higher MET-minutes of TPA per week. The TPA score was composed of 75% OPA, 24% TrPA, and 1% LtPA. Among the males, the proportional contributions of OPA, TrPA, and LtPA were 74%, 25%, and 1%, respectively, while among the females, the proportions were 76%, 24%, and 0.3%, respectively (Table 2).

The survey participants engaged in 4620 median MET-minutes per week of OPA. Those with no formal education, in paid employment, from disadvantaged ethnic groups, residing in the Mountains and rural areas, and of healthy weight status accumulated higher MET-minutes per week of OPA. Likewise, the adults engaged in 1680 MET-minutes per week of TrPA. Only 2% of the adults engaged in some form of vigorous or moderate LtPA. The males, those with higher education, and those retired or unemployed had a higher percentage contribution of LtPA to TPA. Table 2 presents the MET-minutes per week and domain-specific contributions to TPA for different correlates.

### Factors Associated With TPA

The OLS regression analysis showed that higher age, being female, having secondary or higher education, being in retirement or unpaid employment, living in the Terai or urban areas, and nonsmoking were associated with lower TPA. The significance and direction of the associations were consistent between OLS regression and QR except for obesity, which had a significant association with TPA in QR but not in OLS analysis. The QR coefficients indicated that the correlates have dissimilar associations with TPA across the quantiles (Table 3).

The association between age and TPA increased monotonically across the quantiles from lowest to highest. At the 10th quantile, for every 1-year increase in age, the TPA was lower by 74 MET-minutes per week, whereas at the 90th quantile, the decline was 195 MET-minutes per week for each 1-year increase in age. OLS regression found an average decrease of 141 MET-minutes per week for each 1-year increase in age. On average, the females engaged in 1069 fewer MET-minutes per week of TPA than the males; however, the estimates varied across the quantiles. For example, the difference between the males and females was more than 5 times higher at the 90th quantile (2350 MET-min/wk) than at the 10th quantile (434 MET-min/wk). Compared with those without any formal education, having higher education had a negative association with TPA across all the quantiles (except 10th), with the most significant association at the highest quantile. Those with higher education engaged in 1018 fewer MET-minutes of TPA per week at the 10th quantile and 6911 fewer MET-minutes per week at the 90th quantile than those with no formal education. Likewise, having secondary education also had a negative association with TPA. On average, they engaged in 2304 fewer MET-minutes per week of TPA than those without any formal education. The estimate at the 90th quantile (5207 MET-min/wk) is almost double the OLS estimate, indicating greater differences among the most active group. Those retired or unemployed engaged in less TPA than those in paid employment, and the differences increased monotonically across the quantiles. Likewise, living in an urban

**Table 1 Descriptive Characteristics of Study Participants (n = 2139)**

| Characteristics | Unweighted number | Unweighted percentage | Weighted percentage |
|---|---|---|---|
| Age, y | | | |
| 40–49 | 940 | 43.9 | 45.1 |
| 50–59 | 673 | 31.5 | 31.8 |
| 60–69 | 526 | 24.6 | 23.1 |
| Gender | | | |
| Male | 801 | 37.4 | 50.6 |
| Female | 1338 | 62.5 | 49.4 |
| Level of education | | | |
| No formal education | 1251 | 58.5 | 52.5 |
| Primary level | 487 | 22.8 | 24.6 |
| Secondary level | 254 | 11.9 | 14.1 |
| Higher level | 147 | 6.9 | 8.7 |
| Occupation | | | |
| Paid employment | 743 | 34.7 | 42.8 |
| Unpaid employment | 1258 | 58.8 | 49.4 |
| Retired/unemployed | 138 | 6.4 | 7.7 |
| Ethnicity | | | |
| Disadvantaged groups | 1011 | 47.3 | 46.7 |
| Advantaged groups | 1128 | 52.7 | 53.3 |
| Marital status | | | |
| Never married | 27 | 1.3 | 1.1 |
| Currently married | 1903 | 88.9 | 91.3 |
| Divorced/widowed/separated | 209 | 9.8 | 7.6 |
| Ecological zone | | | |
| Mountain | 157 | 7.3 | 6.3 |
| Hill | 946 | 44.2 | 45.5 |
| Terai | 1036 | 48.4 | 48.1 |
| Place of residence | | | |
| Rural | 1733 | 81.0 | 82.1 |
| Urban | 406 | 18.9 | 17.9 |
| Current smoker | | | |
| Yes | 547 | 25.6 | 27.5 |
| No | 1592 | 74.4 | 72.5 |
| Alcohol intake within the last 30 d | | | |
| Yes | 385 | 18.0 | 21.3 |
| No | 1754 | 82.0 | 78.7 |
| Body mass index | | | |
| Underweight | 254 | 11.9 | 11.9 |
| Normal | 1280 | 59.6 | 59.2 |
| Overweight | 471 | 22.1 | 22.4 |
| Obese | 134 | 6.3 | 6.4 |
| Total physical activity | | | |
| Low | 92 | 4.3 | 4.2 |
| Moderate | 343 | 16.0 | 15.2 |
| High | 1704 | 79.7 | 80.6 |

area or the Terai had a negative monotonic association with TPA across the quantiles. The OLS estimate indicated that urban residents engaged in an average of 2234 fewer MET-minutes per week of TPA, while the QR estimates increased in size for the individuals at the higher end of the TPA distribution, with estimates ranging from 959 MET-minutes per week at the 10th quantile to 3104 MET-minutes per week at the 90th quantile. Ethnicity, marital status, having primary education, living in the Mountains, alcohol intake, and being normal weight or overweight were not associated with TPA.

**Table 2 MET-Minutes per Week and Percentage Contribution of OPA, TrPA, and LtPA to TPA**

| Correlates | TPA | | OPA | | | TrPA | | | LtPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Median | Q1–Q3 | Median | Q1–Q3 | % of TPA | Median | Q1–Q3 | % of TPA | Median | Q1–Q3 | % of TPA |
| Age, y | | | | | | | | | | | |
| 40–49 | 8160 | 4620–13,440 | 5880 | 2520–10,560 | 76.9 | 1680 | 840–3360 | 22.5 | 0 | NA | 0.9 |
| 50–59 | 6720 | 3600–11,460 | 4200 | 1800–8640 | 74.2 | 1680 | 840–2880 | 25.1 | 0 | NA | 0.7 |
| 60–69 | 4800 | 2520–9120 | 3360 | 840–6720 | 71.7 | 1680 | 720–2520 | 27.8 | 0 | NA | 0.5 |
| Gender | | | | | | | | | | | |
| Male | 6840 | 3600–12,600 | 4200 | 1680–9960 | 74.2 | 4200 | 1680–9960 | 24.6 | 0 | NA | 1.2 |
| Female | 6720 | 3720–10,920 | 4920 | 2520–8400 | 76.2 | 4920 | 2520–8400 | 23.5 | 0 | NA | 0.3 |
| Level of education | | | | | | | | | | | |
| No formal education | 7080 | 3720–12,000 | 5040 | 2520–9960 | 77.1 | 1680 | 720–2940 | 22.6 | 0 | NA | 0.3 |
| Primary level | 7440 | 3840–12,960 | 5040 | 2160–10,560 | 76.6 | 1680 | 840–2940 | 23.0 | 0 | NA | 0.4 |
| Secondary level | 6168 | 3600–10,080 | 3360 | 1680–7560 | 67.1 | 1680 | 840–3360 | 31.1 | 0 | NA | 1.9 |
| Higher level | 5040 | 2520–9240 | 960 | 3120–7440 | 67.8 | 1680 | 840–2520 | 27.7 | 0 | NA | 4.5 |
| Occupation | | | | | | | | | | | |
| Paid employment | 7920 | 3920–13,440 | 5040 | 1680–10,800 | 75.4 | 1680 | 840–3360 | 23.5 | 0 | NA | 1.1 |
| Unpaid employment | 6720 | 3840–10,920 | 4800 | 2520–8400 | 76.8 | 1680 | 720–2520 | 22.9 | 0 | NA | 0.3 |
| Retired/unemployed | 3720 | 1200–7140 | 1680 | 0–4200 | 55.4 | 1680 | 600–3360 | 43.1 | 0 | NA | 1.5 |
| Ethnicity | | | | | | | | | | | |
| Disadvantaged groups | 6840 | 3840–12,480 | 5040 | 2400–9720 | 76.7 | 1680 | 840–2880 | 22.5 | 0 | NA | 0.7 |
| Advantaged groups | 6720 | 3480–11,280 | 4200 | 1680–8400 | 73.6 | 1680 | 840–2940 | 25.5 | 0 | NA | 0.8 |
| Ecological zone | | | | | | | | | | | |
| Mountain | 10,920 | 6240–16,800 | 8400 | 4200–13,440 | 81.6 | 1680 | 840–3360 | 18.2 | 0 | NA | 0.2 |
| Hill | 7140 | 3840–12,720 | 5040 | 2400–10,080 | 75.1 | 1680 | 840–3360 | 24.4 | 0 | NA | 0.4 |
| Terai | 5880 | 3360–10,080 | 4080 | 1680–7560 | 73.7 | 1680 | 720–2520 | 24.9 | 0 | NA | 1.3 |
| Place of residence | | | | | | | | | | | |
| Rural | 7320 | 4080–12,600 | 5040 | 2400–10,080 | 75.8 | 1680 | 840–3000 | 23.5 | 0 | NA | 0.7 |
| Urban | 4680 | 2520–8400 | 3360 | 960–5880 | 70.7 | 1440 | 720–2520 | 28.2 | 0 | NA | 1.1 |
| Current smoker | | | | | | | | | | | |
| Yes | 7980 | 4200–13,440 | 5760 | 2520–11,352 | 77.5 | 1680 | 840–3360 | 22.2 | 0 | NA | 0.3 |
| No | 6360 | 3360–10,800 | 4200 | 1680–8400 | 74.0 | 1680 | 840–2520 | 25.0 | 0 | NA | 1.0 |
| Alcohol intake | | | | | | | | | | | |
| Yes | 7920 | 3960–13,920 | 5520 | 1680–11,352 | 75.0 | 1680 | 1080–3360 | 23.8 | 0 | NA | 1.2 |
| No | 6720 | 3600–10,920 | 4200 | 2000–8400 | 75.2 | 1680 | 840–2520 | 24.2 | 0 | NA | 0.6 |
| BMI | | | | | | | | | | | |
| Underweight | 6600 | 3360–10,800 | 4800 | 1680–8400 | 75.0 | 1680 | 700–2940 | 24. 2 | 0 | NA | 0.8 |
| Normal | 7560 | 3920–12,960 | 5040 | 2400–10,080 | 75.9 | 1680 | 840–3360 | 23. 6 | 0 | NA | 0.5 |
| Overweight | 5880 | 3720–9660 | 4200 | 1680–7680 | 73. 7 | 1680 | 840–2520 | 24.7 | 0 | NA | 1.6 |
| Obese | 4320 | 3360–8100 | 3360 | 1200–6720 | 69.7 | 1440 | 720–2520 | 28. 9 | 0 | NA | 1.4 |
| Total | 6720 | 3720–11,760 | 4620 | 1920–9120 | 75.1 | 1680 | 840–2880 | 24.1 | 0 | NA | 0.8 |

Abbreviations: BMI, body mass index; LtPA, leisure-time PA; NA, not applicable; OPA, occupational PA; PA, physical activity; TPA, total PA; TrPA, transport-related PA.

**Table 3 Comparison of Regression Coefficients for TPA From Quantile and OLS Regression**

| | Quantile coefficients | | | | | |
|---|---|---|---|---|---|---|
| Correlates | 10% (MET: 1680) | 25% (MET: 3600) | 50% (MET: 6720) | 75% (MET: 11,508) | 90% (MET: 17,520) | OLS coefficients |
| Age | −74.1 (17.6)* | −99.6 (17.9)* | −145.7 (25.6)* | −173.4 (34.9)* | −194.9 (47.6)* | −141.4 (20.3)* |
| Sex | | | | | | |
| Female | −434.1 (418.2) | −560.4 (392.6) | −481.4 (525.8) | −1063.5 (734.9) | −2350.2 (964.6)* | −1069 (459.9)* |
| Ethnicity | | | | | | |
| Advantaged groups | −211.4 (262) | 218.4 (375.1) | 359.7 (462.8) | 125.9 (570.9) | −463.1 (861.6) | −206.6 (423.1) |
| Level of education | | | | | | |
| Primary | −300 (376) | −218.4 (453.8) | −320.1 (555.6) | −877.9 (690.5) | −556.1 (997.9) | −729.1 (526.5) |
| Secondary | 112.7 (496) | −126.0 (501.8) | −1345.5 (646.8)* | −2723 (793.3)* | −5207.8 (1153.9)* | −2304.3 (629.3)* |
| Higher | −1018.2 (522.8) | −1966.8 (613.1)* | −2615.8 (939.8)* | −4501.8 (1145.3)* | −6911.5 (1257.6)* | −4140.6 (707.9)* |
| Occupational status | | | | | | |
| Unpaid employment | 347.7 (387.5) | −140.4 (380.5) | −1114.3 (623.5) | −2755.4 (898.9)* | −3287.1 (959.3)* | −1717.2 (482.8)* |
| Retired/unemployed | −769.1 (443.7) | −2074.8 (546.7)* | −2801.5 (797.1) * | −4196.9 (922.5)* | −5589.3 (1524.8)* | −3705.8 (780.3)* |
| Marital status | | | | | | |
| Currently married | 1789.1 (1517.5) | 452.4 (1233.9) | 1111.2 (1416.8) | 3733.2 (2339.8) | 3723.9 (3345.2) | 2398.1 (1321.1) |
| Divorced/widowed/ separated | 1506.8 (1623.2) | 44.4 (1334.1) | 134.1 (1471.5) | 2834 (2530.3) | 3307.3 (3500.8) | 1579.4 (1460.9) |
| Ecological zone | | | | | | |
| Mountain | −1006.4 (671.2) | 2017.2 (1057.7) | 2340.2 (1351.7) | 1451.4 (2429.3) | 1879.8 (1970.6) | 1501.3 (674.2) |
| Terai | −1027.3 (299.5)* | −1141.2 (394.2)* | −2528.6 (618.9)* | −3163.3 (678.9)* | −5236.4 (1015.1)* | −2973 (513.1)* |
| Place of residence | | | | | | |
| Urban | −959.5 (370.1)* | −1392 (434.7)* | −1918.7 (643.8)* | −3077.1 (671.2)* | −3104.6 (979.7)* | −2234.4 (544.4)* |
| Current smoker | | | | | | |
| Yes | 333.2 (307.2) | 637.2 (313.6)* | 831.7 (449.8) | 1383 (691.9)* | 1630.9 (902.2) | 903.9 (396.1)* |
| Alcohol intake | | | | | | |
| Yes | 15.9 (383.8) | −33.6 (413.5) | 569 (592) | 706.8 (872.6) | 71.5 (1219.5) | 447.7 (491.2) |
| BMI | | | | | | |
| Normal weight | 557.7 (394.1) | 594 (523.6) | 9.8 (631.2) | 1193.2 (781.3) | 1665.1 (1394.4) | 911.4 (557.5) |
| Overweight | 529.5 (466) | 496.8 (553.8) | −341.1 (690.9) | −500.2 (812.8) | 95.7 (1631.2) | −164.9 (641) |
| Obese | 0 (586.8) | −285.6 (678.7) | −2134.1 (837.5)* | −2458.2 (956.1)* | −2031.6 (2253.8) | −1258.8 (733.3) |
| Constant | 4570.9 (1972.1) | 9477.6 (1830.2) | 16,393.1 (2166.4) | 21,239.3 (3235.5) | 29,736 (4848.8) | 17,106.4 (2039.3) |

Abbreviations: BMI, body mass index; MET, metabolic equivalent; PA, Physical activity; TPA, total PA; OLS, ordinary least square. Note: Adjusted for all variables in the model, values in the parenthesis are bootstrapped SEs. Reference categories are as follows: sex = male, ethnicity = disadvantaged groups, level of education = no formal education, marital status = unmarried, occupational status = paid employment, ecological zone = Hill, place of residence = rural, current smoker = no, alcohol intake = no, and BMI = underweight.
*$P < .05$.

## Factors Associated With OPA

The OPA was found to be lower among the participants who were older adults, females, with secondary or higher education, unemployed, retired or unemployed, residing in Terai or urban locations, and nonsmokers. OPA decreased monotonically with increasing age across the distribution. For every 1-year increase in age, OPA declined by 31 MET-minutes per week at the 10th quantile compared with 183 MET-minutes per week at the 90th quantile. OLS regression found an average decline of 127.5 MET-minutes per week for each 1-year increase in age (Table 4). The females engaged on average in 984 fewer MET-minutes per week of OPA than their male counterparts; however, this estimate is more than 2 times lower than the estimate from QR at the 90th quantile, the only quantile where the difference between the males and females was significant.

Compared with those without formal education, having secondary or higher education had a negative association with OPA across all except the 10th quantile, with the strongest association at the highest quantiles. Those with higher education engaged in 1560 and 6055 fewer MET-minutes per week of OPA at the 25th and 90th quantiles, respectively, than those without formal education. Likewise, those with secondary education engaged on average in 2534 fewer MET-minutes per week of OPA, with the estimates from QR ranging between 164 and 4275 MET-minutes per week between the 10th and 90th quantiles. Those in unpaid employment and those retired or unemployed also engaged in fewer total OPA, and the difference increased monotonically across the quantiles. Living in the Terai or an urban area had a negative and statistically significant association with OPA, though the estimates varied across the quantiles of OPA distribution. The difference between

**Table 4 Comparison of Regression Coefficients for OPA From Quantile and OLS Regression**

| | Quantile coefficients | | | | | |
|---|---|---|---|---|---|---|
| Correlates | 10% (MET : 0) | 25% (MET : 1800) | 50% (MET : 4620) | 75% (MET : 9120) | 90% (MET: 14,840) | OLS coefficients |
| Age | −31.0 (11.5)* | −75. 4 (17.3)* | −132.9 (23.6)* | −163.6 (29.1)* | −183.4 (47.7)* | −127.5 (19)* |
| Sex | | | | | | |
| Female | 287.8 (251.2) | −223.6 (421.3) | −480 (439.6) | −1155.2 (669.2) | −2333.7 (968.7)* | −984.3 (427)* |
| Ethnicity | | | | | | |
| Advantaged groups | −56.7 (173.4) | −131. 3 (283.1) | 90 (440.7) | −44.5 (573.1) | −531.7 (776) | −328 (388.4) |
| Level of education | | | | | | |
| Primary | −31 (228.9) | −539. 5 (367.8) | −381.4 (421) | −686.5 (707.1) | −753.2 (1140.3) | −665 (487) |
| Secondary | −163.6 (292.3) | −834.6 (500.2) | −1560 (572.9)* | −2878.8 (733)* | −4275.1 (995.4)* | −2533.6 (571.3)* |
| Higher | −269.3 (354.4) | −1560.5 (523.9)* | −2965.7 (854.6)* | −3349.4 (995.3)* | −6054.6 (1243.4)* | −3807.9 (703.4)* |
| Occupational status | | | | | | |
| Unpaid employment | 251.3 (286.8) | 404.1 (403.4) | −1062.9 (504.7)* | −1930.2 (813)* | −2949.1 (955.4)* | −1304.1 (433.8)* |
| Retired/unemployed | −449 (253.8) | −1139 (463.3)* | −2811.4 (634.8)* | −4854.7 (900.1)* | −5816.6 (1455.8)* | −3622.4 (652.1)* |
| Marital status | | | | | | |
| Currently married | 1109.3 (1042) | 24.6 (1131.8) | 1444.3 (1008.2) | 3348.7 (2368.1) | −187.4 (2616.8) | 1844.6 (1240.9) |
| Divorced/widowed/ separated | 813.7 (1097) | −554.9 (1222.3) | 484.3 (1068.7) | 2427.9 (2538.2) | 231 (2819.4) | 1127.2 (1366.4) |
| Ecological zone | | | | | | |
| Mountain | 1926 (507.4)* | 1213.8 (856.7) | 2245.7 (1295.8) | 1593 (2047.5) | 2844.1 (1952.9) | 1735.6 (1086.6) |
| Terai | −299.1(192.9) | −996.4 (385.6)* | −2207.1 (510.9)* | −3031.6 (645.7)* | −4286.8 (977.6)* | −2440.1 (491.6)* |
| Place of residence | | | | | | |
| Urban | −248.4 (226.7) | −667.2 (360.6) | −1560 (539.5)* | −2652.9 (645.3)* | −2888.8 (014.9)* | −1725.3 (514.4)* |
| Current smoker | | | | | | |
| Yes | 440.6 (188.5)* | 753.8 (271.8)* | 840 (380.4)* | 1190.3 (651.4) | 1405.9 (879.6) | 934.1 (378.3)* |
| Alcohol intake | | | | | | |
| Yes | −127.2 (202.2) | −154.9 (366.4) | 158.6 (427) | 404.8 (718.4) | 21.6 (1087.6) | 163.2 (452.4) |
| BMI | | | | | | |
| Normal weight | 249.6 (237.5) | 554.9 (462.7) | 192.9 (516.4) | 1309.6 (834.9) | 1036.2 (1216.8) | 821.8 (526.5) |
| Overweight | 125.4 (273.3) | 427.2 (498.8) | −312.9 (590.4) | 198 (817.7) | −508.2 (1342.8) | 19.4 (580.2) |
| Obese | −32.8 (303.4) | −309.2 (573.8) | −1808.6 (682.7)* | −1395.2 (1053.9) | −2493.6 (1852.5) | −1069.4 (663.5) |
| Constant | 809 (1358.6) | 6611.8 (1800.8) | 13,371.4 (1834) | 17,876.5 (3192.7) | 29,487.6 (4278.6) | 14,301.1 (1945.5) |

Abbreviations: BMI, body mass index; MET, metabolic equivalent; PA, physical activity; OLS, ordinary least square; OPA, occupational PA. Note: Adjusted for all variables in the model, values in the parenthesis are bootstrapped SEs. Reference categories are as follows: sex = male, ethnicity = disadvantaged groups, level of education = no formal education, marital status = unmarried, occupational status = paid employment, ecological zone = Hill, place of residence = rural, current smoker = no, alcohol intake = no, and BMI = underweight.
*$P < .05$.

rural and urban residents ranged between 1560 MET-minutes per week at the 50th quantile and 2889 MET-minutes per week at the 90th quantile. Likewise, the Terai residents engaged on average in 2440 fewer MET-minutes per week of OPA than the Hill residents, and the coefficients were larger at the higher ends of the OPA distribution. Smoking had a negative monotonic association with OPA at the lower quantiles only. Ethnicity, marital status, having primary education, alcohol intake, and being normal weight or overweight were not associated with OPA across the quantiles.

## Factors Associated With TrPA

Age, higher education, being currently married, unpaid employment, and Terai or urban residence were found to be negatively associated with TrPA in the OLS regression analysis. QR further identified the association of correlates specific to the TrPA quantiles. Table 5 presents the comparison of the regression coefficients for TrPA from the quantile and OLS regression.

For every 1-year increase in age, TrPA decreased by 8 MET-minutes per week at the 10th quantile and 38 MET-minutes per week at the 90th quantile. No significant difference was found in the TrPA levels between the males and females in the OLS as well as the QR analysis. On average, higher educated adults engaged in 560 fewer MET-minutes per week of TrPA than those with no formal education; however, the estimate at the 90th quantile was almost 3 times higher, indicating a greater difference among those who are most active. Those in unpaid employment engaged in less average TrPA, and the difference increased monotonically across the quantiles. Those currently married engaged on average in 522 more MET-minutes per week of TrPA than their unmarried

counterparts did; however, the difference was more than double (1413 MET-min/wk) at the 90th quantile of the TrPA distribution. People living in the Terai had an average decline of 591 MET-minutes per week than those living in the hilly region. The estimates ranged between 295 MET-minutes per week at the 10th quantile and 1070 MET-minutes per week at the 90th quantile. The urban residents had a negative monotonic association with TrPA across the middle quantiles. Ethnicity, being female, having a primary or secondary education and BMI were not associated with TrPA across all the quantiles of the distribution.

## Discussion

Our study found that a vast majority (80%) of the study participants engaged in high TPA and only 4.3% did not meet the WHO recommendations of at least 600 MET-minutes per week of PA. By contrast, another study carried out in a peri-urban area in Nepal, located near the capital Kathmandu, reported a higher prevalence of low PA (43%).[9] This difference may be attributable to participant characteristics, as the STEPS survey has involved both the rural and urban population. A higher prevalence of physical inactivity among urban residents was also found in our study.

Understanding all the PA domains is essential, as the socio-demographic patterns of activities may vary across the domains, and the potential strategies to address inactivity will also differ accordingly. Globally, LtPA is the most prevalent form of PA in high-income countries, while in low- and middle-income countries, the occupational, transport, and household domains of activity are the dominant forms.[28] Consistent with other studies from Nepal,[9,29] we found that occupational (paid, unpaid, and household) activities and active transportation-related activities were the most significant contributors to TPA. Vaidya and Krettek[9] have expressed concern over the public health implications of having occupational activities as the dominant form of PA, because Nepal is undergoing an economic transition and rapid urbanization, which are likely to decrease OPA, as observed in other parts of the world. This highlights the importance of promoting other domains of PA and developing infrastructure to support this.

Engagement in leisure-time activities by this sample was minimal, with LtPA contributing only 1% of TPA. A similar pattern has been observed in studies from other South Asian countries.[30–33] In the Nepalese context, older adults' leisure time mostly constitutes watching television, playing cards, or socializing with other adults in the neighborhood.[9] Engagement in LtPA is mostly associated with younger ages and western culture.[9] Furthermore, the lack of age-friendly sporting facilities, environmental pollution, and limited access to public parks and recreational facilities are likely to act as barriers to engagement in LtPA.[9,34]

Our study's results showed that engagement in total PA and OPA decreased monotonically with increasing age, indicating that older adults were more likely to be the least active. Engagement in TrPA also decreased with increasing age, although the rate of decrease was not monotonic. At the 90th quantile, every 1-year increase in age decreased TrPA by 38, OPA by 183, and TPA by 195 MET-minutes per week. An age-related decline in PA has also been reported in other studies,[35–37] and this study has revealed that, in Nepal, the association is strongest at the upper tail of the PA distribution.

While earlier studies have reported lower PA levels among women compared with men,[9,32,36,38,39] our study found that the difference between males and females was only significant at the highest quantiles of TPA and OPA. This may relate to traditionally defined gender roles of men and women in Nepal, where women generally tend to engage in household and other moderate physical activities, which contribute to lower METs. On the other hand, men engage in outdoor and relatively vigorous activities, which contribute higher METs, potentially leading to these gender differences at the upper quantiles of the PA distribution. Furthermore, in some religious and ethnic groups, cultural expectations may limit women's outdoor movement and participation in certain forms of PA, particularly LtPA.[32] Contrastingly, in the case of TrPA, the difference between males and females was not significant in any of the quantiles.

In the present study, those with higher education engaged in less TPA than those without any formal education, with the most significant differences found at the upper tail of the PA distribution. Earlier studies have shown both a positive[29,40] and negative association[9,38,39,41] between education and engagement in TPA. In Nepal, illiterate individuals or those with lower educational levels tend to engage in physically demanding occupations, such as farm work, construction, rickshaw pulling, and so on. In contrast, those with higher education generally tend to engage in sedentary jobs, such as office-based jobs, teaching, and so on. This is further confirmed by our study, which shows that those with secondary or higher education engaged in less OPA than those without any formal education. A review of PA patterns in South Asian countries has also established that skilled workers and professionals were more inactive than unskilled counterparts in the region.[32] This indicates the potential for workplace-based interventions to address surging inactivity levels in these groups.

The findings of our study show that, compared with those in paid employment, people in unpaid employment or those retired or unemployed engaged in less PA (TPA, OPA, and TrPA). The greatest difference was observed at the upper tails of the PA distribution. A previous review has also shown a positive association between socioeconomic status and PA in low- and middle-income countries.[28] OPA was the major contributor to TPA among Nepalese adults in the present study, which would potentially explain why those who are unemployed or in retirement reported lower overall PA. TrPA would also be lower in these subgroups because they would not need to commute between work and home.

Urban residents engaged in lower TPA, OPA, and TrPA than rural residents, consistent with earlier studies.[36,37,39] Possible reasons could be inadequate open spaces in urban areas, mechanization of household activities, and better access to public and private transport.[9,36] Likewise, those living in Terai had lower TPA, TrPA, and OPA than those living in Hills, possibly because of better access to motorized transportation.

It has been reported that higher body weight could be a driver of physical inactivity,[28] although the opposite pathway of causality is most frequently studied. In the present study, BMI was not associated with any of the PA domains in the OLS analysis, though being obese was associated with lower TPA and OPA in some of the quantiles. The cross-sectional nature of this study limits drawing inferences about causality and the direction of the association. Considering the role of these factors in noncommunicable disease epidemiology, future studies to investigate this association may be valuable.

### Strengths and Limitations

This is the first study that has identified the factors associated with different domains of PA among Nepalese adults using QR. Nationally representative data from the WHO STEPS survey has been used, and the analysis has been adjusted for the complex sampling procedures to generate nationally representative estimates. The use

**Table 5 Comparison of Regression Coefficients for TrPA From Quantile and OLS Regression**

| | Quantile coefficients | | | | | |
|---|---|---|---|---|---|---|
| **Correlates** | **10% (MET: 360)** | **25% (MET: 840)** | **50% (MET: 1680)** | **75% (MET: 2880)** | **90% (MET: 4200)** | **OLS coefficients** |
| Age | −8.4 (3.6)* | −7.2 (4.2) | −12.6 (5.6)* | 0 (8.1) | −38.2 (15)* | −11.7 (5.4)* |
| Sex | | | | | | |
| Female | −178.9 (93.1) | −158.5 (109.1) | −175.7 (133.4) | 0 (221.5) | 152.7 (286.7) | −55.1 (129.3) |
| Ethnicity | | | | | | |
| Advantaged groups | 105.5 (71.4) | 64.6 (75.7) | 125.9 (107) | 0 (149.2) | 303.6 (267) | 124.7 (107.4) |
| Level of education | | | | | | |
| Primary | −27.2 (91) | −29.3 (95.7) | −156.5 (145.4) | 0 (187.7) | −230.9 (347.4) | −59.3 (126.1) |
| Secondary | −130.3 (100.8) | −1.3 (157) | 51.9 (198.2) | 420 (366.8) | 685.5 (418.4) | 142.5 (186.8) |
| Higher | −220.3 (139.9) | −236.1 (165.2) | −384.5 (204.8) | −420 (328.8) | −1565.5 (426.3)* | −560.1 (189)* |
| Occupational status | | | | | | |
| Unpaid employment | −119.4 (105.9) | −181.3 (105.5) | −372.8 (131.3)* | −420 (246.2) | −836.4 (312)* | −409.3 (144.7)* |
| Retired/unemployed | −269.7 (122.5)* | −303.9 (153.9)* | −196.4 (319.7) | 0 (395.9) | 156.4 (724.3) | −86.7 (239.6) |
| Marital status | | | | | | |
| Currently married | 398.5 (308.5) | −7.2 (378.8) | 600.6 (385.1) | 420 (514.8) | 1412.7 (607.8)* | 522.4 (258)* |
| Divorced/widowed/separated | 351 (320.6) | 47.6 (399.9) | 664.5 (406.1) | 0 (522.3) | 1063.6 (675) | 417.1 (276.4) |
| Ecological zone | | | | | | |
| Mountain | −189.5 (189.2) | 32.6 (248.6) | −106.9 (356.2) | −420 (325.3) | −689.1 (518.2) | −256.6 (257.4) |
| Terai | −295 (79.3)* | −290.2 (90.7)* | −423.2 (139.5)* | −840 (186.6)* | −1070.9 (309.9)* | −590.5 (132.1)* |
| Place of residence | | | | | | |
| Urban | −109.4 (85.5) | −192.4 (91.1)* | −346.7 (134.7)* | −840 (256.7)* | −532.7 (339.6) | −469.1 (147.7)* |
| Current smoker | | | | | | |
| Yes | 92.7 (74.6) | 95.9 (82.4) | 69.4 (111.8) | 0 (170.6) | −460 (293.1) | 14 (117.2) |
| Alcohol intake | | | | | | |
| Yes | 151.1 (87.3) | 238.7 (112.8)* | 233.7 (149.3) | 0 (195.9) | 40 (341.1) | 219.2 (141.5) |
| BMI | | | | | | |
| Normal weight | 37.2 (81.8) | 98.5 (95) | 208.8 (162.8) | 0 (232.1) | 229.1 (292) | 130.9 (124.8) |
| Overweight | −46.8 (106.6) | −18.3 (116.3) | −107.2 (190) | −420 (313.8) | −187.3 (337.6) | −186.8 (156.4) |
| Obese | −73.1 (195.5) | −41.1 (139.1) | −94.6 (287.8) | −420 (382.9) | −423.6 (666.9) | −185.6 (213.9) |
| Constant | 711.8 (413.9) | 1457 (488.1) | 2087.8 (566.8) | 3360 (737.4) | 5841.8 (1144.7) | 2668.5 (438.7) |

Abbreviations: BMI, body mass index; MET, metabolic equivalent; OLS, ordinary least square; PA, physical activity; TrPA, transport-related PA. Note: Adjusted for all variables in the model, values in the parenthesis are bootstrapped SEs. Reference categories are as follows: sex = male, ethnicity = disadvantaged groups, level of education = no formal education, marital status = unmarried, occupational status = paid employment, ecological zone = Hill, place of residence = rural, current smoker = no, alcohol intake = no, and BMI = underweight.
*$P < .05$.

of QR has allowed for an examination of sociodemographic differences at different points on the PA distribution. The results indicate that the correlates have dissimilar associations across the quantiles of PA distribution, suggesting that results from models such as OLS may provide a simplified understanding of patterns of participation that does not support the development of tailored interventions. Since physical inactivity is one of the established modifiable risk factors for chronic diseases, these findings may inform public health strategies to address a major component of the burden of disease in Nepal. Furthermore, this study has highlighted the importance of workplace-based interventions and the need to focus on target groups, such as people who are unemployed or retired, as their PA level is very likely to decrease in the context where occupational activities are the most dominant PA forms. The recommendations are also applicable in the case of other developing countries sharing similar socioeconomic characteristics, rates of urbanization, and PA compositions.

However, there are some limitations to consider. STEPS is a cross-sectional survey, which has used GPAQ to assess the participant's self-reported PA levels. While GPAQ is a standard instrument for measuring PA in population-level surveys, its validity and reliability against objective measures have not yet been tested in the Nepalese population. We could not examine household PA, as it was incorporated within the OPA domain in the questionnaire. Furthermore, due to the lack of data, we were not able to examine the association with other important correlates of PA, such as psychosocial and environmental variables.[42]

## Conclusion

Nearly 8 in 10 Nepalese adults aged 40–69 years were found to engage in high TPA. Occupational activities were the dominant form of PA, followed by transport-related activities. Engagement in

LtPA was found to be minimal. The correlates had dissimilar associations across the quantiles of PA distribution. Increasing age, higher education, unpaid employment, unemployment or retirement, and urban or Terai residence were associated with lower PA across all domains, and the association was stronger at the upper tails of the distribution. These factors need to be considered when designing PA promotion interventions to increase or maintain PA in different domains among adults in Nepal and countries facing similar rates of urbanization. Future studies with an objective assessment of PA, longitudinal designs, and an examination of psychosocial and environmental correlates are recommended.

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