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Profile of Daily Living Activities of Urban and Rural Older Adults: Specific Implications for Exercise Recommendations Beyond 60 Years

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Abstract

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Aging is commonly associated with decline in functional independence and Health-Related Quality of Life (HRQOL). Understanding activities of daily living (ADL) profile is therefore essential for designing individualized interventions that support mobility and independent living. Present study aimed to compare ADL profiles of urban and rural older adults to inform targeted strategies for healthy aging. A cross-sectional study was conducted among 1,000 functionally independent community-dwelling Indian older adults, aged ≥ 60 years without comorbidities. Physical activity was assessed using the Global Physical Activity Questionnaire, while ADLs were evaluated using the Barthel Index and the Lawton and Brody Scale. Descriptive and inferential statistical analyses were performed. Mean physical activity levels (MET-min/week) were 2,646 for urban older males, 1,626.2 for urban older females, 6,158.1 for rural older males and 4,914 for rural older females. Rural older adults demonstrated higher moderate and vigorous physical activity than their urban counterparts. Elderly males demonstrated higher level of physical activity than elderly females, probably due to higher overall physical function, which can enable greater engagement in moderate- to vigorous-intensity activities. However, 20% of individuals aged ≥85 years reported no physical activity. Across both settings, stair negotiation and travelling were the most affected ADLs. Although overall physical activity levels met WHO recommendations, older adults showed a progressive decline in stair negotiation ability, with the sharp decline between75-84 and >/85 years. Impaired stair climbing reduces mobility confidence, increases fear of falling, restricts outdoor participation, and contributes to social isolation and loss of independence. Hence rehabilitation strategies need to extend beyond gait training to include targeted stair training, alongside age-friendly infrastructure, to retain outdoor mobility, social participation and independence in older adults.

Keywords: Activity Profile, rehabilitation strategies, older adults

Introduction

The global population is aging at an unprecedented rate. According to the World Health Organization (WHO, 2021), the number of people aged 60 years and above is expected to reach 2.1 billion by 2050, doubling from 1 billion in 2020. India, home to one of the largest elderly populations, is also experiencing this demographic transition. The proportion of older adults (aged 60 and above) in India is projected to rise from 8.6% in 2011 to 13.8% by 2031, amounting to approximately 194 million individuals.[1] Rapid population aging highlights the need to

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maintain and optimize functional independence among older adults, as it is strongly associated with overall health, well-being and Health-Related Quality of Life.

However, advancing age is often accompanied by age-related conditions. Although age-related conditions are not always classified as diseases, they can still lead to decline in physical function (e.g. reduced walking ability, increased risk of falls and incoordination), limitation in performing day to day activities and reduced Health-Related Quality of Life and overall well-being. Such functional abilities are essential for maintaining autonomy in daily life.

Functional capacity is commonly evaluated using two reliable and valid tools: Basic Activities of Daily Living (BADLs) and Instrumental Activities of Daily Living (IADLs). The BADLs encompass essential self-care tasks such as bathing, dressing, eating, toileting and basic mobility within the house.[2] In contrast, IADLs involve more complex activities required for independent living, including managing finances, transportation, shopping, and meal preparation.[3] Together, these measures provide a comprehensive understanding of an individual's level of independence and risk of dependency.

A key modifiable determinant influencing the ability to perform BADLs and IADLs is physical activity, defined as any bodily movement produced by skeletal muscles that requires energy expenditure.[4] Regular engagement in physical activity helps to maintain muscle strength, improve balance, reduce the risk of falls and frailty, and maintain functional independence.[5] Level of engagement in physical activity and physical functional capacity vary across populations due to environmental and sociodemographic differences, particularly between urban and rural settings.

Similarly, level of engagement in physical activity among older adults residing in Maharashtra differ. Maharashtra is one of India's most populous and socioeconomically diverse states. Approximately 45–50% of the state's population in Maharashtra resides in urban areas, while the remaining population lives in rural settings.[6] But these two settings are different in terms of lifestyle, access to resources, and living conditions which influence level of engagement in physical activity. Older adults in rural areas are often engaged in physically demanding work such as agriculture and manual labor, which may lead to higher levels of habitual physical activity. However, they may also face challenges such as limited access to healthcare, lower socioeconomic status and poor nutrition.[7,8] Whereas, urban older adults, have better healthcare access and infrastructure, which supports early diagnosis and management of health conditions. Despite having better healthcare facilities, urban populations are more likely to have sedentary lifestyles due to reduced occupational and daily physical demands. Sedentary lifestyle among urban older adults contributes to increased risk of non-communicable diseases such as obesity, diabetes, and cardiovascular conditions and lower overall physical activity compared to rural populations.

Despite these differences, there is limited literature informing the physical activity profile of urban and rural older adults. Present gap highlights the need to assess the profile of daily living activities in community-dwelling older adults aged 60 years and above, who live independently in private homes rather than in institutional care settings such as hospitals or nursing homes.[9]

Early screening of daily living activity profile in older adults can guide targeted exercise interventions based on individual needs and impairments. In addition, timely interventions and environmental modifications, such as assistive devices, barrier-free access, and age-friendly infrastructure, can help older adults maintain functional independence for a longer period. Therefore, the present study aimed to compare ADL profiles of urban and rural community-dwelling older adults residing in Maharashtra, India to inform targeted strategies for healthy aging.

Methods

Ethical approval was obtained from the Institutional Ethical Committee for Research on Human Participants (Ethical approval letter number: MGMIHS/RES/02/2022/365) prior to the commencement of the study. The trial was registered at Clinical Trial Registry of India (Registration number: CTRI/2021/09/036613). The study adopted a cross-sectional study design.

Participants

The sample size was calculated using Slovin's formula for cross-sectional studies. based on an Indian elderly population of 9,900,000 a 95% confidence level and a 5% margin of error, the estimated sample size was 400. After adjusting for a 10% anticipated dropout, the sample size was increased to 440 per setting. A final sample of 500 participants per setting was included in the present study to ensure adequate representation of the population (n=500 urban and n=500 rural older adults, Total=1000 older adults).

Functionally independent, community-dwelling older adults aged ≥ 60 years were included in the study if they were able to stand independently for at least 90 seconds and walk 50 meters indoors and outdoors, with or without a walking aid. Older adults were also required to follow visual, verbal, and auditory commands and communicate effectively in Hindi, Marathi, or English. Older adults with diagnosed age-related conditions, such hyperthyroidism, urinary incontinence, Grade 1 hypertension, diabetes, sub-acute or chronic osteoarthritis with mild pain (pain on numerical rating scale: 4/10), osteoporosis, partial hearing or visual impairment and mild cognitive impairment (Mini-Cog score 1/5) were included in the study.

Exclusion criteria were defined in accordance with the World Health Organization's International Classification of Diseases, 10th Revision (ICD-10). Older adults with diagnosed neurological, musculoskeletal, connective tissue, circulatory, respiratory, metabolic, endocrine, genitourinary, visual or auditory disorders, as well as those presenting with severe joint pain, fractures or structural deformities that could impair independent sitting, standing, walking or stair negotiation, were excluded from the study.

Based on inclusion and exclusion criteria 1000 community-dwelling older adults were recruited in the study.

All participants signed a written informed consent form in accordance with the guidelines of the Declaration of Helsinki before the commencement of the assessment. This research was carried out fully in accordance with the ethical standards of the International Journal of Exercise Science.[10]

Protocol

Physical activity levels of urban and rural older adults were assessed using the Global Physical Activity Questionnaire (GPAQ), administered through a paper-and-pen format via face-to-face interviews. The GPAQ evaluated physical activity across three domains: work-related activity, travel to and from places, and recreational activities by capturing the frequency and duration of activities performed per week, along with time spent in sedentary behavior. Activity intensity was expressed in metabolic equivalents (METs), with 4 METs assigned to moderate-intensity activities and 8 METs to vigorous-intensity activities in accordance with established GPAQ guidelines, reflecting higher energy expenditure compared with resting states.[11,12] Recreational activities were further classified into moderate and vigorous intensity based on Centers for Disease Control and Prevention guidelines. For example, brisk walking, light cycling, household chores such as sweeping or washing clothes, gardening, weeding, light farming tasks like sowing seeds etc were considered moderate-intensity activities (4 METs). While running, fast cycling, swimming, aerobic dancing, and heavy farming work such as ploughing, carrying heavy loads, or digging fields etc. were considered vigorous-intensity activities (8 METs).[13] Basic activities of daily living were assessed using the Barthel Index, which evaluated performance in feeding, bathing, grooming, dressing, bowel and bladder control, toilet use, transfers, mobility, and stair use, with each activity scored as completely dependent, requiring assistance, or independent. Scores across the ten activities were summed to yield a total score out of 100 and categorized into levels of independence ranging from total dependence to full independence.[14] Instrumental activities of daily living were assessed using the Lawton and Brody IADL Scale, which measured independent performance in tasks such as telephone use, shopping, food preparation, housekeeping, laundry, transportation, medication management, and financial handling, with each item scored dichotomously as dependent or independent[15]

9-step climb test.

Stair-climbing ability, lower extremity muscle strength and endurance were evaluated using the 9-step climb test. The test required participants to ascend and descend flight of nine steps (16–17 cm height), with performance quantified by the time taken to complete the task.[16]

Statistical Analysis

Physical activity scores and activity of daily living scores were reported as mean and standard deviation. Independent sample t-test was used to compare the physical activity of urban and rural older adults among males and females. Level of significance was set at ($p \leq 0.05$). Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) software for Windows version 24.

To analyze the difference in physical activity level between gender and setting a standardized mean difference was calculated using Cohen's d. Since the groups were assumed to have homogeneous variances, the pooled standard deviation was utilized as the standardizer.

Following Cohen's d calculation, the effect size was interpreted as small ($d = 0.20–0.49$), medium ($d = 0.50–0.79$), or large ($d = \geq 0.80$), allowing for a clear assessment of the practical impact of the observed results.

Results

Table 1. Physical activity score of older adults stratified according to stratified age group, gender and setting.

Total Global Physical activity Score (MET/ Week)	**Urban Males (UM) (n=250)**	**Urban Females (UF) (n=250)**	**Independent sample t test Comparison between UM and UF**	**Cohen's d Size of Difference (UM vs UF)**	**Rural Males (RM) (n=250)**	**Rural Females (RF) (n=250)**	**Independent sample t test Comparison between RM and RF**	**Cohen's d Size of Difference (RM vs RF)**	**Independent sample t test Comparison between UM and RM**	**Cohen's d Size of Difference (UM vs RM)**	**Independent sample t test Comparison between UF and RF**	**Cohen's d Size of Difference (UF vs RF)**
	Mean (SD)	**Mean (SD)**	**p value (≤ 0.05)**		**Mean (SD)**	**Mean (SD)**	**p value (≤ 0.05)**		**p value (≤ 0.05)**		**p value (≤ 0.05)**	
60-74	1437.2 (138.1)	1204.3 (808.6)	≤ 0.05 *	0.40 (small)	7382 (190.1)	5040 (351.9)	≤ 0.05 *	8.28 (Large)	≤ 0.05 *	-35.78 (Large)	≤ 0.05 *	-6.15 (Large)
75-84	1286.3 (102.3)	860 (264.3)	≤ 0.05 *	2.13 (Large)	4587 (121.1)	1464 (846.3)	≤ 0.05 *	5.17 (Large)	≤ 0.05 *	-29.45 (Large)	≤ 0.05 *	-0.96 (Large)
Moderate intensity activities												
Moderate work-related activity (MET/ Week)	**Urban Males (UM) (n=250)**	**Urban Females (UF) (n=250)**	**Independent sample t test Comparison between UM and UF**	**Cohen's d Size of Difference (UM vs UF)**	**Rural Males (RM) (n=250)**	**Rural Females (RF) (n=250)**	**Independent sample t test Comparison between RM and RF**	**Cohen's d Size of Difference (RM vs RF)**	**Independent sample t test Comparison between UM and RM**	**Cohen's d Size of Difference (UM vs RM)**	**Independent sample t test Comparison between UF and RF**	**Cohen's d Size of Difference (UF vs RF)**
	Mean (SD)	**Mean (SD)**	**p value (≤ 0.05)**		**Mean (SD)**	**Mean (SD)**	**p value (≤ 0.05)**		**p value (≤ 0.05)**		**p value (≤ 0.05)**	**Mean (SD)**
60-74	826.1 (112.6)	703.3 (148.5)	≤ 0.05 *	0.93 (Large)	1263.4 (836.2)	986.4 (525.7)	≤ 0.05 *	0.40 (Small)	≤ 0.05 *	-0.73 (Medium)	≤ 0.05 *	-0.73 (Medium)
75-84	662.3 (313.6)	603.4 (162.4)	≤ 0.05 *	0.22 (Small)	952.8 (536.3)	875.7 (483.3)	≤ 0.05 *	0.15 (Small)	≤ 0.05 *	-0.62 (Medium)	≤ 0.05 *	-0.76 (Medium)
Moderate recreational activity (MET/ Week)	**Urban Males (UM) (n=250)**	**Urban Females (UF) (n=250)**	**Independent sample t test Comparison between UM and UF**	**Cohen's d Size of Difference (UM vs UF)**	**Rural Males (RM) (n=250)**	**Rural Females (RF) (n=250)**	**Independent sample t test Comparison between RM and RF**	**Cohen's d Size of Difference (RM vs RF)**	**Independent sample t test Comparison between UM and RM**	**Cohen's d Size of Difference (UM vs RM)**	**Independent sample t test Comparison between UF and RF**	**Cohen's d Size of Difference (UF vs RF)**
	Mean (SD)	**Mean (SD)**	**p value (≤ 0.05)**		**Mean (SD)**	**Mean (SD)**	**p value (≤ 0.05)**		**p value (≤ 0.05)**		**p value (≤ 0.05)**	
60-74	1004.7 (214.1)	834.2 (129.3)	≤ 0.05 *	0.96 (Large)	0	0	-	-	-	-	-	-

75-84	769 (326.4)	612.4 (148.3)	≤ 0.05 *	0.61 (Medium)	0	0	-	-	-	-	-	-
Vigorous intensity activities												
Vigorous intensity work-related activity (MET/Week)	**Urban Males (UM) (n=250)**	**Urban Females (UF) (n=250)**	**Independent sample t test Comparison between UM and UF**	**Cohen's d Size of Difference (UM vs UF)**	**Rural Males (RM) (n=250)**	**Rural Females (RF) (n=250)**	**Independent sample t test Comparison between RM and RF**	**Cohen's d Size of Difference (RM vs RF)**	**Independent sample t test Comparison between UM and RM**	**Cohen's d Size of Difference (UM vs RM)**	**Independent sample t test Comparison between UF and RF**	**Cohen's d Size of Difference (UF vs RF)**
	Mean (SD)	**Mean (SD)**	**p value (≤ 0.05)**		**Mean (SD)**	**Mean (SD)**	**p value (≤ 0.05)**		**p value (≤ 0.05)**		**p value (≤ 0.05)**	
60-74	0	0	-	-	3360 (634.5)	2880 (846.3)	≤ 0.05 *	0.64 (Medium)	-	-	-	-
75-84	0	0	-	-	2400 (831.9)	1920 (863.4)	≤ 0.05 *	0.57 (Medium)	-	-	-	-
Vigorous intensity recreational activity (MET/Week)	**Urban Males (UM) (n=250)**	**Urban Females (UF) (n=250)**	**Independent sample t test Comparison between UM and UF**	**Cohen's d Size of Difference (UM vs UF)**	**Rural Males (RM) (n=250)**	**Rural Females (RF) (n=250)**	**Independent sample t test Comparison between RM and RF**	**Cohen's d Size of Difference (RM vs RF)**	**Independent sample t test Comparison between UM and RM**	**Cohen's d Size of Difference (UM vs RM)**	**Independent sample t test Comparison between UF and RF**	**Cohen's d Size of Difference (UF vs RF)**
	Mean (SD)	**Mean (SD)**	**p value (≤ 0.05)**		**Mean (SD)**	**Mean (SD)**	**p value (≤ 0.05)**		**p value (≤ 0.05)**		**p value (≤ 0.05)**	
60-74	0	0	-	-	0	0	-	-	-	-	-	-
75-84	0	0	-	-	0	0	-	-	-	-	-	-
Travel	**Urban Males (UM) (n=250)**	**Urban Females (UF) (n=250)**	**Independent sample t test Comparison between UM and UF**	**Cohen's d Size of Difference (UM vs UF)**	**Rural Males (RM) (n=250)**	**Rural Females (RF) (n=250)**	**Independent sample t test Comparison between RM and RF**	**Cohen's d Size of Difference (RM vs RF)**	**Independent sample t test Comparison between UM and RM**	**Cohen's d Size of Difference (UM vs RM)**	**Independent sample t test Comparison between UF and RF**	**Cohen's d Size of Difference (UF vs RF)**
	Mean (SD)	**Mean (SD)**	**p value (≤ 0.05)**		**Mean (SD)**	**Mean (SD)**	**p value (≤ 0.05)**		**p value (≤ 0.05)**		**p value (≤ 0.05)**	
60-74	372.5 (263.1)	234.5 (72.3)	≤ 0.05 *	0.72 (Medium)	815.3 (351.9)	749.4 (161)	≤ 0.05 *	0.24 (Small)	≤ 0.05 *	-1.43 (Large)	≤ 0.05 *	-4.13 (Large)
75-84	180.5 (127.3)	106 (92.6)	≤ 0.05 *	0.67 (Medium)	748.3 (462.4)	612.1 (253.5)	≤ 0.05 *	0.37 (Small)	≤ 0.05 *	-1.67 (Large)	≤ 0.05 *	-2.65 (Large)

Sedentary Behavior (minutes/ day)	Urban Males (UM) (n=250)	Urban Females (UF) (n=250)	Independent sample t test Comparison between UM and UF	Cohen's d Size of Difference (UM vs UF)	Rural Males (RM) (n=250)	Rural Females (RF) (n=250)	Independent sample t test Comparison between RM and RF	Cohen's d Size of Difference (RM vs RF)	Independent sample t test Comparison between UM and RM	Cohen's d Size of Difference (UM vs RM)	Independent sample t test Comparison between UF and RF	Cohen's d Size of Difference (UF vs RF)
	Mean (SD)	Mean (SD)	p value (≤ 0.05)		Mean (SD)	Mean (SD)	p value (≤ 0.05)		p value (≤ 0.05)		p value (≤ 0.05)	
60-74	493 (325.2)	324.1 (114)	≤ 0.05 *	0.69 (Medium)	364.1 (114)	292.4 (180)	≤ 0.05 *	0.48 (Small)	≤ 0.05 *	0.53 (Medium)	≤ 0.05 *	0.21 (Small)
75-84	562.3 (26.7)	480.6 (264.1)	≤ 0.05 *	0.44(Small)	453.2 (135)	382.1 (157.2)	≤ 0.05 *	0.49 (Small)	≤ 0.05 *	1.12 (Large)	≤ 0.05 *	0.45 (Small)

UM: Urban males, UF: Urban Females, RM: Rural Males, RF: Rural Females, (-): Not Computable, ≤ 0.05*: Statistically significant difference, ≥ 0.05: not statistically significant difference

Table 2. Basic Activity of daily living score of urban and rural older adults according to according to stratified age group, gender and setting.

Barthel score: Basic activity of daily living

Age group (year)	Urban Males (UM) (n=250)	Urban Females (UF) (n=250)	Independent sample t test Comparison between UM and UF	Cohen's d Size of Difference (UM vs UF)	Rural Males (RM) (n=250)	Rural Females (RF) (n=250)	Independent sample t test Comparison between RM and RF	Cohen's d Size of Difference (RM vs RF)	Independent sample t test Comparison between UM and RM	Cohen's d Size of Difference (UM vs RM)	Independent sample t test Comparison between UF and RF	Cohen's d Size of Difference (UF vs RF)
	Mean (SD)	Mean (SD)	p value (≤ 0.05)		Mean (SD)	Mean (SD)	p value (≤ 0.05)		p value (≤ 0.05)		p value (≤ 0.05)	
60-74	97 (1)	94 (9.9)	≤ 0.05 *	0.43 (Small)	98.2	97.3 (1.1)	≤ 0.05 *	0.86 (Large)	≥ 0.05	-1.14 (Large)	≥ 0.05	-0.47 (Medium)
75-84	95 (2.4)	93.8 (2.4)	≤ 0.05 *	0.50 (Medium)	95.5 (7.1)	94.3 (4.2)	≥ 0.05	0.21 (Small)	≥ 0.05	-0.09 (Small)	≥ 0.05	-0.15 (Small)
≥85	93.2 (5.7)	92 (5.1)	≥ 0.05	0.22 (Small)	94 (6.5)	93.2 (2.6)	≥ 0.05	0.16 (Small)	≥ 0.05	-0.13 (Small)	≥ 0.05	-0.30 (Small)

UM: Urban males, UF: Urban Females, RM: Rural Males, RF: Rural Females, ≤ 0.05*: Statistically significant difference, ≥ 0.05: not statistically significant difference

Table 1 presents the mean physical activity score of urban and rural older adults. Physical activity (moderate and vigorous intensity activities and travel activity) of physically independent rural males and females was higher than age-matched urban males and females (p value ≤ 0.01)

A linear decline was observed in the physical activity with advancing age in both urban and rural older adults (Linear trend: p value ≤ 0.01). Total physical activity of young-old adults (60 to74 years) was higher than old-old adults (75 to 84 years) in urban as well as rural setting. Total physical activity of young-old urban males was 11% higher than old-old urban males. Similarly, total physical activity of young-old urban females was 33.3% higher than old-old urban females.

In rural setting, total physical activity of young-old rural males was 47% higher than old-old rural males. Similarly, total physical activity of young-old rural females was 91% higher than old-old rural females.

Physical activity of male older adults was higher than female older adults in both the settings (p value ≤ 0.01). On, the other hand, older males had higher sedentary behavior than older females in both the settings.

Rural older adults aged 60 to 75 years were not engaged in moderate or vigorous intensity recreational activities. Whereas, urban older adults aged 60 to 75 years were not engaged in vigorous work-related and recreational activities.

Activity of daily living profile of total 100 individuals aged > 85 years was assessed (Females: n=50, Males: n=50). All older adults aged > 85 years (100%) did not participate in moderate and vigorous intensity work-related or recreational activities irrespective of gender.

Cohen's effect size analysis demonstrated that the observed differences in physical activity were not only statistically significant but were also meaningful in terms of functioning. Urban males reported higher total physical activity, moderate work-related and recreational activity, travel activity and sedentary time than urban females, with size of difference ranging from small to large (d ≈ 0.2–0.8+), and particularly large size of difference (d ≥ 0.8) for total physical activity and moderate recreational activity. In rural settings, males similarly demonstrated higher total physical activity, moderate and vigorous work-related activity, and travel activity than rural females, with medium to large size of difference (d ≈ 0.5–0.8+), indicating substantial gender-based disparities. Comparisons between urban and rural males revealed consistently large size of difference (d ≥ 0.8) across all physical activity domains, reflecting markedly higher activity levels among rural males and emphasizing strong setting-related differences. Likewise, rural females demonstrated significantly higher total physical activity, moderate work-related activity, and travel activity than urban females, with medium to large size of difference (d ≈ 0.5–0.8+). Collectively, these findings confirm that both gender and residential setting exert strong and clinically relevant influence on physical activity patterns in older adults, with rural residence and male gender associated with substantially higher activity levels.

Table 2 displays the basic activity of daily living findings. Urban (100%) and rural older adults (100%) were able to independently perform basic activities such as feeding, bathing, grooming, bowel and bladder, toileting, mobility on level surface and transfers. Whereas, stair ascent and descent was the most limited basic activity of daily living in urban and rural older adults. Rural

Table 3. 9 step climb test score of urban and rural older adults according to stratified age group, gender and setting.

Time taken to ascent and descent 9 steps (second)												
Age group (year)	**Urban Males (UM) (n=250)**	**Urban Females (UF) (n=250)**	**Comparison of Time taken to ascent and descent 9 steps between UM and UF Independent t-test**	Cohen's d Size of Difference (UM vs UF)	**Rural Males (RM) (n=250)**	**Rural Females (RF) (n=250)**	**Comparison of Time taken to ascent and descent 9 steps between RM and RF Independent t-test**	Cohen's d Size of Difference (RM vs RF)	**Comparison of Time taken to ascent and descent 9 steps between UM and RM Independent t-test**	Cohen's d Size of Difference (UM vs RM)	**Comparison of Time taken to ascent and descent 9 steps between UF and RF Independent t-test p value**	Cohen's d Size of Difference (UF vs RF)
	Mean (SD)	**Mean (SD)**	**p value**		**Mean (SD)**	**Mean (SD)**	**p value**		**p value**		**p value (≤ 0.05)**	
60-74	14.2 (3.1)	16.9 (6.9)	≤ 0.05 *	-0.50 (Medium)	11.6 (7.1)	15.4 (8.3)	≤ 0.05 *	-0.49 (Medium)	≤ 0.05 *	0.47 (Medium)	≤ 0.05 *	0.20 (Small)
75-84	17.9 (4.6)	20.1 (8.2)	≤ 0.05 *	-0.33 (Small)	16.3 (6.2)	18.5 (3.6)	≤ 0.05 *	-0.44 (Medium)	≤ 0.05 *	0.29 (Small)	≤ 0.05 *	0.25 (Small)
≥85	26.4 (2.5)	29.2 (8.4)	≤ 0.05 *	-0.45 (Medium)	23.3 (4.8)	25.3 (4.7)	≤ 0.05 *	-0.42 (Medium)	≤ 0.05 *	0.81 (Large)	≤ 0.05 *	0.57 (Medium)
ANOVA (p value≤ 0.05)	≤ 0.05 *	≤ 0.05 *			≤ 0.05 *	≤ 0.05 *						
Linear trend (p value ≤ 0.01)	≤ 0.01 *	≤ 0.01 *	-		≤ 0.01 *	≤ 0.01 *	-		-		-	

UM: Urban males, UF: Urban Females, RM: Rural Males, RF: Rural Females, ≤ 0.05*: Statistically significant difference, ≥ 0.05: not statistically significant difference

Table 3 presents 9 step climb test score of urban and rural older adults
Age-Related Decline.
Across all categories (urban/rural, male/female), there was a clear trend of increasing time taken to ascend steps as age increases, reflecting a decline in physical mobility and strength with advancing age.
Gender Differences.

older adults exhibited higher limitation in stair ascent and descent compared to age-matched urban older adults. In urban setting, 8% urban older males and 23% of urban older females reported difficulty in stair ascent and descent. In rural setting, 21% of rural older males and 15.2% of rural older females reported difficulty in stair ascent and descent. Among all the instrumental activities, travelling was the most limited activity in both urban and rural older adults. Individuals aged ≥75 years demonstrated higher limitation in activity of daily living findings compared to individuals aged 60 to 74 years.

Cohen's size of difference analysis revealed that differences in basic activities of daily living (ADL) performance ranged from small to medium across gender and settings.

Urban and rural females took longer time to ascend the steps compared to age-matched urban and rural males suggesting that older females demonstrated lesser lower extremity strength/ mobility.

Urban vs. Rural Differences.

Rural males and females took longer time to complete 9 step flight test than age-matched urban males and females in all age groups.
Cohen's size of difference analysis revealed that differences in stair negotiation performance ranged from small to medium across gender and settings.

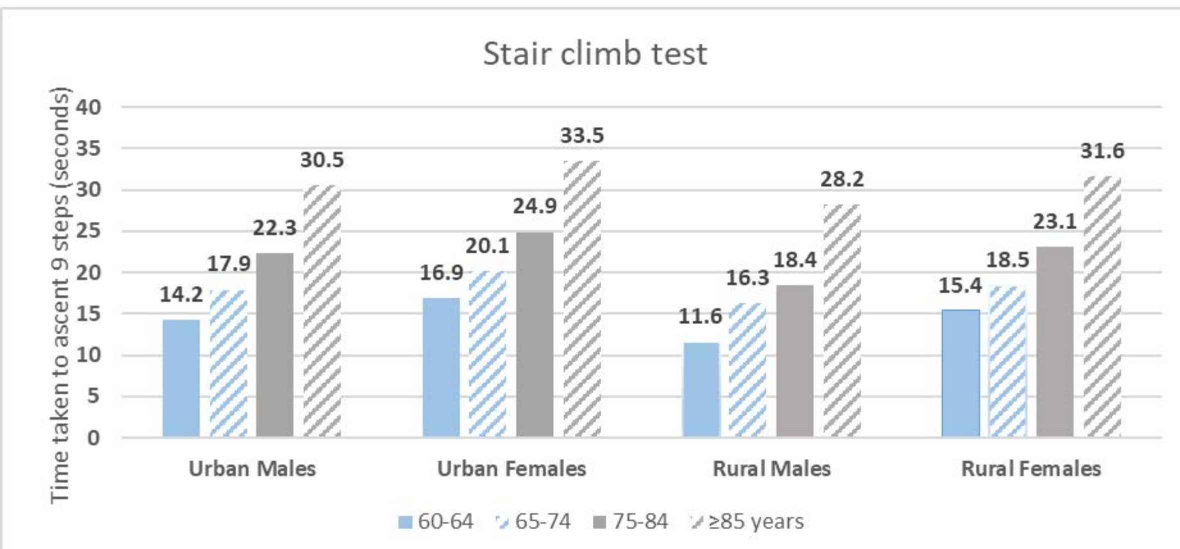

Figure 1. Graphical presentation of 9 step climb test score of urban and rural older adults according to stratified age group, gender and setting.

Discussion

Present study aimed to compare the ADL profiles of functionally independent community-dwelling urban and rural older adults without comorbidities to inform evidence-based exercise planning strategies for healthy aging.

Level of engagement in physical activity differed between urban and rural older adults, with rural older adults reporting higher total level of engagement in physical activity than their age-matched urban counterparts. Present difference is largely attributable to their regular engagement in moderate- to vigorous-intensity occupational activities, such as farming, which are more physically demanding. Farming work-related tasks require greater upper and lower extremity strength, involve sustained whole-body effort, and result in higher energy expenditure. In contrast, urban older adults were more engaged in moderate- to vigorous-intensity recreational activities, likely due to retirement and more leisure time. In both groups, physical activity declined with increasing age.

Although rural older adults reported higher level of engagement in physical activities than their age-matched urban older adults, their physical functional capacity was comparatively lower than that of age-matched urban older adults. One possible explanation for this finding is that a majority of the rural participants belonged to lower socioeconomic strata, which may be associated with inadequate nutritional intake and consequent loss of skeletal muscle mass.[17] Loss of muscle mass is well documented to contribute to reduction in muscle strength and muscle mass. The combined decline in muscle mass and strength adversely affects overall physical performance in older adults.[17,18]

The World Health Organization recommends that older adults should engage in at least 150–300 minutes of moderate-intensity physical activity or 75–150 minutes of vigorous-intensity physical activity per week.[19] In the present study, both urban and rural older adults aged 60 to 84 years met these recommended physical activity levels through their routine daily activities. In contrast, all (100%) males and females aged ≥85 years reported no engagement in moderate and vigorous work-related or recreational activities irrespective of gender, indicating a marked age-related decline in physical activity engagement. On plausible explanation for this finding is that in comparison to the young-old (60–69 years) and middle-old adults (70–84 years), the oldest-old (≥85 years) often experience greater reduction in muscle strength and endurance, balance impairments and musculoskeletal pain, which limit their ability to perform both daily and recreational activities. Chronic health conditions, such as cardiovascular disease, arthritis or respiratory problems, are more prevalent in this age group, further restricting movement. Cognitive decline and fear of falling also contribute to reduced engagement in physical activity. In addition, old-old adults (≥85 years) may face environmental and social barriers, including lack of access to safe walking areas, limited support from caregivers, or living alone, all of which make participation in routine or structured physical activity more difficult than in young and middle aged older adults.

The level of physical activity among older males was consistently higher than that of older females. Present difference may reflect both physiological and sociocultural factors. Higher levels of physical activity are generally associated with greater muscle strength, balance, and overall functional capacity in older adults. Older males often have higher muscle mass, cardiorespiratory endurance, and strength, which enable them to engage greater in moderate- to vigorous-intensity activities, including both work-related and recreational tasks. In contrast, older females typically exhibit lower baseline physical function, which may limit their ability or confidence to participate in physically demanding activities.

Despite meeting WHO recommendations, older adults continued to experience difficulty with high-demand tasks such as climbing up and down stairs. The ability to climb stairs declined with advancing age. Rural older adults aged 60-74 years had 42.3% higher stair climb ability than rural older adults aged ≥ 75 years. Similarly, urban older adults aged 60-74 years had 41.4% higher stair climb ability than urban older adults aged ≥ 75 years. Present findings indicates that general physical activity does not fully develop the task-specific strength, balance, and motor control needed for stair negotiation. Previous biomechanical studies also report that stair ascent and descent place high loads on the knee and ankle joints, often pushing older adults close to their maximum strength capacity.[20,21] To maintain stability while using stairs, older adults commonly use compensatory strategies such as slowing their speed, widening their step width, using handrails for support, shifting more load to the hip muscles, reducing ankle motion, placing the whole foot on the step instead of the forefoot, and taking shorter steps.[22] Real-world environments further increase the challenge, as older adults need to navigate uneven surfaces, variable step heights and stairs at building entrances.

Research from a wide range of countries are similar to these findings, reporting that environmental barriers strongly limit older adults' outdoor mobility. In Europe, traffic dangers and uneven streets have been reported to reduce older adults' willingness to walk outdoors.[23,24] Finnish studies have linked obstacles such as steep entrances, high doorsteps, and poorly maintained paths to lower mobility and worse health outcomes.[25,26] In China, older adults living in buildings without elevators are less likely to leave home because climbing stairs is unavoidable.[28]Similarly, in Brazil, streets with slopes and steps make walking difficult for the elderly. Moreover, several studies have reported stairs, broken sidewalks, and rough surfaces as major hindrances to outdoor mobility even among physically active older adults.[23-27]

Limitations in stair ascent and descent have significant implications for older adults living in urban environments, where stairs are embedded in everyday mobility routes including access to public transport stations, pedestrian overpasses, commercial buildings, and residential complexes. Difficulty negotiating stairs can therefore act as a direct barrier to outdoor travel, reducing the feasibility of routine activities that require moving through multi-level infrastructure. Functional challenges often diminish mobility confidence and heightens fear of falling, prompting older adults to avoid travel and thereby limiting social participation and engagement.[27] Such withdrawal increases the risk of social isolation, a known contributor to poorer health outcomes and reduced health-related quality of life among older adults.[28]

Furthermore, traveling independently was identified as the most significant instrumental activity limitation among urban elderly individuals. Limitation in travelling coupled with limited stair ascent/descent, creates a practical and clinical bottleneck that limits access to healthcare, groceries, public transport, and social activities. Present finding aligns with population studies showing an age-related rise in specific IADL limitations and reduced life-space mobility.[29]

Together, these findings imply three actionable clinical responses: (a) routine screening of urban older patients for independent travel ability and stair negotiation; (b) early implementation of task-specific interventions with meticulous attention to psychological contributors such as fear of falling; and (c) age-friendly urban design interventions, including ramps, handrails, and smooth walkways, to overcome environmental barriers and help older people remain active within their communities.

Present study has following limitations that should be considered when interpreting the findings. First, convenience sampling may limit the generalizability of the results to the broader older adult population, particularly those with lower functional capacity or institutionalized individuals who were not included. Second, physical activity was assessed using a self-reported questionnaire, which may be subject to recall bias and over- or underestimation of activity levels. Third, although standardized tools were used to assess ADLs and stair-climbing performance, environmental factors such as stair design, surface conditions, and availability of handrails were not controlled, which could have influenced performance. Finally, psychosocial factors such as fear of falling, motivation, and social support were not directly measured, despite their potential influence on stair negotiation and outdoor mobility. Future longitudinal studies incorporating objective activity measures and psychosocial assessments are warranted to address these limitations.

Present study reports findings are based on a sample of older adults from urban and rural settings from two districts of one state in India. Therefore the present study findings cannot be generalized to older adults from other countries across the globe.

Rural older adults were more physically active than urban older adults. Whereas, 20% of males as well as females aged ≥85 years in both settings reported no engagement in recreational and work-related activities. Despite meeting WHO recommendations through regular participation in physical activity, stair negotiation and travelling outdoor emerged as the most limited activities of daily living, particularly in individuals aged ≥ 75 years. Present findings highlight the importance of incorporating targeted stair-specific training and age-friendly environmental modifications in rehabilitation to maintain independence and participation in older adults.

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References

1. Ministry of Health and Family Welfare, Government of India. National Programme for the Health Care of the Elderly (NPHCE). 2022.

2. Katz S, Ford AB, Moskowitz RW, Jackson BA, Jaffe MW. Studies of illness in the aged. The index of ADL: a standardized measure of biological and psychosocial function. *JAMA*. 1963;185(12):914-919. https://doi.org/10.1001/jama.1963.03060120024016

3. Lawton MP, Brody EM. Assessment of older people: self-maintaining and instrumental activities of daily living. *Gerontologist*. 1969;9(3):179-186. https://doi.org/10.1093/geront/9.3_Part_1.179

4. Caspersen CJ, Powell KE, Christenson GM. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Rep*. 1985;100(2):126-131.

5. Paterson DH, Warburton DER. Physical activity and functional limitations in older adults: a systematic review related to Canada's Physical Activity Guidelines. *Int J Behav Nutr Phys Act*. 2010;7:38. https://doi.org/10.1186/1479-5868-7-38

6. Maharashtra Population 2026 | Sex Ratio & Literacy rate 2026. Census2011.co.in. Published 2026.

7. Das M, Pal S, Ghosh A. Rural urban differences of cardiovascular disease risk factors in adult Asian Indians. *American Journal of Human Biology*. 2008;20(4):440-445. https://doi.org/https://doi.org/10.1002/ajhb.20757

8. Chowdhury R, Ramond A, O'Keeffe LM, et al. Environmental toxic metal contaminants and risk of cardiovascular disease: systematic review and meta-analysis. *BMJ*. 2018:k3310. https://doi.org/https://doi.org/10.1136/bmj.k3310

9. Vermeulen J, Neyens JCL, van Rossum E, Spreeuwenberg MD, de Witte LP. Predicting ADL disability in community-dwelling elderly people using physical frailty indicators: a systematic review. *BMC Geriatrics*. 2011;11:33. https://doi.org/10.1186/1471-2318-11-33

10. Navalta JW, Stone WJ, Lyons TS. Ethical issues relating to scientific discovery in exercise science. *Int J Exerc Sci.* 2019;12(1):1-8. https://doi.org/10.70252/eycd6235

11. Bonnefoy M, Kostka T, Berthouze SE, Lacour JR. Validation of a physical activity questionnaire in the elderly. *Eur J Appl Physiol Occup Physiol.* 1996;74(6):528-533. https://doi.org/10.1007/BF02376768

12. World Health Organization. Global Physical Activity Questionnaire (GPAQ). Accessed 2022.

13. Centers for Disease Control and Prevention. Physical activity for adults: an overview. Published 2023.

14. Harale M, Oommen A, Faruqi AA, et al. Cross-sectional study comparing activities of daily living using Barthel Index within a geriatric population having non-communicable diseases. *Cureus.* 2024;16(7):e65046. https://doi.org/10.7759/cureus.65046

15. Graf C. The Lawton instrumental activities of daily living (IADL) scale. *Medsurg Nurs.* 2009;18(5):315-316.

16. Bean JF, Kiely DK, Herman S, et al. The relationship between leg power and physical performance in mobility-limited older people. *J Am Geriatr Soc.* 2002;50(3):461-467. https://doi.org/10.1046/j.1532-5415.2002.50111.x

17. Carbone JW, Pasiakos SM. Dietary protein and muscle mass: translating science to application and health benefit. *Nutrients.* 2019;11(5):1136. https://doi.org/10.3390/nu11051136

18. Deutz NEP, Ashurst I, Ballesteros MD, et al. The underappreciated role of low muscle mass in the management of malnutrition. *J Am Med Dir Assoc.* 2019;20(1):22-27. https://doi.org/10.1016/j.jamda.2018.11.021

19. World Health Organization. *WHO Guidelines on Physical Activity and Sedentary Behaviour.* Geneva, Switzerland: World Health Organization; 2020. Accessed January 1, 2026. https://www.who.int/publications/i/item/9789240015128

20. Silder A, Besier TF, Delp SL. The biomechanical functional demand placed on knee and hip muscles of older adults during stair ascent and descent. *J Biomech.* 2011;44(9):1891-1896. https://doi.org/10.1016/j.jbiomech.2011.04.032

21. Mian OS, Thom JM, Ardigo LP, Narici MV, Minetti AE. Biomechanical demands at the knee during stair ascent and descent: plateau or decline with ageing? *Gait Posture.* 2007;25(3):462-469. https://doi.org/10.1016/j.gaitpost.2006.06.002

22. Buckley JG, Spanjaard M, Mazzà C, van der Linden ML, Lacey MG, Maganaris CN. Is stair descent in the elderly associated with high downward accelerations of the centre of mass? *Gait Posture.* 2013;38(4):961-966. https://doi.org/10.1016/j.gaitpost.2013.05.003

23. Rantakokko M, Mänty M, Iwarsson S, et al. Fear of moving outdoors and development of outdoor walking difficulty in older people. *J Am Geriatr Soc.* 2009;57(4):634-640. https://doi.org/10.1111/j.1532-5415.2009.02182.x

24. Rantakokko M, Iwarsson S, Kauppinen M, Leinonen R, Heikkinen E, Rantanen T. Quality of life and barriers in the urban outdoor environment in old age. *J Am Geriatr Soc.* 2010;58(11):2154-2159. https://doi.org/10.1111/j.1532-5415.2010.03143.x

25. Rantakokko M, Iwarsson S, Mänty M, Leinonen R, Rantanen T. Perceived barriers in the outdoor environment and development of walking difficulties in older people. *Age Ageing.* 2012;41(1):118-121. https://doi.org/10.1093/ageing/afr136

26. Rantakokko M, Iwarsson S, Vahaluoto S, Portegijs E, Viljanen A, Rantanen T. Perceived environmental barriers to outdoor mobility and feelings of loneliness among community-dwelling older people. *J Gerontol A Biol Sci Med Sci.* 2014;69(12):1562-1568. https://doi.org/10.1093/gerona/glu069

27. Rantakokko M, Portegijs E, Viljanen A, Iwarsson S, Rantanen T. Mobility modification alleviates environmental influence on incident mobility difficulty among community-dwelling older people: a two-year follow-up study. *PLoS One.* 2016;11(4):e0154396. https://doi.org/10.1371/journal.pone.0154396

28. Schepens B, Pannemans K, Van Hees W, et al. Fear of falling and its consequences for physical activity and daily life in community-dwelling older adults. *Aging Clin Exp Res.* 2021;33(2):331-339. https://doi.org/10.1007/s40520-020-01524-3

29. Mueller-Schotte S, Zuithoff NPA, Schuurmans MJ, et al. Trends in risk of limitations in instrumental activities of daily living over age in older persons with and without multiple chronic conditions. *J Gerontol A Biol Sci Med Sci.* 2020;75(1):197-205. https://doi.org/10.1093/gerona/gly28