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Original Research Article

Assessment of age-based variations in physiological and anthropometric metrics in Kashmiri men

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ABSTRACT

Background: This study investigates age-related variations in physiological and anthropometric metrics among Kashmiri men aged 60-70 years, focusing on cardiovascular and body composition parameters across two age groups (60-65 and 66-70 years).
Methods: Conducted under ethical approval from the university of Delhi, the study included 200 physically active participants, evenly divided into two age groups. Physiological metrics-systolic blood pressure (SBP), diastolic blood pressure (DBP), resting heart rate (RHR), body mass index (BMI), body fat percentage (BFP), waist-to-hip ratio (WHR), and basal metabolic rate (BMR)-were measured using validated tools. Data were analysed using descriptive statistics, independent t-tests, and Pearson's correlation analysis, with significance set at $p<0.05$.
Results: Significant differences were observed in RHR and BMR between the age groups. Participants aged 66-70 exhibited higher RHR (82.33±3.71 bm^{-1}) compared to those aged 60-65 (80.88±3.46 bm^{-1}, $p=0.01$). Conversely, the 60-65 group showed a higher BMR (1555.19±184.65 kcal/day) than the 66-70 group (1487.42±165.96 kcal/day, $p=0.01$). Non-significant differences were noted for SBP, DBP, BMI, BFP, and WHR, though BFP approached significance ($p=0.06$). Correlation analysis revealed strong interrelations among BMI, BFP, and BMR, with weaker associations between blood pressure metrics and WHR.
Conclusions: Age-related changes in RHR and BMR highlight physiological adaptations among older Kashmiri men. These findings underscore the need for tailored health interventions addressing cardiovascular and metabolic risks in this demographic.

Keywords: Basal metabolic rate, Body fat percentage, Resting blood pressure, Resting heart rate, Senior citizens

INTRODUCTION

The aging process is an inevitable aspect of life, marked by progressive physical and functional limitations that often lead to increased dependency in older individuals.[1] As people age, their ability to perform daily activities declines, requiring greater reliance on caregivers and healthcare systems. This phenomenon has become a significant global concern, particularly due to the rapid expansion of the elderly population-defined as individuals aged 60 and above. This demographic shift is especially pronounced in developing nations, where socioeconomic challenges and inadequate health infrastructure exacerbate the complexities of aging. Projections made as early as the mid-20th century anticipated this demographic shift,[2] and subsequent data affirm these forecasts. By 2019, over 280 million elderly individuals resided in developing regions, accounting for 58% of the global elderly population.[3] These trends highlight the urgency for policymakers to prioritize geriatric health care and implement targeted interventions, especially in emerging economies experiencing an accelerated rise in their aging populations compared to wealthier nations. This demographic shift underscores the need for robust, evidence-based health

policies tailored to the specific needs of older adults in these regions.

India exemplifies this challenge, with 7.6% of its population being over 60 years of age. Elderly individuals in India face multifaceted issues such as financial instability, evolving family dynamics due to urban migration, and escalating healthcare costs.[4] The financial burden on families is often compounded by the lack of comprehensive social security systems, placing significant strain on both caregivers and the elderly themselves. Cardiovascular health emerges as a critical area of concern within this population. Research consistently identifies cardiovascular decline as a prominent issue among the elderly, with stroke ranking as a leading cause of mortality worldwide.[5] Intriguingly, studies indicate that elderly individuals in India experience lower stroke rates compared to their counterparts in Western nations, potentially due to regional variations in risk factors, genetic predispositions, and disparities in healthcare access.[6] However, this observation necessitates further exploration to understand the underlying causes and implications for public health strategies.

Physiological changes associated with aging are equally significant. Aging results in reductions in fat-free mass (FFM), which includes muscle, bone, and water, alongside increases in fat mass (FM). These shifts contribute to heightened risks of malnutrition, disability, and chronic illnesses.[7,8] Excess fat accumulation can impair mobility and exacerbate health conditions, yet the replacement of muscle with fat during aging often obscures overall weight changes, complicating health assessments.[9] Reliable indicators such as BMI, BMR, BFP, RBP, and RHR are widely utilized to evaluate health risks among the elderly. These measures provide valuable insights into the prevalence of chronic diseases and guide intervention strategies.[10-13]

The situation in Kashmir, a region undergoing a demographic shift toward an aging population, exemplifies the unique interplay between environmental, dietary, and sociocultural factors influencing elderly health outcomes. Kashmir's high-altitude environment imposes distinct physiological stresses on its residents, while traditional diets rich in local staples may offer both protective and detrimental health effects. Additionally, the region's changing social structures, driven by migration and urbanization, have altered familial support systems, posing further challenges for the elderly. Despite these unique factors, there is limited research on the physiological and anthropometric traits of elderly populations in Kashmir, leaving a critical gap in understanding their health risks.[14] This study aims to address this gap by comparing physiological characteristics, including BMI, BMR, BFP, RBP, and RHR, between two age groups (60-65 and 66-70 years) of Kashmiri men. By analysing these variables, the study seeks to illuminate the health risks faced by the elderly in Kashmir and contribute to the development of region-specific health interventions that can improve their quality of life and well-being.

METHODS

Participants

This was a cross-sectional study conducted at Lifeline Clinic, Shalimar, Srinagar, India. A total of 200 male senior citizens from diverse regions of Kashmir, India, participated in the study. Participants were purposively sampled and divided equally into two age groups: 60-65 years (n=100) and 66-70 years (n=100). The sampling process was designed to ensure representation from various geographic and sociocultural backgrounds within the region, reflecting the diversity of the population. Inclusion criteria required participants to be physically active and free of chronic illnesses that could affect the study's measurements, such as cardiovascular or metabolic disorders. Exclusion criteria involved any medical conditions or disabilities that might prevent safe participation in the assessments. Equal distribution across age groups ensured that each category had sufficient representation, facilitating meaningful comparisons of physiological and anthropometric variables. Participants were informed of the study's purpose and procedures, and written consent was obtained to adhere to ethical guidelines for human research.

Study period

The study was conducted between June 2023 and July 2023.

Study's procedure

The study examined physiological variables, including SBP, DBP, RHR, BMI, BFP, WHR, and BMR. Measurements were conducted using validated instruments: SBP, DBP, and RHR were measured with the Omron automatic blood pressure monitor (HEM 7120), a clinically validated device.[15] BMI, BFP, and BMR were assessed using the Omron body composition analyzer (HBF-375), which has been validated in previous studies.[16] WHR was calculated using waist and hip circumferences measured with a flexible, non-stretchable tape. All measurements adhered to standard protocols to ensure reproducibility.

Statistical analysis

A priori power analysis using G*Power determined a required sample size of 176 participants (effect size=0.5, α=0.05, power=0.95). The study's sample size of 200 participants exceeded this requirement, ensuring robust analysis. Descriptive statistics (mean and standard deviation) were calculated for all variables. Group comparisons were performed using independent t-tests to evaluate differences between the two age groups. Welch's t-test was used for variables with unequal variances, as

indicated by Levene's test. Pearson's correlation analysis was employed to assess relationships among physiological variables within each group. Statistical significance was set at $p<0.05$, and all analyses were conducted using SPSS (version 29).

Ethics approval

This study adhered to the ethical guidelines of the department of physical education and sports sciences, university of Delhi. Approval was granted by the department research committee and the board of research studies prior to data collection. Participants were fully informed about the purpose, procedures, and their rights, and explicit written consent was obtained. The physical activity readiness questionnaire (PAR-Q) was administered to ensure participant's safety and readiness for the study. Privacy and confidentiality were maintained in accordance with national and institutional ethical standards.

RESULTS

The findings of this study provide a comprehensive overview of the variations in physiological metrics among elderly populations, offering valuable insights into age-associated changes. The following sections detail the observed trends and statistical analyses for each parameter.

This Table 1 provides the means and standard deviations for physiological and anthropometric variables across two age groups of adult men in Kashmir: 60-65 years and 66-70 years. SBP was 138.74±7.87 mmHg for the 60-65 age group and 141.05±11.81 mmHg for the 66-70 age group. DBP was 95.81±6.24 mmHg for the 60-65 group and 96.68±7.79 mmHg for the 66-70 group. RHR was 80.88±3.46 bm^{-1} for the 60-65 group and 82.33±3.71 bm^{-1} for the 66-70 group.

BMI was 25.79±3.86 kg/m² for the 60–65 age group and 25.97±2.79 kg/m² for the 66-70 group. BFP was 27.29±4.98% for the 60-65 group and 28.69±5.29% for the 66-70 group. WHR was 0.98±0.05 for both groups. Finally, BMR was 1555.19±184.65 kcal/day for the 60-65 group and 1487.42±165.96 kcal/day for the 66-70 group.

Table 2 summarizes independent samples t test results comparing physiological and anthropometric metrics between two age groups (60-65 years and 66-70 years). Metrics assessed include SBP, DBP, RHR, BMI, BFP, WHR, and BMR.

Levene's test indicated unequal variances for SBP ($F=14.99$, $p<0.001$), DBP ($F=10.30$, $p<0.001$), and BMI ($F=6.38$, $p=0.01$). Consequently, Welch's t-test was applied for these metrics.

Significant differences were observed for RHR and BMR. The 66-70 age group had a significantly higher RHR ($t(198)=2.86$, $p=0.01$), whereas the 60-65 age group had a significantly higher BMR ($t(198)=2.73$, $p=0.01$). Non-significant differences were observed for SBP ($p=0.11$), DBP ($p=0.38$), BMI ($p=0.71$), BFP ($p=0.06$), and WHR ($p=0.51$). BFP approached statistical significance ($p=0.06$).

This analysis highlights that, among the metrics evaluated, RHR and BMR differed significantly between the two age groups, suggesting age-related physiological changes in these parameters.

Table 3 presents the Pearson correlation coefficients (r) for physiological and anthropometric metrics in a combined sample of adults aged 60-70 years. BMI exhibited strong positive correlations with BFP; $r=0.77$, $p<0.01$) and BMR; $r=0.63$, $p<0.01$), and moderate correlations with SBP; $r=0.34$, $p<0.01$), DBP; $r=0.31$, $p<0.01$), and RHR; $r=0.41$, $p<0.01$).

BFP also showed moderate positive correlations with SBP ($r=0.40$, $p<0.01$), DBP ($r=0.24$, $p<0.01$), RHR ($r=0.39$, $p<0.01$), and WHR; $r=0.27$, $p<0.01$). SBP and DBP were strongly correlated ($r=0.65$, $p<0.01$).

Significant but weaker correlations were observed between WHR and BMI ($r=0.18$, $p<0.05$), DBP ($r=0.15$, $p<0.05$), and BMR ($r=0.21$, $p<0.01$). No significant correlations were found between SBP and RHR or WHR, or between RHR and WHR.

These results indicate that BMI, BFP, and BMR are strongly interrelated, while blood pressure metrics and WHR show more moderate associations with other variables. The findings underscore the complex interplay between anthropometric and physiological factors in this age group.

Table 1: Descriptive statistics for physiological and anthropometric metrics by age group (60-65 vs. 66-70 years).

Metric	Age group (in years)	N	Mean±standard deviation
SBP (mm Hg)	60-65	100	138.74±7.87
	66-70	100	141.05±11.81
DBP (mm Hg)	60-65	100	95.81±6.24
	66-70	100	96.68±7.79
RHR (bm^{-1})	60-65	100	80.88±3.46
	66-70	100	82.33±3.71
BMI (kg/m^2)	60-65	100	25.79±3.86
	66-70	100	25.97±2.79

Continued.

Metric	Age group (in years)	N	Mean±standard deviation
BFP (%)	60-65	100	27.29±4.98
	66-70	100	28.69±5.29
WHR	60-65	100	0.98±0.05
	66-70	100	0.98±0.05
BMR (kcal/day)	60-65	100	1555.19±184.65
	66-70	100	1487.42±165.96

*Data are presented as mean±standard deviation.

Table 2: Independent samples t-test results for physiological and anthropometric metrics by age group (60-65 vs. 66-70).

Metric	Levene's test for equality of variances		T test for equality of means				
	F	P	T	Df	P	Mean difference	Std. error difference
SBP (mmHg)	14.99	<0.001	1.63	172.47	0.11	2.31	1.42
DBP (mmHg)	10.30	<0.001	0.87	189.02	0.38	0.87	1.00
RHR (bm^{-1})	1.55	0.22	2.86	198	0.01	1.45	0.51
BMI (kg/m^2)	6.38	0.01	0.37	180.40	0.71	0.18	0.48
BFP (%)	0.03	0.86	1.93	198	0.06	1.40	0.73
WHR	3.30	0.07	0.65	198	0.51	0.01	0.01
BMR (kcal/day)	1.96	0.16	2.73	198	0.01	67.77	24.83

*Levene's test was used to assess the equality of variances. For variables where variances were unequal, Welch's t-test was applied.

Table 3: Correlation matrix for physiological and anthropometric metrics among adults aged 60–70 years.

Metric	Coefficient of correlation (r)						
	BMI (kg/m^2)	BFP (%)	SBP (mmHg)	DBP (mmHg)	RHR (bm^{-1})	WHR	BMR (kcal/day)
BMI (kg/m^2)	1.00						
BFP (%)	0.77**	1.00					
SBP (mmHg)	0.34**	0.40**	1.00				
DBP (mmHg)	0.31**	0.24**	0.65**	1.00			
RHR (bm^{-1})	0.41**	0.39**	0.08	0.11	1.00		
WHR	0.18*	0.27**	0.04	0.15*	0.06	1.00	
BMR (kcal/day)	0.63**	0.34**	0.10	0.16*	0.10	0.21**	1.00

*R values represent Pearson correlations. p<0.05 (*), p<0.01 (**).

DISCUSSION

This study aimed to assess age-based variations in physiological and anthropometric metrics among Kashmiri adult men aged 60 to 70 years. The findings provide critical insights into the physiological changes associated with aging and highlight the complex interplay between anthropometric and physiological factors in this population. The discussion evaluates these findings in light of existing literature and explores their implications for health and aging in older adults.

The study observed a non-significant increase in SBP and DBP in the 66-70-year-old group compared to the 60-65-year-old group. These findings align with prior research suggesting that blood pressure generally increases with age due to arterial stiffening and decreased vascular compliance.[17-19] However, the lack of significant differences may reflect the relatively healthy and physically active status of the participants, as outlined in the inclusion criteria. RHR, however, was significantly higher in the older age group, consistent with age-associated reductions in parasympathetic tone and autonomic function.[20,21] These changes underscore the importance of monitoring cardiovascular health in aging populations to mitigate potential risks of hypertension and related conditions. The results revealed no significant differences in BMI or WHR between the two age groups, suggesting relative stability in these parameters within the studied population. However, BFP approached statistical significance, indicating a trend toward increased adiposity with advancing age. This is consistent with previous studies highlighting shifts in body composition, such as increased FM and decreased lean mass, as hallmarks of aging.[22-24] BMR was significantly lower in the older group, aligning with the known decline in metabolic rate with age due to reductions in lean body mass and mitochondrial efficiency.[25] The significant decrease in BMR emphasizes the need for tailored dietary and exercise interventions to counteract the metabolic challenges associated with aging. Pearson correlation analysis revealed strong interrelations between BMI, BFP, and BMR, consistent with the

literature highlighting the metabolic implications of adiposity and body composition.[26,27] Interestingly, systolic and DBP were moderately correlated with BMI and BFP, reflecting the potential impact of adiposity on cardiovascular health.[28,29] These findings reinforce the multifaceted nature of aging, where physiological and anthropometric factors collectively influence overall health outcomes. The weak correlations observed between WHR and other variables may suggest that WHR alone is insufficient to capture the nuanced changes in body composition associated with aging. Additionally, the absence of significant correlations be-tween RHR and blood pressure metrics highlights the independent regulation of these parameters in the studied population.

The significant differences in RHR and BMR, coupled with trends in BFP, underscore the physiological challenges faced by older adults in maintaining cardiovascular and metabolic health. These findings highlight the need for comprehensive health monitoring and interventions tailored to the specific needs of aging populations in Kashmir. The study also emphasizes the importance of promoting physical activity and balanced nutrition to mitigate age-related declines in metabolic and cardiovascular function.[30-32]

Limitations

This study has certain limitations that should be acknowledged. The cross-sectional design precludes causal inferences about age-related changes.[33] Longitudinal studies are needed to confirm these findings and explore the trajectories of physiological and anthropometric metrics over time. Additionally, the exclusion of individuals with chronic conditions may limit the generalizability of the results to broader populations. Future research should con-sider more diverse samples and investigate the impact of lifestyle factors, such as diet and physical activity, on the observed metrics.[34,35]

CONCLUSION

This study reveals significant age-related differences in RHR and BMR among Kashmiri men aged 60-65 and 66-70 years. Trends in BFP indicate increased adiposity with advancing age, highlighting the physiological and anthropometric shifts that occur in this critical age range. These findings underscore the complex interplay between aging processes and sociocultural factors unique to this population. The results emphasize the pressing need for targeted health interventions to address the rising cardiovascular and metabolic risks among older adults. Interventions should be designed with cultural sensitivity and focus on reducing adiposity and promoting cardiovascular health in this population. Future research should expand on these findings by adopting longitudinal approaches to examine aging patterns over time, exploring gender-specific variations, and incorporating regional comparisons. By advancing the understanding of aging in the sociocultural context of Kashmir, this study provides a foundation for developing evidence-based strategies that improve health outcomes and enhance the quality of life for older adults.

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