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Original Article

Association Between Walking Intensity and Self-Reported Chronic Diseases among Adults in Abha: A Cross-Sectional Analysis

Abdullah Hassan Alasmri[1], Hassan M. AlShaiban[2], Othman Omair[3], Mohammed Mufateh Alaidan[4], Najim Z. Alshahrani[5,*]

[1]Preventive Medicine Physician, General Directorate of Health Affairs in Asser Region, Ministry of Health, Abha, SAUDI ARABIA.
[2]Saudi Board of Preventive Medicine Program- Aseer Health Cluster, Ministry of Health, Abha, SAUDI ARABIA.
[3]Emergency Medicine Consultant, Head of Emergency Medicine Department, Aseer Central Hospital, Ministry of Health, Abha, SAUDI ARABIA.
[4]Director of Capacity Department, Aseer Health Cluster, Ministry of Health, Abha, SAUDI ARABIA.
[5]Department of Family and Community Medicine, Faculty of Medicine, University of Jeddah, Jeddah, SAUDI ARABIA.

ABSTRACT

Background: Chronic diseases are escalating globally, largely due to sedentary lifestyles accentuated in urban settings. This study aims to explore the relationship between walking intensity and self-reported chronic diseases, with a focus on gender differences, aiming to understand how physical activity impacts health outcomes among adults in Abha. **Materials and Methods:** This analytical cross-sectional study, conducted from October to December 2024 in Abha, aimed to investigate the association between self-reported walking intensity, measured by weekly step counts, and chronic diseases among adults aged 18 and over. Participants were selected based on residency in Abha, with exclusions for non-consent or incomplete data. Using multivariate logistic regression, the study analysed the relationship between walking intensity and self-reported chronic diseases, adjusting for confounders and reporting adjusted odds ratios, 95% Confidence Intervals (CIs), and *p*-values. A *p*-value below 0.05 was considered statistically significant. **Results:** In this study of 462 participants, 95 (20.6%) reported chronic diseases, while 367 (79.4%) did not. Walking 10,000 steps per week or more was linked to a lower likelihood of chronic diseases in the overall population, with a crude Odds Ratio (OR) of 0.58 (95% CI: 0.37-0.92, *p*=0.018) and an adjusted OR of 0.62 (95% CI: 0.37-0.99, *p*=0.049), after adjustments. Gender-stratified analysis showed no significant change in chronic disease odds for males walking over 10,000 steps, with an adjusted OR of 1.22 (95% CI: 0.55-2.68, *p*=0.624), while for females, the association was significant, with both crude and adjusted ORs at 0.25 (95% CI: 0.11-0.56, *p*=0.001; and 95% CI: 0.11-0.60, *p*=0.002), indicating a pronounced protective effect of higher walking intensity against chronic diseases. **Conclusion:** Our study highlights the link between walking intensity and chronic diseases in Abha, particularly noting walking's preventive health benefits for women and suggesting its integration into public health interventions and urban planning.

Keywords: Physical activity, Walking Intensity, Chronic Diseases, Public Health, Saudi Arabia.

Correspondence:
Prof. Najim Zafer Alshahrani
Assistant Professor of Travel Medicine, Department of Family and Community Medicine, Faculty of Medicine, University of Jeddah, Jeddah-21589, SAUDI ARABIA.
Email: nalshahrani@uj.edu.sa.

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INTRODUCTION

Chronic diseases, including cardiovascular conditions, diabetes, and obesity, are major contributors to global morbidity and mortality (Hajat and Stein, 2018). These conditions strain health systems worldwide and are exacerbated by sedentary lifestyles, a trend particularly evident in rapidly urbanizing regions (Park *et al*., 2020). In Saudi Arabia, the rising prevalence of chronic diseases among adults mirrors this global trend (Alzahrani *et al*., 2023). Walking, a widely accessible form of physical activity, is recognized as an effective strategy for reducing chronic disease risks (Omura *et al*., 2019). However, the impact of walking intensity on chronic disease prevention and management remains underexplored, particularly in the Middle Eastern context, where cultural, environmental, and social factors significantly shape physical activity patterns.

Existing literature primarily focuses on the general benefits of physical activity, often overlooking the specific effects of walking intensity on health outcomes. Studies in affluent nations emphasize the protective relationship between increased physical activity and reduced chronic disease risk (Anderson and Durstine, 2019; Marques *et al*., 2018a, 2018b; Booth *et al*., 2012). However,

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such research often fails to differentiate between activity types and intensities, which is particularly relevant in cities like Abha, where cultural and environmental factors pose challenges to physical activity promotion (Albujulaya and Stevinson, 2023). Limited research on walking habits in these regions highlights a gap in understanding the correlation between walking intensity and chronic disease prevalence. This gap underscores the relevance of this study, especially given Saudi Arabia's efforts to promote physical activity, particularly among women, through initiatives such as sports programs in girls' schools and national competitions (Albujulaya and Stevinson, 2023). Furthermore, the Saudi Ministry of Health has launched campaigns like the National Day for Walking to encourage regular walking and support individuals with chronic diseases (Arab News, 2024).

Research from Western societies has established a link between moderate to high-intensity physical activity and a reduced risk of chronic diseases (Rehn *et al*., 2013; Dawkins *et al*., 2022). However, findings from Abha cannot be directly applied due to differences in lifestyles, urban design, and cultural practices. For instance, Abha's public spaces and neighborhood layout may not always support high-intensity walking (Mandeli, 2019). Additionally, cultural norms and climate conditions significantly influence outdoor physical activity patterns (Al-Hazzaa, 2018). These differences highlight the need for region-specific research to clarify the relationship between walking intensity and chronic disease outcomes. This cross-sectional study examines the association between walking intensity (weekly step count) and self-reported chronic diseases among adults in Abha. It explores whether higher-intensity walking is linked to lower chronic disease prevalence compared to lower-intensity or inactive lifestyles. Gender-stratified analyses assess variations in this association. Findings aim to guide public health strategies and policies tailored to Abha's demographic and cultural context, promoting physical activity for healthier communities.

MATERIALS AND METHODS

Study Design and Setting

This analytical cross-sectional study was designed to explore the association between walking intensity and chronic diseases. Conducted from October to December 2024, the study was strategically designed to capture a contemporaneous overview of walking behaviors and chronic disease prevalence within the population (Wang and Cheng, 2020; Kesmodel, 2018; Capili, 2021). The research took place in Abha, Saudi Arabia, a pivotal urban city known for its diverse demographic composition and unique urban structure (Murad, 2014). Abha serves as an exemplary setting for investigating physical activity patterns, particularly walking intensity, and its correlation with chronic disease incidence in an urban Saudi population.

Sampling and Participant Selection

To achieve a representative sample, a stratified sampling method was employed, beginning with the selection of four distinguished walking locations within Abha. These sites were specifically chosen based on their popularity and their representation of different urban areas, ensuring a wide-ranging and inclusive sample reflective of Abha's adult population. The study aimed to engage 444 participants, a figure informed by the city's diverse demographic characteristics and the anticipated variance in physical activity levels, particularly walking intensity.

The initial sample size was determined to be 384, based on a 95% confidence interval and a 5% margin of error, with an expected engagement rate in regular walking activity estimated between 15% and 18%. To accommodate potential non-responses and enhance the reliability of the findings, the final participant count was adjusted to 462. This careful application of stratified sampling from selected walking areas enabled the collection of a rich and representative dataset, crucial for analysing the relationship between walking intensity and the prevalence of chronic diseases.

Adults aged 18 years and older who reside in Abha and consented to participate were eligible for inclusion in the study. Participants were excluded if they declined participation or provided incomplete data in the survey.

Exposure Definition

The exposure of interest in this study is walking intensity, operationalized by participants' self-reported weekly step counts. The survey question designed to measure this was, "How many steps do you take per week?" Based on their step counts, participants were classified into two groups for subsequent analysis: Lower walking intensity: Defined as taking fewer than 10,000 steps per week, and Higher walking intensity: Defined as taking 10,000 steps per week or more.

This categorization allows for the assessment of walking intensity as the independent variable to examine its association with the presence of chronic diseases.

Outcome Measurement

The primary outcome variable is the self-reported diagnosis of chronic diseases. Participants were queried, "Have you been diagnosed by your doctor to have chronic diseases?" with response options of "Yes" or "No." List of chronic non-communicable diseases was provided for them to understand the question clearly. This binary variable provides a straightforward method for identifying individuals with a medical diagnosis of one or more chronic diseases, enabling the analysis of the relationship between walking intensity (the exposure) and chronic disease status (the outcome).

Data Collection Method

Data were collected through a structured web-based survey administered via Google Forms for accessibility and convenience, improving response rates. The survey was validated by two methodology experts to ensure clarity and relevance. Participants received clear instructions on estimating weekly step counts, a widely accepted self-report method in epidemiological research due to its feasibility and reliability (Omura *et al*., 2019; Albujulaya and Stevinson, 2023). To ensure cultural and linguistic appropriateness, the questionnaire was developed in Arabic. It included structured and multiple-choice questions covering walking intensity, chronic disease status, and socio-demographic factors such as age, gender, education, marital and employment status, income, BMI, smoking habits, and high-intensity physical activity.

Ethical Considerations

This study was approved by the Asser Institutional Review Board (IRB), Saudi Arabia (NCBE-KACST Registration No: H-06-B-091; IRB Log No: REC-1-8-2024, October 20, 2024). All participants provided informed consent, and data were collected anonymously to ensure confidentiality.

Statistical Analysis

Statistical analysis was performed using Stata 18. Descriptive statistics summarized socio-demographic characteristics, while Chi-Square tests assessed categorical variable associations. Due to non-normality, the Wilcoxon rank-sum test was used for continuous variables. Multivariate logistic regression examined the association between walking intensity (step count) and self-reported chronic diseases, adjusting for variables with $p<0.05$. Adjusted Odds Ratios (ORs), 95% Confidence Intervals (CIs), and p-values were reported. Gender-stratified analyses explored differences between male and female participants. Variance Inflation Factor (VIF) analysis confirmed no multicollinearity. Statistical significance was set at $p<0.05$.

RESULTS

Participants with chronic diseases had a higher median age (44 years, IQR: 28-64) vs. 28 years (IQR: 22-52) for those without ($p<0.001$). Gender distribution did not differ significantly ($p=0.730$). Marital and employment status showed significant differences. Fewer single individuals reported chronic diseases (34.7% vs. 54.5%, $p=0.001$), while more married participants had chronic diseases. Employment status also varied, with higher proportions of unemployed (13.7%), employed (54.7%), and retired (13.7%) individuals reporting chronic diseases compared to those without ($p<0.001$). Education level differences were not statistically significant ($p=0.142$). 77.9% of those with chronic diseases had higher education compared to 70.3% without (see Table 1).

Income level differences were not statistically significant between the groups ($p=0.237$), with a similar proportion of participants reporting middle income whether they had chronic diseases (45.3%) or not (45.2%). Body Mass Index (BMI) categories showed significant differences; participants with chronic diseases had a higher prevalence of overweight (48.4%) and obesity (25.3%) compared to those without (32.2% and 19.4%, respectively) ($p=0.001$). The frequency of high-intensity physical activity did not significantly differ between participants with and without chronic diseases ($p=0.454$). The smoking status was also similar between the two groups, with 20.0% of participants with chronic diseases and 16.9% without being smokers ($p=0.478$). Self-rated health quality showed a significant divergence; 77.9% of those with chronic diseases rated their health as good compared to 54.5% of those without, and 22.1% of the former rated their health as excellent compared to 45.5% of the latter ($p<0.001$).

In the analysis of the association between walking intensity and chronic diseases, our results revealed significant findings both before and after adjustments for confounding variables (see Table 2). For the overall population, participants who walked 10,000 steps per week or more were associated with a lower likelihood of having chronic diseases compared to those walking fewer than 10,000 steps, with a crude Odds Ratio (OR) of 0.58 (95% Confidence Interval [CI]: 0.37 - 0.92, $p=0.018$). This association persisted even after adjusting for age, gender, marital status, employment status, BMI, and self-rated health quality, with an adjusted OR of 0.62 (95% CI: 0.37 - 0.99, $p=0.049$).

Gender-stratified analyses painted a more nuanced picture (See Figure 1). Among male participants, walking more than 10,000 steps per week did not significantly alter the odds of reporting chronic diseases, with an adjusted OR of 1.22 (95% CI: 0.55-2.68, $p=0.624$). Conversely, the association was pronounced in female participants; those with a walking intensity of 10,000 steps or more per week had significantly lower odds of chronic diseases, both crude and adjusted ORs being 0.25 (95% CI: 0.11-0.56, $p=0.001$; and 95% CI: 0.11-0.60, $p=0.002$, respectively), after controlling for age, marital status, employment status, BMI, and self-rated health quality.

DISCUSSION

Our study's findings suggest a positive association between higher walking intensity and lower reports of chronic diseases, aligning with previous research (Ungvari *et al*., 2023; Morris and Hardman, 1997; Zhao *et al*., 2015). After adjusting for age, gender, marital status, employment status, BMI, and self-rated health, this association remained significant, reinforcing walking as a protective behavior against chronic conditions. Prior studies emphasize the benefits of increased physical activity for chronic disease prevention (Warburton and Bredin, 2017; Schwartz *et al*., 2019), and our findings support this, particularly in the context of walking as a primary form of physical activity. However, our

Table 1: Socio-demographic characteristics of the participants by self-reported chronic disease status.

Variable	Has Chronic Disease (*n*=95)	No Chronic Disease (*n*=367)	*p*-value
Age, median (IQR), years	44 (28-64)	28 (22-52)	<0.001*
Gender, n (%)			0.730
Male	49 (51.6)	182 (49.6)	
Female	46 (48.4)	185 (50.4)	
Education, n (%)			0.142
Higher Education (Bachelor/Masters/PhD)	74 (77.9)	258 (70.3)	
Secondary or less	21 (22.1)	109 (29.7)	
Marital status, n (%)			0.001*
Single	33 (34.7)	200 (54.5)	
Married	62 (65.3)	108 (43.4)	
Employment status, n (%)			<0.001*
Unemployed	13 (13.7)	72 (19.6)	
Employed	52 (54.7)	166 (45.2)	
Retired	13 (13.7)	14 (3.8)	
Student	17 (17.9)	115 (31.3)	
Income level, n (%)			0.237
Low Income	17 (17.9)	92 (25.1)	
Middle Income	43 (45.3)	166 (45.2)	
High Income	35 (36.8)	109 (29.7)	
BMI, n (%)			0.001*
Underweight	4 (4.2)	25 (6.8)	
Normal Weight	21 (22.1)	153 (41.7)	
Overweight	46 (48.4)	118 (32.2)	
Obesity	24 (25.3)	71 (19.4)	
High-intensity PA, n (%)			0.454
0 to 2 days per week	68 (71.6)	248 (67.6)	
3 to 7 days per week	27 (28.4)	119 (32.4)	
Smoker, n (%)			0.478
Yes	19 (20.0)	62 (16.9)	
No	76 (80.0)	305 (83.1)	
Self-rated health quality, n (%)			<0.001*
Good	74 (77.9)	200 (54.5)	
Excellent	21 (22.1)	167 (45.5)	
Walking intensity, n (%)			0.018*
< 10,000 steps per week	54 (56.8)	159 (43.3)	
≥ 10,000 steps per week	41 (43.2)	208 (56.7)	

*Statistically significant *p*-value < 0.05.

study adds nuance by specifically examining walking intensity, demonstrating that not just walking itself, but its intensity, is linked to chronic disease outcomes.

The gender-stratified analysis revealed notable distinctions. While previous studies report mixed findings on gender differences in the health benefits of physical activity, our research indicates that higher walking intensity is significantly associated with lower reports of chronic diseases among women, but not men (Sattelmair *et al.*, 2011; Bassuk and Manson, 2010). This aligns with some studies suggesting that women may derive greater health benefits from physical activity due to biological, behavioral, or social factors. For instance, engaging in low to moderate-intensity activities, such as brisk walking, has been shown to offer a protective effect against cardiovascular disease and diabetes (Sattelmair *et al.*, 2011; Bassuk and Manson, 2010; Hu *et al.*, 1999), with evidence suggesting that this effect may be more pronounced in women than in men. Our findings contribute to this ongoing discussion by emphasizing the importance of gender considerations in assessing the health benefits of physical activity. These results may suggest a need for gender-specific public health strategies to promote walking and other forms of moderate-intensity physical activity.

Table 2: Crude, adjusted and gender stratified association between chronic diseases and walking intensity.

Overall		
Walking intensity, n (%)	**Crude Odds Ratio (95% CI), *p*-value**	**Adjusted Odds Ratio (95% CI), *p*-value**
< 10,000 steps per week	Ref	Ref
≥ 10,000 steps per week	0.58 (0.37 - 0.92), *p*=0.018	+0.62 (0.37 - 0.99), *p*=0.049*
Male		
< 10,000 steps per week	Ref	Ref
≥ 10,000 steps per week	0.99 (0.50 - 1.94), *p*=0.975	++1.22 (0.55 - 2.68), *p*=0.624
Female		
< 10,000 steps per week	Ref	Ref
≥ 10,000 steps per week	0.25 (0.11 - 0.56), *p*=0.001	++0.25 (0.11 - 0.60), *p*=0.002*

+ = Adjusted for Age, Gender, Marital Status, Employment Status, BMI, Self-Rated Health Quality;++ = Adjusted for Age, Marital Status, Employment Status, BMI, Self-Rated Health Quality;*Statistically significant *p*-value < 0.05.

Comparatively, the lack of significant findings among men in our study presents a contrast to some previous research that has demonstrated benefits for both genders. This discrepancy may reflect cultural, environmental, or biological differences between populations and suggests that interventions in Abha may need to be tailored to address these nuances. It may also signal that factors beyond our measured confounders could be influencing the relationship between walking intensity and chronic diseases in men. These findings underscore the complexity of designing effective physical activity interventions and the necessity for further research to uncover the underlying reasons for these gender-specific associations.

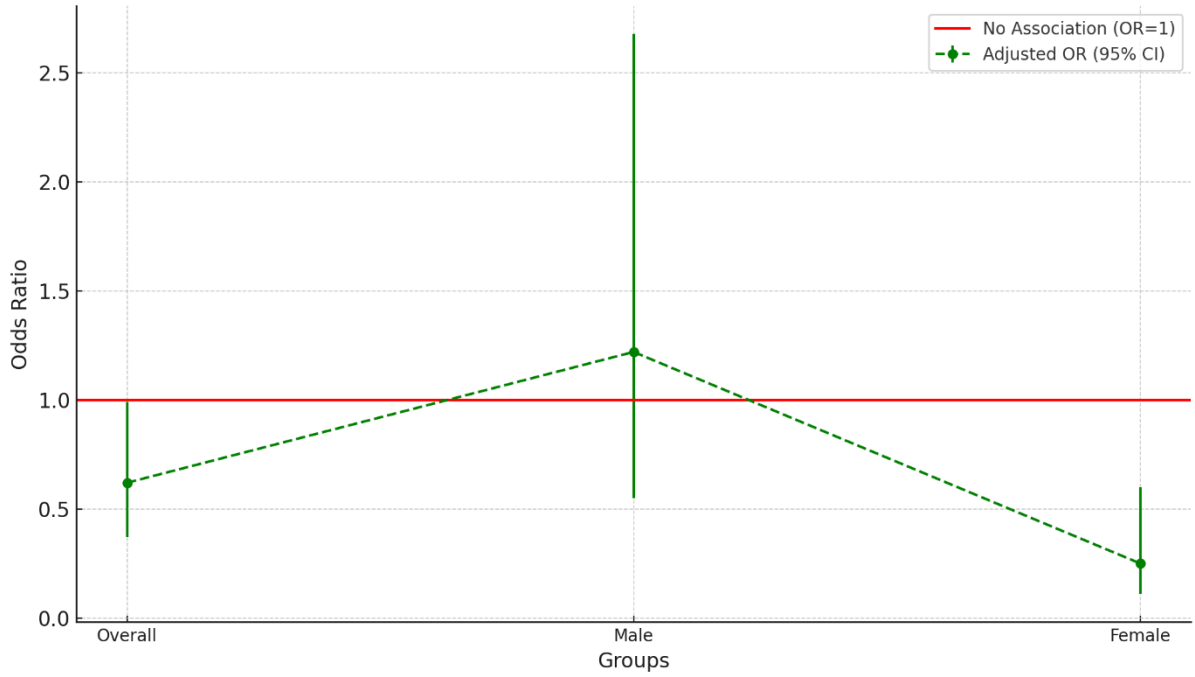

Figure 1: Adjusted gender-stratified association between chronic diseases and walking intensity.

The implications of our findings for policy, practice, prevention, and public health are multifaceted and significant. For policymakers, the clear association between increased walking intensity and lower reports of chronic diseases in women suggests that promoting higher intensity walking could be a cost-effective strategy to reduce the burden of chronic illnesses. In clinical practice, healthcare providers could prioritize prescriptions of physical activity, particularly walking interventions at higher intensities, as part of routine care for disease prevention, especially for women. Prevention strategies could also be tailored to encourage more vigorous forms of walking, leveraging technology such as step counters and health apps to motivate and track progress. For public health, these results bolster the importance of creating urban environments that support and encourage walking, such as pedestrian-friendly infrastructure and community walking programs. Such environmental modifications have the potential to make high intensity walking a more attainable goal for the general population. Additionally, the gender differences observed suggest that public health campaigns should consider targeted messaging that resonates with and addresses the unique barriers faced by men and women in adopting more active lifestyles. Lastly, these findings advocate for a paradigm shift in public health promotion, where the focus is not only on increasing the quantity of physical activity but also on enhancing the quality and intensity of such activities.

While informative, this study has limitations. Its cross-sectional design prevents causal inference, allowing only associations at a single time point (Adebisi *et al.*, 2024). Self-reported data on walking intensity and chronic diseases may introduce recall and social desirability biases, affecting accuracy. Using step counts as a measure of walking intensity does not capture duration or frequency of physical activity, which may influence health outcomes. The reliance on self-reported steps instead of objective measures (e.g., pedometers) may further impact data accuracy. Findings are specific to Abha and may not be generalizable to regions with different cultural, environmental, and lifestyle factors. Unmeasured confounders like diet and genetics may also influence the results. Additionally, gender differences in walking intensity and chronic disease associations require longitudinal studies for deeper insight. Finally, reliance on technology-based surveys may have introduced selection bias, limiting participation among certain groups.

CONCLUSION

Our study illuminates the association between walking intensity and self-reported chronic diseases in Abha, underscoring the potential of walking as a preventative health measure, particularly for women. These insights can guide the development of targeted public health interventions and urban planning that promote walking. While our findings are promising, they also highlight the need for longitudinal research to establish causality and further explore gender-specific health outcomes. The study's implications for policy and practice point towards the tangible benefits of integrating higher intensity walking into daily routines as a strategy for chronic disease prevention.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

BMI: Body Mass Index; **CI:** Confidence Interval; **IRB:** Institutional Review Board; **IQR:** Interquartile Range; **KSA:** Kingdom of Saudi Arabia; **OR:** Odds Ratio; **PA:** Physical Activity; **SRH:** Self-Rated Health; **VIF:** Variance Inflation Factor.

ETHICAL APPROVAL

The study was conducted in accordance with the Declaration of Helsinki and approved by Asser Institutional Review Board of Research Ethics Committee (Registration number H-06-B-091), application number: REC-1-8-2024 and date of approval 10/20/2024).

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