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The Role Of Built Environment In Reducing The Occurrence Of Cvds Among Amman Residents Through Physical Activity Pathway

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Abstract

Objectives: This research aims to investigate the association between built environment and the occurrence of cardiovascular diseases (CVDs) among Amman residents and illustrate the role of physical activity in this relationship.

Background: Previous studies have shown that built environment that enhances physical activity might reduce the occurrence of CVDs. Yet rapid urbanization has resulted in substantial changes to urban built environments, which have negatively affected human health by increasing a sedentary lifestyle. As a result, CVDs are increasingly becoming the leading cause of mortality worldwide. In Jordan, which characterized by rapid urban growth, CVDs are the leading cause of a high percentage of mortality of noncommunicable diseases. Also, the effect of built environment on CVDs and physical activity in Jordan is not well studied.

Method: In this cross-sectional study, 384 adults from two Amman neighborhoods participated. A questionnaire based on three touchstones: the International Physical Activity Questionnaire, the Neighborhood Walkability Scale, and the Jordan National Stepwise Survey was used to collect data. Using the SPSS program, the connections were investigated.

Results: The results indicate that the quality of sidewalks, land use diversity, and neighborhood aesthetics are related to CVDs risk. The results also demonstrate the significance of physical activity in this relationship, i.e., built environment reduces the occurrence of CVDs by encouraging an active lifestyle for the neighborhood's residents. Conclusions: The research conclude that it is essential to create a built environment that enhances physical activity levels among the population to reduce the risk of developing CVDs.

Keywords: Built environment; cardiovascular diseases; physical activity; walking; sidewalks; land use; Jordan; Amman.

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Introduction

The environment in which people live has an impact on their health. This impact becomes more challenging to urban planners, who are required to enhance the public health and the well-being of citizens, especially that most people live in cities, and that by 2050, 68% of the population will be living there in cities (1).

Cities are centers of jobs and money making, but at the same time, they are the sites where pollution and diseases spread (2). Modern cities are built while automobiles are taken into consideration, as opposed to ancient cities, which were built while walking on feet was taken in mind. The planning of modern cities leads to an increased dependence on cars as a mode of transportation and, consequently, to urban sprawl (3). This situation results in a lack of green spaces, poor active transportation infrastructure, and high exposure to certain environmental blights, such as pollution, noise, and the greenhouse effect, which can result in a sedentary lifestyle (4). This sedentary lifestyle, which mainly results from the absolute dependence on automobile, may lead to higher rates of CVDs (5).

According to 2019 World Health Organization (WHO) statistics, CVDs account for around 17.9 million deaths per year; this makes them the top cause of mortality globally (6). In Jordan, who statistics demonstrate a significant prevalence of CVDs risk in adults (45-69 years old) at 25% (7). More than 70% of the global burden of CVDs is attributed to modifiable risk factors, including individual lifestyle and the built environment's characteristics. Lack of physical activity is among the modifiable risk factors linked to CVDs. (8)

In examining how built environment affects CVDs, it is found that physical activity matters as it is considered one of the factors that put most adults at risk of CVDs; as CVDs risk are twice as high for inactive people compared to active people (9,10). For example; walking, one of the most popular kinds of physical activity among people in their local areas, is connected to a reduced risk of hypertension, coronary heart disease, and stroke (8). Furthermore, it is one of the mechanisms in which built environment might affect negatively or positively the rate of the occurrence of CVDs among populations (11). Based on the above, an environmental design that encourages walking and physical activity can make residents healthier. Jordan, which has 90.3% of the population in urban areas as more and more people are continually moving into cities, is characterized by rapid urban growth due to several variables. This rapid urbanization makes Jordan one of the top 50 most urbanized nations worldwide (12). With this rapid change in urban areas, which result in a lack of open spaces, green areas, and pedestrian mobility infrastructure (12,13), Jordan faces a critical challenge in building environments that promote physical activity. In its turn, this challenge limits the country's ability to reduce the occurrence of CVDs risk.

Background

The rapid growth of urban populations worldwide is one of the high priority public health concerns of the twenty-first century (14). Even though moving into an urban environment offers many advantages, it poses new and distinct health challenges (15,16). Prior research reveal that urban populations are more likely than rural ones to experience CVDs (17,18). In a study conducted among Thailand adults to examine the relationship between moving to urban areas and CVDs risk, the study finds that within four years of their movement, rural-urban migrants experience increased CVDs risk (19). The challenges to people's health in the rapidly urbanizing world are due to ongoing changes in the urban environment including land use patterns, transportation, and open spaces; which enhances sedentary lifestyle (2,20,21). As a result, chronic non-communicable diseases such as CVDs are increasingly replacing infectious diseases as the leading cause of mortality in many cities (20). It is becoming, increasingly, evident that CVDs prevention strategies must address the multidimensional, intricate range of factors affecting individuals' health daily such as the physical environments in which people live, work, travel, and play (22,23). The degree to which built environments encourage or discourage physical activity is one of the ways that these built environments impact cardiovascular health, and it is widely known that physical exercise has numerous advantages for cardiovascular health (24). It is obvious that when it comes to people's decisions to walk and engage in other sorts of physical activity, the physical environment's quality is important (25). Practices in urban planning and transportation, such as more compact planning, mixed-use development, increased street connectivity, street furniture, safe urban environments, and amenities for pedestrians and cyclists, could encourage healthy active commuting patterns and physical activity behavior and incorporate them into daily routines (26,27,28). These habits are crucial for combating modern physical inactivity, which is a serious health concern and a crucial issue at a time when individuals are typically too busy to engage in physical activity during their free time (5). Built environments, however, are complex systems, requiring more data on interconnected elements for decision-makers to target activities affecting cardiovascular health (5).

Also, most studies on built environment-CVDs relationship are in the high-income countries (11). Moreover, A limited number of research use a subjective questionnaire-based evaluation of the built environment (8). In the light of the aforementioned fact and given that the studies' results from high-income nations on the relationship between built environment and CVDs cannot be easily to transfer due to the effect of varied social and cultural backgrounds on CVDs incidence throughout the regions (29,30), this study aims to investigate the relationship between built environment, physical activity and CVD risk in Jordan by analyzing the case of Amman. It seeks to provide insights and solutions for urban agencies, and to suggest suitable policies to promote physical activity and overall health.

Method

Study Area

Amman is the governorate with the highest percentage of urban residents in Jordan (97.2%), due to high rate of domestic migration. Amman's urban planning strategy is mainly responsive to rapid domestic migration. This responsive planning affects the built environment of Amman neighborhoods negatively, and hinders the residents' physical activities; for example, the city is not friendly to pedestrians' mobility which contributes to increased reliance on private transportation and, consequently, to non-communicable diseases problems. (12)

As shown in Figure 1, the study area focuses on analyzing two neighborhoods of Amman (Abu-Alia, and Umm Uthainah Al Sharqi). These two neighborhoods represent the diversity of Amman's neighborhoods as seen in Table 1; such diversity helps to develop a set of solutions that can be applied to most of other Amman's neighborhoods basing on the distinctive qualities of each of these neighbourhoods.

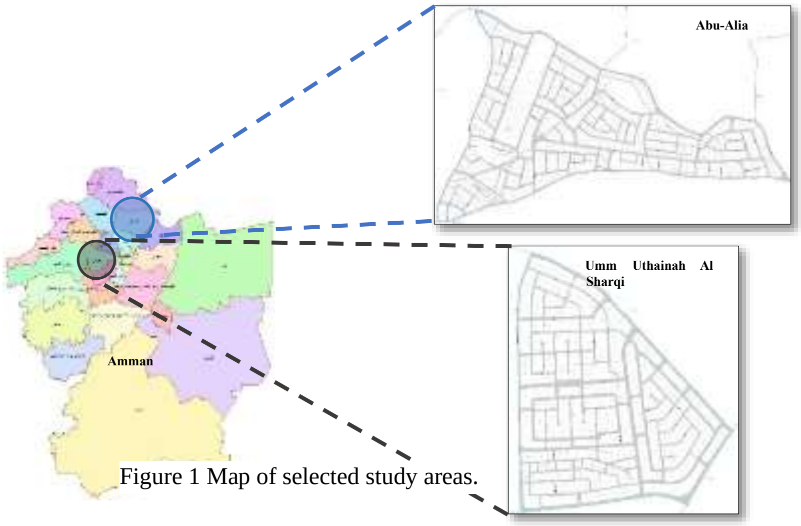

Figure 1 Map of selected study areas.

Greater Amman Municipality (GAM). (2023, March 13). Map of selected study areas. GIS department. Taken by the Author.

Table 1 Summery for the characteristics of the two neighborhoods.

Variables (Neighbourhood)	Abu-Alia	Umm Uthainah Al Sharqi
Location	Tariq district-East Amman	Zahran district-West Amman
Population	22515 persons	14702 persons
Area	1845206 m^2	1168152 m^2
Population Density	12.2 person per km^2	12.58 person per km^2
Soci-economic status	Low to middle income	Middle to high income
Land use and service availability	Commercial facilities located at the periphery	Commercial facilities located in the center
Topography	Featured with a high average slope	Featured with a low average slope

Study Population

The study sample size of 380 respondents calculated through using Krejcie and Morgan table (31). The participants involved in the study sample included all adults over the age of eighteen who live in either neighborhood.

Data Collection and Management

This study used quantitative method to collect necessary data through a well-designed questionnaire which was sent randomly online to the two neighborhoods residents to collect data related to the demographic information, CVDs prevalence, physical activity level, and information about how they perceived their neighborhood-built environment features. The participants in this study were informed about the nature and the goals of this research subject through a short brief at the beginning of the questionnaire.

1- Demographic Information

This includes self-reported data about the address, gender, age, and marital status.

2- Health status

The CVDs risk outcomes were self-reported history of coronary heart disease, cerebrovascular disease, peripheral arterial disease, rheumatic heart disease, and congenital heart disease diagnosed by doctors (7). Participants were considered CVDs patients if they had ever been diagnosed by a doctor with one of these conditions mentioned above. Although this survey did not provide any clinical data, earlier studies that concerned the validity and reliability of self-reported diseases have revealed a good level of agreement with medical records for most of the conditions covered here (32).

3- Measurement of Physical Activity Level

This section includes self-reported data about the participants' engagement in physical activities and walking. Using a short form of an international physical activity questionnaire (IPAQ), all survey participants answered multi-choice questions related to their level of physical exercise and walking over a typical week. The validity and reliability of the IPAQ have been thoroughly examined across 12 nations (33).

4- Measurement of Built Environment Exposure

This section includes self-reported data about this study neighborhoods-built environment features using the neighborhood walkability environment scale (NEWS). A wide range of nations have demonstrated the validity and reliability of the NEWS questionnaire in capturing neighborhood walkability and the perceived neighborhood environment (34), which evaluate the built environment's perception on the following chosen categories (sidewalk's quality (3 items), connectivity (4 items), mixed land use (3 items), neighborhood aesthetics (3 items), and safety from traffic (5 items)). Responses to these questions range from strongly disagree (1) to strongly agree (5) on a 5-point Likert scale. For statistical purposes, the responses to the questions are minimized into three categories: disagree, agree, and neither disagree or agree.

Data analysis

All data obtained from the questionnaire were analyzed using the SPSS program. Then, for all variables, descriptive statistics have conducted to calculate frequencies.

To investigate how the built environment might affect CVDs, binary and ordinal logistic regression models were created to determine any potential cofounder between the three variables; firstly, between physical activity and CVDs; secondly, between the built environment and CVDs; and finally, between the built environment and physical activity. The link between these variables was determined if the null hypothesis was rejected using the p-value corresponding to the Chi-square statistic. Based on whether the beta coefficient parameter was positive or negative, the direction of this association was established. To make interpretation easier, adjusted odds ratios were also calculated.

Results

Results illustrate that out of (384) participants, 35 participants were excluded due to either incomplete answers or their answers were considered an error by the SPSS program, (349) participants from the two neighborhoods completed the questionnaire; 177 participants from AbuAlia neighbourhood and 172 participants from Umm Uthainah Al Sharqi neighbourhood.

Table 2. Descriptive characteristics of study population by location.

Variables	Gender		Age				Marital status	
	Male	Female	19-29	30-50	51-70	>70	Married	single
Umm Uthainah Al Sharqi	86	86	22	60	82	8	140	32
Abu-Alia	78	99	27	102	42	6	143	34

Table 2 shows a detailed description of the study population. Out of (349) participants, there were 50.7 % from Abu-Alia neighborhood, and 49.3 % from Umm Uthainah Al Sharqi neighborhood. Of all participants, there were 53% women, 47% men, 28% aged (30-39) years, and 81.1 % married. In terms of health status and physical activity as illustrated in Table 3, of all participants, 28.7 % self-reported having CVDs. Table 3 also shows that the percentage of participants who reach the recommended level of physical activity stated by WHO is relatively low; 4.9 % do at least 75 minutes of vigorous activities per week, while 20.1 % do at least 150 minutes of moderate activities per week. Regarding walking, only 30.9 % of the participants walk at least 150 minutes per week.

Table 3. Descriptive characteristics of the study population regarding health status and physical activity level.

Variables	CVDs incidence		Vigorous physical activity			Moderate physical activity			Walking activity		
	Yes	No	Sedentary	<75 min	>75 min	Sedentary	<150 min	>150 min	Sedentary	<150 min	>150 min
Umm Uthainah Al Sharqi	34	138	106	55	11	47	79	46	23	80	69
Abu-Alia	66	111	118	58	6	93	63	21	33	105	39

Table 4 illustrates the attributes of perceived built environment in the both neighborhoods. The percentage of participants (who perceived that sidewalk are of high quality, streets are well connected, land use is diverse and accessible on foot, and neighborhood aesthetics of good quality) is higher in Umm Uthainah Al Sharqi than Abu-Alia neighborhood. On the other hand, Abu-Alia participants' agreement percentage concerning traffic safety is higher than that of Umm Uthainah Al Sharqi's.

Table 4. Descriptive characteristics of the built environment features.

Variables	Sidewalks			Connectivity			Mixed land use			Neighborhood aesthetics			Traffic safety		
	Agree	Neutral	Dis-agree	Agree	Neutral	Dis-agree	Agree	Neutral	Dis-agree	Agree	Neutral	Dis-agree	Agree	Neutral	Dis-agree
Umm Uthainah Al Sharqi	84	29	59	87	43	42	87	30	55	96	33	55	61	48	63
Alm-Alla	33	23	121	65	42	70	63	28	86	41	36	100	72	35	70

Binary regression analyses were conducted to identify any potential relationship between the three types of physical activity (vigorous, moderate, and walking) and CVDs. The results shown in Table 5 determined an inverse relationship between vigorous, moderate physical activity, and walking with the incidence of CVDs. This table shows that the chance of having CVDs is lower among the residents who are engaged in vigorous physical activity (B= -1.352; OR = 0.259; p = 0.000), while those who are engaged in moderate physical activity (B= -1.183; OR = 0.306; p = 0.000), and those who are engaged in walking activity (B= -0.341; OR = 0.711; p = 0.05).

Table 5. Association between vigorous, moderate physical activity, and walking with the incidence of CVDs, using binary regression analyses

Physical activity	CVDs incidence		
Variables	B	Sig.	OR
Vigorous physical activity	-1.352	0	0.259
Moderate physical activity	-1.183	0	0.306
Walking	-0.341	0.05	0.711

B= parameter estimate of the beta coefficient; OR= odd ratio; Sig. /P = p-value < 0.05.

Table 6 summarizes the relationship between the built environment, physical activity, and CVDs. Firstly, Binary regression analyses were conducted to identify any potential relationship between the built environment and CVDs. These results show that the chance of having CVDs is lower among residents who see that the quality of sidewalks is at good conditions (B= -0.293; OR = 0.746; p = 0.00001), those who perceived that the land use is diverse and most of destinations located within walking distance (B= -0.202; OR = 0818; p = 0.017), and those who see that the neighborhood aesthetics are at high quality (B= -0.528; OR = 0.590; p = 0.002). However, street connectivity and traffic safety were no longer associated with the incidence of CVDs; p > 0.05.

Secondly, ordinal regression analyses were conducted to identify any potential relationship between the built environment and three types of physical activity (vigorous, moderate, and walking). The results shown in Table 6 indicate that regarding vigorous physical activity, there is a positive relationship only with neighborhood aesthetics (B= 0 .398; OR = 1.484; p = 0.008), and there is no relationship with the other built environment criteria; p> 0.05. Concerning the moderate physical activity, the table indicates that the chance of achieving recommended moderate physical activity increased among residents who see that the quality of sidewalks is good (B= 0.254; OR = 1.286; p = 0.000), safety from traffic (B= 0.658; OR = 1.922; p = 0.002), the street is well connected and free of cul-de-sacs (B= 0.183; OR = 1.199; p = 0.000), and neighborhood aesthetics are of good quality (B= 0.634; OR = 1.877; p = 0.000). However, mixed land use was no longer associated with moderate physical activity; p> 0.05. Concerning the walking, table 6 shows that the chance of achieving 150 minutes of walking per week increased among residents who see that the quality of sidewalks is good (B= 0.158; OR = 1.167; p = 0.005), safety from traffic (B= 0.929; OR = 2.516; p = 0.000), the street is well connected and free of cul-de-sacs (B= 0.184; OR = 1.200; p = 0.000), mixed land use (B= 0.177; OR = 1.192; p = 0.0256), and neighborhood aesthetics are of good quality (B= 0.631; OR = 1.870; p = 0.000).

Table 6. Relationship between built environment, three type of physical activity, and CVDs. Using both binary and ordinal regression analysis.

Built environment characteristics	Vigorous physical activity			Moderate physical activity			Walking activity			CVDs incidence			CVDs risk factors		
Variables (Agree vs Disagree)	B	Sig.	OR	B	Sig.	OR	B	Sig.	OR	B	Sig.	OR	B	Sig.	OR
Sidewalks	0.081	0.172	1.083	0.254	0.000	1.286	0.158	0.005	1.167	-0.295	0.000	0.744	-0.151	0.011	0.859
Street connectivity	-0.037	0.437	0.964	0.183	0.000	1.199	0.184	0.000	1.200	0.048	0.351	1.049	-0.134	0.006	0.873
Land use diversity	-0.176	0.513	0.840	0.009	0.885	1.009	0.177	0.026	1.192	-0.202	0.017	0.818	-0.184	0.077	0.833
Neighborhood Aesthetic	0.398	0.008	1.484	0.634	0.000	1.877	0.631	0.000	1.870	-0.325	0.002	0.758	-0.303	0.030	0.739
Traffic safety	0.403	0.087	1.492	0.658	0.002	1.922	0.929	0.000	2.516	-0.268	0.290	0.765	-0.113	0.634	0.893

B= parameter estimate of the beta coefficient; OR= odd ratio; Sig. /P = p-value < 0.05.

Discussion

Built Environment, CVDs, and Physical Activity Conditions

The findings indicated that the prevalence of CVDs occurrence among participants was high, with nearly one-third self-reported having CVDs. This finding conforms to the Jordan National Stepwise Survey for Noncommunicable Diseases Risk Factors 2019 findings (7). A proportion of participants reached the recommended level of physical activity and walking (38%). However around (10 %) of all participants didn't engage in any physical activity or walking. Recently, research on how the built environment affects health-related behaviors has blossomed. This research could be considered as one of the few that examine the relationship between CVDs, three types of physical activity, and built environment characteristics. To understand how the built environment might affect CVDs. Firstly, the research studies the relationship between physical activity and CVDs. Then it studies the relationship between built environment, CVDs, and physical activity.

Physical Activity and the Risk of Developing CVDs Risk.

The study outcomes concerning physical activity are consistent with previous studies that state the positive role of physical activity in enhancing overall health and reducing CVDs (35,36). An important correlation between increasing one's physical activity and a lower risk of developing CVDs was proved. Similar to this study's findings, a study by Carnethon finds that more physical activity is associated with a lower chance of the incidence of CVDs as compared to a less physical activity (37). Such increase in physical activity may in turn reduce the buildup of fatty material in the arteries, which consequently enhance CVD health (38). Even a short time of vigorous physical activity can help to reduce CVDs risk. A study conducted among 71 893 adults in the United Kingdom revealed that a lower incidence and mortality of CVDs are linked with 15-20 minutes of intense physical activity weekly. Regarding walking, according to a meta-analysis, walking for 30 minutes five days a week is thought to reduce the risk of coronary heart disease by 19% (39).

Built environment and the risk of developing CVDs risk.

The research indicates that there is an inverse proportion between built environment characteristics and the occurrence of CVDs through physical activity pathway; it indicates that the built environment characteristics might reduce the risk of developing CVDs by enhancing physical activity among populations. This result supported the growing evidence that concerned the relationship between built environment and CVDs (40,11). The research finds that residents who live in areas with well maintained **sidewalks** and free of any obstacles have a lower risk of CVDs. This result might be explained by the role of sidewalks in enhancing residents' engagement in physical activity and walking, for instance, a meta-analysis of studies that use self-reported measures of the built environment discovers that people who report having sidewalks in their neighborhood are more likely to engage in physical activity, and the presence of sidewalks was the factor most strongly linked to engaging in the recommended periods of physical activity (41,42).Another study conducted in a low-middle-income country indicates that the presence of good quality sidewalks is associated with reaching the recommended level of both physical activity and walking (43). Participants who self-reported that there are many fascinating sights to see while walking, the neighborhood was free of litter, and there are trees along the streets that give shading to sidewalks, have a lower risk of developing CVDs. It sounds logical to say that living in a good quality **neighborhood aesthetics** might increase one's physical activity. Several studies indicate that neighborhood aesthetics are associated positively with meeting the recommended level of physical activity (43,44). In Nigeria, young individuals' perceptions of many intriguing sights are substantially correlated with how long they walk (45). Finally, participants who perceive many destinations that are easily accessible on foot (**mixed land use**) have a lower risk of CVDs. Little data support the link between land use diversity and the risk of CVDs in developing Asian countries (30). However, one reason of low CVDs in these countries is the accessibility and proximity of different destinations encouraged residents to walk; walking in its turn might reduce the risk of CVDs. This result was aligned with the results of many studies that link land use diversity with walking (46,47). A study conducted in Malaysia to assess the impact of built environment on hospital admissions for CVDs suggests that lower admissions to cardiovascular hospitals in the city of Kuala Lumpur are connected to land use variety (30). Furthermore, the findings indicate that the quality of sidewalks and neighborhood aesthetics are the most built environment characteristics that are associated with physical activity and low occurrence of CVDs.

Conclusion

This research is based on self-reported data for CVDs, physical activity level, and built environment outcomes. Based on the research findings, one might conclude that the majority of CVDs incidences and physical inactivity have concentrated among participants who resided in a low-quality neighborhood-built environment; this emphasizes the significant role of built environment on human health. In an attempt to detect a mechanism by which the built environment affected CVDs risk, it concluded that the built environment could reduce the possibility of developing CVDs by encouraging physical activity among the population. Likewise, one might conclude that the presence of good quality sidewalks and a high order of aesthetics in the neighborhood might significantly augment cardiovascular health, as they increase physical activity levels and walking among residents. Mixed land use could negatively affect the risk of developing

CVDs, as they encourage walking activity among neighborhood residents. Through the finding of this study, it is noticed that in the existing neighborhoods, where it is difficult to install a park or changing land use or connectivity, the development of CVDs risk could be reduced by installing or enhancing existing sidewalks or the quality of neighborhood aesthetics. This research concludes that for long-term improvements, it is essential to take action that ensures the compatibility between different built environment characteristics as it affected the degree to which these characteristics encouraged neighborhood residents to engage in physical activity and enhance walking behavior, therefore reducing the risk of developing CVDs among them. The findings could contribute to the growing body of research that investigate the association between built environments and CVDs by providing evidence from a high-population density neighborhoods in a middle-income country, such as Jordan. Also, the findings offer enormous potential for evidence that incorporates health into urban planning and tackling the epidemic of CVDs in urban environments. However, this research provides guidance for urban planning experts, local authorities, and anyone interested in city development on how to reduce the wide prevalence of CVDs among residents.

Future Research

Further research in Jordan is required for a better understanding of the mechanism through which built environment affects CVDs. In order to give a larger collection of data, to comprehend the problems and come up with solutions, that assist in identifying the most prevalent and major hurdles of physical activity, the future research might expand their scope to include more neighborhoods. In addition, further research might study in details each of the characteristics of the built environment that have been proven to be related to both physical activity and CVDs and investigate them in details; this may provide specific guidelines for urban planning policies.

Limitation and Strength

The study has some constraints; instead of using measured built environment, physical activity and clinical data for CVDs objectively, it depends on self-reported physical activity, CVDs, and built environment which may recall bias. Also, causal associations cannot be established because of the cross-sectional methodology of this study. The strength of this study is that it assesses the relationship between subjectively measured built environment, CVDs risk, both vigorous and moderate physical activity and walking. Also, using both NEWS and IPAQ as references in this study questionnaire makes it comparable to other studies conducted around the world.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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