Walking down the street: how does the built environment promote physical activity? A case study of Indonesian cities

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ABSTRACT
This research merges individual self-reported physical-activity data from the fifth wave of the Indonesia Family Life Survey (IFLS) with data on Indonesian cities’ and municipalities’ built environments and employs cross-sectional multilevel regression to disentangle the relevant factors that affect individual incentives to engage in physical activity. The results suggest that high-density settings and land-use diversity in Indonesian urban settings adversely affect the incentive to engage in physical activity. Our finding reflects the common case of developing countries where the main problem arises from insufficient urban planning, which further results in other issues such as conventional land use and low-level safety and security. Thus, the result implies the urgency to improve built-environment planning in Indonesia to create a more supportive living environment that encourages residents to be more physically active, hence creating a healthier society.

1. Introduction
Physical inactivity has become an increasingly prevalent trend in the majority of today’s global population and increases the prevalence of many major non-communicable diseases (NCDs) around the world (Bauman et al. 2012; Gordon-Larsen et al. 2000; Giles-Corti and Donovan 2002). NCDs cause nearly two-thirds of the world’s death, and 80% of the NCDs takes place in low and middle-income countries (Haileamlak 1970). According to data released by WHO 2020, one in four adults are insufficiently active and up to five million deaths per year could be prevented if the global population were more physically active. These facts create some urgency in both developed and developing countries to disentangle the factors that encourage people to increase their physical activity (PA) in order to create a healthier society. However, while many recent studies in developed countries have found that physical activity is influenced by the surrounding built environment where individuals live, studies in developing countries regarding this matter are still limited. The results also remain widely varied. Assessing the built environment’s impact on physical activity in developing countries is attractive due to the problem of inappropriate urban planning, which often occurs in developing countries (Arifwidodo 2012). This issue generates various situations, such as conventional land use, poor urban design and unorganised density, which raises safety and security issues (Xu et al. 2010; Leather et al. 2011). Consequently, these problems might cause inconsistent results with the majority finding in developed countries where built environments positively contribute to physical activity. Increasing awareness of the importance of the built environment in promoting physical activity, especially in developing countries, is crucial because of the high prevalence of insufficient physical activity and the
prevalent lack of consideration of health impact in project planning (Das and Horton 2012; Zapata-Diomed et al. 2016). Moreover, until recently, especially most cities in Global South countries, there is no political campaign or initiative has the concern to promote physical activities or convince people not to rely on private mode. Promotion and campaign to engage in physical activities, safe pedestrian, and walkability are mostly performed only by a certain informal community or limited social movements. Therefore, this research aims to analyse how the surrounding built environment can affect individual incentives to engage in physical activity using the case study of Indonesian cities/municipalities (kota/kabupaten).

As some individual socioeconomic attributes, such as age, sex, marital status, education level, health condition, and income per capita, affect individual decisions to engage in physical activity (Oakes et al. 2007; McCormack et al. 2014), some studies have revealed that high quality-built environments incentivise physical activity (Oakes et al. 2007; McCormack et al. 2014; Wang et al. 2016). There are three attributes commonly used in the literature to define built environment: density, mixed land use, and connectivity (Saelens and Handy 2010; Zapata-Diomed et al. 2016; Xiao et al. 2020). Density is an important proxy of perceived safety since higher densities tend to create a critical mass of people: there are more people walking and seeing others walking, and the number of people increases the feeling of safety (Forsyth et al. 2007; Oakes et al. 2007). This proxy is believed to be important since it has direct effects on utilitarian physical activity and it may also serve as a proxy for income (Chaudhury et al. 2012). Mixed land use could also affect physical activity since access to common spaces provides the opportunity within the neighbourhood for walking, cycling, and other forms of physical activity (Pearce et al. 2011). Finally, connectivity is thought to matter because it affects the directness of travel, making travel more or less efficient and determining the number of alternative routes with implications for interest, walkability, and safety (Saelens et al. 2003; Oakes et al. 2007).

A growing body of literatures provides robust evidence that density, mixed land use, and connectivity promotes physical activity. Devarajan et al. (2020) and Wang et al. (2016) found that individuals living in a neighbourhood with attractive natural sights, better air quality, and relatively mild weather are more inclined to engage in physical activity outside enclosed spaces. Similarly, higher-density areas with mixed land use that reduces distances between destinations are said to be effective in encouraging active forms of transportation, such as walking and cycling, by reducing the incentives to drive motorised vehicles (Saelens and Handy et al. 2010; McCormack et al. 2014; Heath et al. 2016; Wang et al. 2016). Others have also noted that perceived access to public spaces, parks, or recreational facilities can promote outdoor activities (Kemperman and Timmerman 2009; Sallis et al. 2012; Wang et al. 2016).

Nevertheless, the vast majority of evidence in this area is limited to developed countries. To date, studies examining the association between the built environment and physical activity in developing countries are still rare, and there is still some ambiguity in their findings. For instance, residential density is found to have an inconsistent association with physical activity. A significant negative association between density and physical activity was found in urban India (Adlakha et al. 2017) while a study by Siqueira Reis et al. (2013) in Brazil did not detect any similar significant relationships. In the case of China, Day (2016) found that physical activity is highly associated with providing non-residential spaces while Su et al. (2014) contrastingly found that residential density in urban China was instead associated with more walking among female populations. Using two levels of data at individual level (sociodemographic characteristics and anthropometric measures) and community level (residential density and public green space), Wang et al. (2019) investigated the association between residential density and physical activity in China. Moreover, they also employ a multi-stage sampling approach to select participants in their study which potentially causes clustering effect at neighbourhood level. Therefore, they considered this potential clustering effects using mixed – effects regression in the analysis. The result showed a negative association between residential density and physical activities that contrast with the majority finding from Western countries. Interestingly, Wang et al. (2019) pointed out that community-level factors are more impactful on residents’ physical activity than individual level-factors. Therefore, the closure remains inconclusive.

Similarly, contradictory findings also occur in relation to mixed land use. Adlakha et al. (2017) did not find any significant association between mixed land use and leisurely physical activity. Still, they found
a positive association between mixed land use and physical activity for travel. Moreover, studies have also revealed an inconsistent association between the provision of recreational facilities and physical activity. In this case, Oyeyemi et al. (2011), Cerin et al. (2006) and Chen et al. (2017) found a significant relationship between the two in Africa and China, especially related to the relationship between the proximity of green recreational facilities or urban green space (such as city parks) and leisure physical activities. These results were not observed in Hallal et al.’s (2010) study in Brazil and Adlakha et al. (2017) in India. The cross-sectional study by Adlakha et al. (2017) did not reveal any significant association between land-use mix access or proximity of recreational facilities and leisure PA among urban Indian adults. They argued that this result is driven by the fact that in low-and-middle-income countries such as India, areas with high land use mix and density include a large number of individuals or households living together which results in overcrowding (Adlakha et al. 2017). These neighbourhoods are often unattractive and then hinder residents’ physical activities.

Meanwhile, Hallal et al. (2010) specifically reported an inverse relationship between aesthetics and travel PA in urban Brazil. Individuals who perceived their neighbourhood as not pleasant (presence of garbage and open sewage) were more likely to practise transport-related physical activities. This is because there is some evidence that low socio-economic status populations in Latin America are more likely to use walking and bicycling as a means of transportation regardless of the environment conditions (Hallal et al. 2010). Therefore, there is still a gap in the current knowledge on how built environments can promote or constrain physical activity, particularly in specific developing countries. Examining the different contexts of the study is crucial because physical activity may differ due to cultural factors and specific built-environment characteristics (Day 2016).

This study provides analysis regarding the role of the built environment in promoting physical activity using the case of Indonesian cities/municipalities. Investigating the link between the built environment and physical activity in the Indonesian context is important for several reasons. First, it is estimated that about a quarter of the adult population in Indonesia is overweight or obese (Ministry of Health 2018; WHO 2018). Second, increasing obesity and NCD prevalence has been found to be associated with physical inactivity among the population (Ministry of Health 2018; WHO 2018; Oddo et al. 2019; Andriyani et al. 2020). This data supported the results of a study from Basic Health Research (RISKESDAS) in 2018 – a cross-sectional and community-based nationwide survey to evaluate public health indicators conducted every 5–6 years – which revealed that 33.5% of Indonesians lacked physical activity. The implications of the rising incidence of these diseases cannot be neglected, as they place additional pressure upon the national health system and economic productivity (WHO 2018). Third, designing the built environment in Indonesia to promote physical activity has not received considerable attention (Oddo et al. 2019). Furthermore, as part of the global south country, Indonesia is currently facing rapid urbanisation and faster-growing cities that are not followed by adequate infrastructures and proper city planning (World Bank 2016). Furthermore, most cities in Indonesia also lack sufficient bike lanes, safe sidewalks, and public parks, which may reduce physical inactivity (UNICEF 2016).

This study contributes to extending the existing literature on the effect of the built environment towards physical activity in developing countries, especially in Indonesia. To the best of our knowledge, there is no further empirical study on this issue in Indonesia. Existing empirical studies investigating the relationship between the built environment and physical activity are rarely found in the Indonesian context, and the studies that do exist, such as Tanan and Darmoyono (2017) and Sulinda and Lo (2011), focus on a specific metropolitan area (Jakarta dan Bogor). Tanan and Darmoyono (2017) applied a more qualitative study to analyse walkability and discussed the approach to policy and planning of pedestrian facilities that facilitate walking in Bogor City. They found that the government policy in terms of making a ‘pedestrian design competitions’ in the city of Bogor has encouraged public participation to support the idea of a green city.

Meanwhile, Sulinda and Lo (2011) examines the issue of walkability planning in Jakarta by investigating what matters to pedestrians and how pedestrian space is produced by using in-depth qualitative analysis as well as statistical analysis. Nevertheless, these two studies focus more on qualitative analysis. Besides, they also only discuss Bogor and Jakarta, two large cities located within the metropolitan area
in Indonesia, namely Jabodetabek (Jabodetabek is an abbreviation of the name of metropolitan areas consists of Jakarta-Bogor-Depok-Tangerang-Bekasi). As two cities located in the Jabodetabek metropolitan area, the walkability and urban design in these two areas is certainly much different from other cities in Indonesia. Thus, the results only apply to a limited context and cannot be generalised. Therefore, this issue remains open for further discussion to raise awareness of the importance of the built environment in promoting physical activity and enhancing health quality. Including more samples across cities/municipalities in Indonesia, which is done in this study, enables us to analyse the importance of the built environment from a broader perspective. This paper is organised as follows: Section 2 discusses the research methods and introduces the data employed in the paper. Section 3 presents the empirical findings and discussion. While the last section summarises the limitations, conclusions and recommendations of the study.

2. Methods

Data and variables

This study combines two main data sets: the fifth wave of the Indonesia Family Life Survey (IFLS) 2014 and geographical databases provided by the Indonesia Geospatial Information Agency. The IFLS is a longitudinal survey representing 83% of the Indonesian population living in 13 of the 34 provinces in Indonesia and contains rich data about individuals, families, households and communities in Indonesia. The IFLS provides a detailed record of individual physical activity, which is the primary concern of this study. Meanwhile, the data regarding the built environment is obtained using ArcGIS software, including density, mixed land use and connectivity. This research uses a cross-sectional data set from 2014 that combines these two sources, resulting in a total of 4,025 individuals from 153 of the 500 cities/municipalities in Indonesia.

In the IFLS, data regarding self-reported physical activities for individuals aged 15 and above are asked particularly in Book 3B, Section KK (Kondisi Kesehatan/Health Status). The IFLS divides physical activity into three main categories: vigorous activities, moderate physical effort, and walking. Based on the IFLS, vigorous activities are defined as activities that make an individual breathe harder than normal and may include heavy lifting, aerobics, fast bicycling, or cycling with loads. In contrast to vigorous activities, moderate physical effort is defined as physical activities that make an individual breathe somewhat harder than normal and may include carrying light loads or bicycling at a regular pace. Lastly, walking includes walking at work and home or walking to travel from one place to another. However, data for walking and other physical activity in IFLS does not differentiate the walking purpose and includes all walking activities, whether for recreation, sport, exercise, or leisure, as an aggregate. Consequently, the data also does not allow us to identify specific locations where the physical activities have been carried out. For example, on weekdays, workers who have more time-use for out-of-home activities will spend most of his/her time in the built environment near their workplace which may be totally different from the built environment near their residential areas. This issue then also becomes a limitation of this study.

The dependent variables in this study were created for three main activity categories (vigorous activities, moderate physical effort, and walking). Each category was proxied using three main questions related to physical activity in the fifth wave of the IFLS. For the first question, respondents were asked, ‘During the last seven days, did you do any [...] for at least 10 minutes continuously?’ The respondents were expected to answer ‘Yes’ or ‘No’ to this question. We created a binary variable with a value of 1 if the respondent answered ‘Yes’ and 0 if the respondent answered ‘No’ for each activity category. The second question asked, ‘How much time did you usually spend doing [...] on one of those days?’ and included four possible answers: (1) <30 minutes; (2) 30 minutes–2 hours; (3) 2–4 hours; and (4) ≥4 hours. The mean of the descriptive statistics was set as the threshold value. The mean value for the duration of time engaging in vigorous activities was 30 minutes to 2 hours. We assigned 1 or ‘high’ for the respondents who answered above the threshold and 0 if otherwise for vigorous activities. Meanwhile, the mean value of the duration of moderate and walking activities was <30 minutes. Similarly, the dummy variable for moderate and walking activities was created and assigned as 1 if the duration of time was above the threshold and 0 if below the threshold value.

In addition, we also measured the duration of time spent on vigorous and moderate activities based on
the WHO standard for physical activity. WHO (2020) recommended that the duration of vigorous and moderate activities be 75–150 minutes and 150–300 minutes, respectively. Accordingly, we also created additional dummy variables on vigorous and moderate activities using this standard. This standardisation is presented in Table 1.

Last, the third question asked, ‘During the last 7 days, on how many days did you do […]?’ The mean of the respondent’s response for each activity was then calculated, and we set the value as the threshold. Respondents who answered below the average were then recoded as 0, while 1 was used for respondents who reported above the average. We excluded observation with missing answers related to physical activities. Regarding the ability of respondents to do physical activity, the samples we used are those who are able to do physical activity with the categories ‘easily’, ‘with difficulties’, and ‘can do with help’ according to the questions contained in the KK03 question in the IFLS. We acknowledged that respondents who fill the ‘with difficulties’ and ‘can do with help’ categories may have limitations in carrying out physical activities. However, we control for this by including perceived health variable in the regression.

Moreover, the number of respondents who answered ‘unable’ to do physical activities from all IFLS respondents only amounted to 1.8% of the total respondents and did not fill out questions regarding physical activity frequency, intensity, and duration. Therefore, we argued that their number was not considerable and such respondents were not included in the sample of this study. Hence, the total number of observations used in this study included 4,025 individuals aged 15 and above spread across 153 of the 512 districts in Indonesia. All of the dependent-variable categorisations are given in Table 2.

Next, the ArcGIS software was used to develop three main urban-form measurements at the city and municipality levels: density, mixed land use, and connectivity. Density was proxied using residential density, the ratio of the residential area to the total area (Burton 2002; Yang 2008; Wood et al. 2012), following Forsyth et al. (2007). In this study we also used residential density to represent connectivity following Forsyth et al. (2007) and Seong et al. (2021). Bramley et al. (2009) argued that density is not only represents physical element, but also closely linked with social environment configuration. High residential density reduces travel time per person and create a more walkable environment because shorter distance between destinations, means that it can also represent high connectivity (Forsyth et al. 2007; Wood et al. 2012; Patacchini et al. 2015; Seong et al. 2021). Thus, we utilised residential density to represent both density and walkability. Meanwhile, this study used density of local destinations per unit area to measure mixed land use (Oakes et al. 2007; Day 2016; Cleland et al. 2019). We disaggregated the land-use mix into three main categories: public, commercial, and recreational amenities, as these places provide the opportunity for physical activity among adults, the elderly, and even children (Addy et al.

Table 1. Categorisation for WHO standard binary dependent variable.

| Physical Activity | IFLS Questions | Categorisation for WHO Standard |
|-------------------|----------------|---------------------------------|
| Vigorous Activity | How much time did you usually spend doing […] on one of those days? [kk02n] | During the last 7 days, on how many days did you do […]? [kk02o] |
| [WHO Standard: 75–150 minutes at minimum] | <30 minutes [median: 15 minutes] | 0–5 days |
| | 30 minutes–2 hours [median: 75 minutes] | 0–7 days |
| | 2–4 hours [median: 18 minutes] | 0–7 days |
| Moderate Physical Effort and Walking | [WHO Standard: 150–300 minutes at minimum] | ≥4 hours |
| | <30 minutes [median: 15 minutes] | 0–7 days |
| | 30 minutes–2 hours [median: 75 minutes] | 0–7 days |
| | 2–4 hours [median: 18 minutes] | 0–7 days |
| | ≥4 hours | |

Source: Classified by authors from IFLS categorisation and WHO standard for physical activity (WHO 2020, November 26)
2004; Davison and Lawson 2006; Cohen et al. 2007; Li et al. 2008; Pearce et al. 2011). Schools, hospitals and government offices were included as public amenities. Contrastingly, commercial amenities include some places such as supermarkets, bookshop, food stores, convenience stores, etc. Moreover, places like museums, parks, cinema, etc. were included as recreational amenities.

It is also intuitive to assume that individuals living in an urban area would be less active than their rural counterparts (Springer et al. 2006; Liu et al. 2008; Albarwani et al. 2009; Ismailov and Leatherdale 2010). Urban areas pose a challenge for encouraging people to be more physically active since surrounding areas are generally not as inviting for walking and cycling because larger roads (for cars) and greater distances between urban functions discourage physical activity as part of daily life (WHO 2017). However, research dealing with the impact of urban settings on physical activity has not been entirely consistent (Cicognani et al. 2008). Some studies have found that physical-activity levels are higher in urban areas than in rural areas, and, correspondingly, physical inactivity is higher in rural areas than in urban areas (Parks 2003; Martin et al. 2005). Thus, the results are still inconclusive. Accordingly, we created a dummy variable to examine whether there are any differences in physical activity between urban and rural areas, with 1 representing the urban area of a city/municipality and 0 representing the rural area.

Based on Law No. 22/1999, Indonesian territory is divided into four main administrative areas: province, city/municipality, district (kecamatan), and subdistrict (kelurahan/desa). Cities and municipalities are of an equal level and have their own local government and legislative bodies. Each city/municipality consists of several districts/subdistricts, and the size of a municipality is greater than that of a city. Each city is headed by a city major, while a regent leads the municipality. Furthermore, a city or municipality is classified as an urban area if it (1) has a population density of 5,000 persons per square kilometre, (2) less than 25% of households work in the agricultural sector, and (3) there are 8 or more specific kinds of urban facilities, including basic facilities (schools, hospitals, and health care), roads that can accommodate 3- and 4-wheeled motorised vehicles, telephones, post offices, markets with buildings, shopping centres, banks, factories, restaurants, as well as public electricity and equipment-rental services.

We also included the individual-level socio-economic characteristics as predictors of physical activity. These variables were age, sex, marital status, education level, income per capita, and perceived health condition, following Oakes et al. (2007) and McCormack et al. (2014). These variables were treated as binary, except age and income per capita, which are continuous variables.

**Empirical strategy and model specifications**

A two-level multilevel regression was used as the estimation strategy in this research since the combined data set in this study had a hierarchical
Table 3. Summary statistics.

| Variable                                                                 | Types  | Obs       | Mean    | Std. Dev. | Min | Max |
|--------------------------------------------------------------------------|--------|-----------|---------|-----------|-----|-----|
| A. Dependent Variables                                                   |        |           |         |           |     |     |
| During the last 7 days, did you do any […] for at least 10 minutes continuously? | Binary | 4,025     | 0.313   | 0.4638    | 0   | 1   |
| Vigorous Physical Activity [1 = Yes]                                     | Binary | 4,025     | 0.6045  | 0.4890    | 0   | 1   |
| Moderate Physical Effort [1 = Yes]                                       | Binary | 4,025     | 0.7675  | 0.4225    | 0   | 1   |
| How much time did you usually spend doing […] on one of those days?     | Binary | 4,025     | 0.7677  | 0.4224    | 0   | 1   |
| Vigorous Physical Activity [1 = Above average]                          | Binary | 4,025     | 0.6007  | 0.4898    | 0   | 1   |
| Moderate Physical Effort [1 = Above average]                            | Binary | 4,025     | 0.4527  | 0.9782    | 0   | 1   |
| Walking [1 = Above average]                                             | Binary | 4,025     | 0.2671  | 0.4425    | 0   | 1   |
| During the last 7 days, how many days did you do […]?                   | Binary | 4,025     | 0.5347  | 0.4986    | 0   | 1   |
| Vigorous Physical Activity [1 = Above average]                          | Binary | 4,025     | 0.6917  | 0.4616    | 0   | 1   |
| Moderate Physical Effort [1 = Above average]                            | Binary | 4,025     | 0.7101  | 0.4538    | 0   | 1   |
| During the last 7 days, did the respondent do […] according to the WHO standard at the minimum? | Binary | 4,025     | 0.9605  | 0.1948    | 0   | 1   |
| Vigorous Physical Activity [1 = Yes]                                    | Binary | 4,025     | 0.7883  | 0.4085    | 0   | 1   |
| Moderate Physical Effort [1 = Yes]                                      | Binary | 4,025     | 0.7101  | 0.4538    | 0   | 1   |
| Walking [1 = Yes]                                                        | Binary | 4,025     | 0.3307  | 0.8941    | 0.0001 | 7.5314 |
| B. Independent Variables                                                 |        |           |         |           |     |     |
| Residential Density                                                     | Continuous | 4,025 | 0.3307 | 0.8941   | 0.0001 | 7.5314 |
| Public-Essentials Density                                               | Continuous | 4,025 | 0.1889 | 0.6796   | 0   | 8.1566 |
| Commercial -Essentials Density                                          | Continuous | 4,025 | 0.4481 | 1.3053   | 0   | 10.816 |
| Recreation-Facility Density                                             | Continuous | 4,025 | 0.4664 | 1.4514   | 0   | 12.431 |
| Urban Status [1 = Urban]                                                | Continuous | 4,025 | 0.4807 | 0.4997   | 0   | 1   |
| B2. Control Variable                                                     |        |           |         |           |     |     |
| Age                                                                      | Continuous | 4,025 | 40.109 | 14.194   | 15  | 93  |
| Marital Status [1 = Married]                                            | Binary | 4,025     | 0.7508  | 0.4326    | 0   | 1   |
| Sex [1 = Male]                                                          | Binary | 4,025     | 0.5776  | 0.4934    | 0   | 1   |
| Highest Education Level Elementary [1 = Yes]                            | Binary | 4,025     | 0.3774  | 0.4848    | 0   | 1   |
| Highest Education Level Secondary [1 = Yes]                             | Binary | 4,025     | 0.4681  | 0.4990    | 0   | 1   |
| Highest Education Level Tertiary [1 = Yes]                              | Binary | 4,025     | 0.1014  | 0.3016    | 0   | 1   |
| Log Per capita Expenditure                                              | Continuous | 4,025 | 13.601 | 6.236    | 11.1912 | 16.6495 |
| Perceived Health [1 = Healthy]                                          | Binary | 4,025     | 0.8002  | 0.3999    | 0   | 1   |

Source: Fifth wave IFLS. Observations with missing answers, especially those related to physical activity, were dropped from the sample, were observations who lived in some cities or municipalities where the built environment data were not available.

structure nesting individuals (first level) within cities or municipalities (second level). Multilevel regression has become increasingly popular in analysing cross-sectional data related to physical activity (Li et al. 2005; Ewing and Hamidi 2014; Su et al. 2014). Using the hierarchical data structure, we might expect that individuals residing in the same city/municipality will tend to be more alike or maybe closely related. For example, individuals learn the features of their environment, such as road characteristics and the habit of other individuals in the neighbourhood, which are likely to influence their physical activity behaviour. Because of these effects, we would expect that physical activity behaviour for individuals in the same neighbourhood to be more alike than individuals from different neighbourhood. Thus, it violated the independence assumption in Ordinary Least Square (OLS). Therefore, using a multilevel regression was a more advisable approach since it addresses dependency problems (Snijders and Bosker 1999; Hox 2002; Steele 2008).

A two-step modelling procedure was used in this research. The empty model (Step 1) with no explanatory variable was used to calculate intra-class correlation (ICC). The ICC represents the proportion of the total variance in physical activity due to differences within the city/municipality (Su et al. 2014). The value of ICC also provides a guarantee for using multilevel regression (Hox et al. 2018). The ICC generated in Step 1 indicates the extent to which the contextual level explains physical activity. A two-tailed p-value of 0.01 and 0.05 was considered to be significant. In Step 2, a multilevel model was developed to simultaneously examine how the individual-level and the city/municipality-level characteristics were associated with
physical activity. Multilevel logistic regression was used to estimate the following model specifications:

Level 1 (individual level):

\[
\log \left( \frac{\pi_{ij}}{1 - \pi_{ij}} \right) = \beta_0 + \beta_1 Age_{ij} + \beta_2 DM\text{Married}_{ij} \\
+ \beta_3 DM\text{ale}_{ij} + \beta_4 DE\text{elementary}_{ij} \\
+ \beta_5 D\text{second}_{ij} + \beta_6 DT\text{ertiary}_{ij} \\
+ \beta_7 I\text{ncomePerCapita}_{ij} + \beta_8 D\text{Health}_{ij}
\]

(1)

Level 2 (city/municipality level):

\[
\beta_0j = \gamma_{00} + \gamma_{01}R\text{esidentDensity}_{ij} + \gamma_{02}P\text{ublicAmenities}_{ij} \\
+ \gamma_{03}R\text{etailAmenities}_{ij} \\
+ \gamma_{04}R\text{ecreationalAmenities}_{ij} + \gamma_{05}D\text{Urban}_{ij} + u_{0j}
\]

(2)

Where \(i = 1, 2, 3, \ldots, N\) \((N = 4,025)\) and \(j = 1, 2, 3, \ldots, J (J = 153)\). In Step 2, we estimated each dependent variable separately using several models: a model adjusted with sociodemographic attributes and built-environment characteristics and the full model. However, only the main results are discussed, and the complete results are given in the Appendix.

3. Results and discussions

Descriptive statistics for all variables, including respondent health and socioeconomic characteristics, are displayed in Table 3. The mean age was 40 years old, and the respondents were predominantly male (58%). The majority of the sample had received a lower level of education (below tertiary education), had a middle income (mean expenditure IDR 806,129.75 per month), and 75% of them lived with their spouse. Moreover, 48% lived in the urban area, and 80% also perceived themselves as healthy.

It can be seen that walking dominated the other two activities for the first question (duration of time at least 10 minutes continuously) and the third question (duration of days). Meanwhile, vigorous activity showed a higher mean than the other two activities (duration of time engaging in the activities) for the second question. This result also holds when we used the WHO standard for physical activity. This may be due to the inclusion of the types of physical activity in the IFLS. In IFLS, physical activities that are part of work and not intended for increasing health conditions, such as digging, ploughing, mopping, or sweeping the floor, are also included in vigorous activities (for digging and ploughing) and moderate physical effort (for mopping and sweeping). However, in the literature, physical activity can be manifested in various ways (Caspersen et al. 1985). Furthermore, Cleland et al. (2019) and Strath et al. (2013) divided physical activity into occupational, domestic, transportation, and leisure domains. The occupational domain includes work-related physical activity involving manual labour tasks, walking, and carrying or lifting objects. The domestic domain includes housework, yard work, childcare, chores, self-care, shopping, and other domestic physical activities. Based on this literature, we argue that the inclusion, as mentioned previously, is still relevant.

Regression results and discussions

The ICC for each specification shows that about 1%–6% of the variation in vigorous physical activity, moderate physical effort, and walking was attributed to differences in cities or municipalities. The results of the relationship between built environments and vigorous physical activity, moderate physical activity, and walking are presented in Table 4. The results presented in this table are the full model or model adjusting for covariates. However, a significant association between the built environment and physical activity only appeared for vigorous activities.

Interestingly, as seen in the table, the result shows that residents living in a denser area were less likely to be more physically active, particularly in relation to vigorous activities (OR: 0.8750, CI: 0.7785–0.983). Moreover, they were also more likely to spend fewer days engaging in these activities (OR: 0.8646, CI: 0.7639–0.9786). Contrary to previous studies, the findings of this study suggest that residents in denser areas are less likely to undertake physical activity, particularly for the vigorous-activity category. The results appeared both in the duration of time doing said activities (at least 10 minutes continuously) and the number of days doing the activity. This inverse result also appeared in some previous studies (Forsyth et al. 2007; Su et al. 2014; Wang et al. 2019). Forsyth et al. (2007) used self-reported measures of aggregate physical activity for 715 respondents in the US and objectively measured gross density and median block size to measure density, found that density is associated with the purpose of walking (travel, leisure), but
Table 4. Regression result for vigorous physical activity, moderate physical effort, and walking.

| Variables                        | A. During the last 7 days, did you do any [...] for at least 10 minutes continuously?[^a] | B. How much time did you usually spend [...] on one of those days? | C. During the last 7 days, on how many days did you do [...]? |
|----------------------------------|---------------------------------------------------------------------------------------------|-----------------------------------------------------------------|---------------------------------------------------------------|
|                                  | Binary (logit) [1 = Yes] OR [95% CI] p-val                                                | Binary (logit) [1 = Above Average] OR [95% CI] p-val             | Binary (logit) [1 = Above Average] OR [95% CI] p-val          |
| **Vigorous Physical Activity**   |                                                                                           |                                                                 |                                                               |
| Residential Density              | 0.8750** [0.7785–0.9835] 0.025                                                           | 1.089 [0.9886–1.1213] 0.121                                       | 0.8646** [0.7639–0.9786] 0.021                                   |
| Public-Essentials Density        | 1.2345* [0.9663–1.5771] 0.092                                                            | 0.8808 [0.7116–1.0902] 0.244                                       | 1.1524 [0.8950–1.4837] 0.271                                     |
| Commercial-Essentials Density    | 0.8761 [0.7289–1.0530] 0.159                                                            | 1.0639 [0.9113–1.2421] 0.433                                       | 0.9088 [0.7522–1.0980] 0.322                                     |
| Recreation-Facility Density      | 1.0204 [0.9056–1.1499] 0.740                                                            | 0.9992 [0.8971–1.1128] 0.988                                       | 1.0279 [0.9080–1.1637] 1.663                                     |
| Urban Status [1 = Urban]         | 0.8166** [0.6791–0.9811] 0.031                                                           | 0.0810 [0.9122–1.2810] 0.368                                       | 0.7840** [0.6484–0.9480] 0.012                                     |
| ICC, null model                  | 0.0382                                                                                   | 0.0051                                                            | 0.0358                                                         |
| **Moderate Physical Effort**     |                                                                                           |                                                                 |                                                               |
| Residential Density              | 1.0869 [0.9671–1.2217] 0.162                                                            | 0.9408 [0.8572–1.0324] 0.198                                       | 1.0719 [0.9566–1.2010] 0.231                                     |
| Public-Essentials Density        | 1.1266 [0.8667–1.4628] 0.371                                                            | 0.9582 [0.7763–1.1827] 0.691                                       | 1.1582 [0.8952–1.4986] 0.264                                     |
| Commercial-Essentials Density    | 0.9399 [0.7758–1.1387] 0.527                                                            | 1.0073 [0.8653–1.1726] 0.925                                       | 0.9145 [0.7560–1.1063] 0.358                                     |
| Recreation-Facility Density      | 0.9985 [0.8898–1.1205] 0.981                                                            | 1.0028 [0.9134–1.1010] 0.952                                       | 1.0106 [0.9016–1.1328] 0.856                                     |
| Urban Status [1 = Urban]         | 1.0639 [0.8835–1.2812] 0.513                                                            | 0.9038 [0.7679–1.0636] 0.223                                       | 1.0613 [0.8837–1.2745] 0.524                                     |
| ICC, null model                  | 0.0412                                                                                   | 0.0190                                                            | 0.0409                                                         |
| **Walking**                      |                                                                                           |                                                                 |                                                               |
| Residential Density              | 0.9937 [0.8697–1.1353] 0.962                                                            | 1.0111 [0.9205–1.1107] 0.816                                       | 0.9420 [0.8400–1.0563] 0.307                                     |
| Public-Essentials Density        | 1.1312 [0.8077–1.5844] 0.473                                                            | 0.9760 [0.6300–0.9724] 0.029                                       | 1.1825 [0.8753–1.5975] 0.275                                     |
| Commercial-Essentials Density    | 1.0500 [0.8399–1.3127] 0.668                                                            | 1.0001 [0.8562–1.1681] 0.999                                       | 1.0149 [0.8339–1.2533] 0.882                                     |
| Recreation-Facility Density      | 0.9829 [0.8612–1.1212] 0.798                                                            | 1.0737 [0.9761–1.1811] 0.143                                       | 1.0001 [0.8893–1.1248] 0.998                                     |
| Urban Status [1 = Urban]         | 0.7301*** [0.5891–0.9049] 0.004                                                          | 0.9843 [0.8365–1.1583] 0.850                                       | 0.7383*** [0.6092–0.8947] 0.002                                     |
| ICC, null model                  | 0.0592                                                                                   | 0.0221                                                            | 0.0516                                                         |
| Control Variables                | YES                                                                                       | YES                                                              | YES                                                            |
| N                                | 4025                                                                                      | 4025                                                             | 4025                                                           |
| No. of Groups                    | 153                                                                                       | 153                                                             | 153                                                           |

Source: Fifth wave IFLS. * p < 0.1, ** p < 0.05, *** p < 0.01. Observations with missing answers, especially those related to physical activity, were dropped from the sample, as were observations from those who lived in cities or municipalities where the built-environment data were not available. Control variable included age, sex, marital status, education level, income per capita, and perceived health condition. Note: *Regression result for the full model can be seen in the Appendix.

not the amount of overall walking or overall physical activity. Furthermore, Su et al. (2014) argued that the negative result might be attributable to the densely settled cities. Even though not as populous as China, Indonesia is the fourth-largest country in terms of population (World Bank 2016). In addition, World Bank (2016) reported that most areas in Indonesia, mainly urban areas, are characterised by high-

Table 5. Regression result for conformity with WHO standard for vigorous activity, moderate physical effort, and walking.

| Variables                        | Vigorous Activity | Moderate Physical Effort | Walking |
|----------------------------------|-------------------|--------------------------|--------|
|                                  | Binary (logit) [1 = Yes] OR [95% CI] p-val | Binary (logit) [1 = Yes] OR [95% CI] p-val | Binary (logit) [1 = Yes] OR [95% CI] p-val |
| Residential Density              | 1.0620 [0.8265–1.3646] 0.638 | 0.9589 [0.8628–1.0657] 0.437 | 0.9788 [0.8872–1.0799] 0.670 |
| Public-Essentials Density        | 0.6132** [0.4127–0.9110] 0.015 | 0.9157 [0.7249–1.1569] 0.461 | 0.9334 [0.7538–1.1558] 0.528 |
| Commercial-Essentials Density    | 1.1554 [0.8221–1.2638] 0.405 | 1.0254 [0.8650–1.2154] 0.773 | 0.9598 [0.8215–1.1212] 0.605 |
| Recreation-Facility Density      | 1.0910 [0.8184–1.4543] 0.552 | 1.0056 [0.9057–1.1166] 0.916 | 1.0614 [0.9611–1.1723] 0.239 |
| Urban Status [1 = Urban]         | 0.8888 [0.6295–1.2548] 0.503 | 0.9183 [0.7591–1.1109] 0.051 | 0.8776 [0.7386–1.0427] 0.138 |
| ICC, Null Model                  | 0.0221 0.0185 | 0.0210 | |
| Control Variables                | YES YES YES | 4025 4025 4025 | |
| N                                | 4025 4025 4025 | 153 153 153 | |
| Number of Groups                 | 153 153 153 | |

Source: Fifth wave IFLS. * p < 0.1, ** p < 0.05, *** p < 0.01. Observations with missing answers, especially those related to physical activity, were dropped from the sample, as were observations from those who lived in cities or municipalities where the built-environment data were not available. Control variable included age, sex, marital status, education level, income per capita, and perceived health condition.

[^a]: This model was dropped from the analysis as the number of observations was not sufficient.
density features. Population distribution across the islands in Indonesia is also highly uneven, and more than half of the population is clustered in Java Island (Jones 2015). Thus, corroborating Su et al. (2014), this adverse result might be due to the majority of observations in our sample living in Java and Bali (68.25%), the most densely populated island in Indonesia (Jones 2015).

Meanwhile, the higher the density of public amenities, the greater the odds that individuals engage in vigorous activity (OR: 1.2345, CI: 0.9663–1.5771). In other words, a significant association appeared only between public amenities and vigorous activity means that the higher the density of public amenities, the greater the odds of individuals engaging in vigorous activity. In our study, public amenities is more associated with the availability of basic public infrastructures. Latham and Layton (2019) argued that public infrastructures may also serve as social infrastructures which essential for nurturing public life and as an integral part of urban systems. The availability of public infrastructures can facilitate a broader range of community activities (Roskruge et al. 2012; Latham and Layton 2019). Nevertheless, we found an inverse association between public amenities and physical activities.

These results were similar to the studies by Zhang et al. (2014) and Ding et al. (2014). Devarajan et al. (2020) argued that mixed land use in developing countries is already high. Hence, it tended to choke walkability and discourage people from walking. Moreover, Inoue et al. (2010) also showed that increased land-use diversity is commonly associated with heavy traffic, which may weaken people’s incentive to undertake physical activity. High traffic volume worsened by narrow streets may suggest outdoor activities are not sufficiently safe. Thus, people might choose to stay at home (Wang et al. 2019). As explained previously, this situation also commonly found in many cities Indonesia. Narrow sidewalks often riddles with informal food street vendor, tree roots, open sewer and motorcycle driver also often butt into these sidewalks, reflect low level of safety and security for pedestrians (Nugroho et al. 2017; Bliss 2019, August 1). Furthermore, uneven urban development and significant gap in infrastructure investment particularly for pedestrian facilities across cities may also the reason behind this negative result (Bliss 2019, August 1; Ellis, 2010; Roberts et al., 2019).

Furthermore, as seen in Table 5, using the WHO standard of physical activities, none of the built-environment attributes were significantly associated with the three activities. We argued that these results appeared because the WHO standard is higher than the criteria used in the IFLS. On the other hand, these results echoed and supported the data that many Indonesians lack physical activity, or in other words, we can say that most of the adult population in Indonesia are physically inactive (Ministry of Health 2018; WHO 2018; Oddo et al. 2019; Andriyani et al. 2020). Recent study by Stanford University conducted by Althoff et al. (2017) corroborated that Indonesians walk an average of 3,513 steps per day, making Indonesians as the laziest people to engage walking activities in the world. This number is far below the global average of 5,000 steps daily. A news article published in CNBC Indonesia written by Sadiyah (2022) also highlighted that there are at least three primary reason why Indonesians are ‘lazy’ to walk. First, as explained previously, most cities in Indonesia are lack of pedestrian friendly infrastructures. Second, climate factors also consider as essential because the average temperature in most places in Indonesia is between 30–33 degrees Celsius. And last, security also plays as crucial consideration especially for woman since they potentially experience unwanted catcalling on the street.

Moreover, the results reveal that urban-area residents tend to engage in fewer vigorous activities (OR: 0.8166, CI: 0.6791–0.9811) and spend less time doing said activities than their rural counterparts (OR: 0.7840, CI: 0.6484–0.9480). The results were also consistent for walking activities, of which rural residents seem to do more (OR: 0.7301, CI: 0.5891–0.9049) and for greater amounts of time (OR: 0.7383, CI:0.6092–0.8947). Using the argument proposed by Cerin et al. (2017), these results can be explained by the notion that people in high-density areas have shorter distances to travel to reach several destinations. Thus, they tended to make multiple trips rather than a single trip. A previous study by Cerin et al. (2013) also asserted that high-density settings might reduce people’s willingness to undertake any physical activity, as they can move easily from one place to another by public transit. Xu et al. (2010) added that high-density settings in cities might increase concern about traffic safety and hinder physical activity. Indonesia also has a similar problem regarding this issue. High-density areas in Indonesia are often characterised by narrow roads, lack of safe pedestrians and higher traffic volume (Nugroho et al. 2017). Thus, people around the neighbourhood are less likely to
perceive their places as secure places to do outdoor activities (Xu et al. 2010; Nugroho et al. 2017). Hence, it hinders the willingness to engage physical activity, particularly walking.

However, in general, the results for overall physical activity indicate no significant relationship between these physical activities and built-environment attributes. Moreover, these results were mixed, and some of them were not as expected, similar to the previous finding by Forsyth et al. (2007), Gallagher et al. (2012), and Gell et al. (2015). Moreover, the result revealed that residents in urban areas are less physically active and spend fewer days engaging in physical exercise, particularly vigorous and walking activities. We argue that this finding might indicate that built-environment attributes primarily in urban areas in Indonesia have not enabled and supported people to do physical activities. Moreover, our regression results indicate that individual-level factors, such as age, sex, educational level, income, and perceived health, have a greater impact on physical activity. Our results contradict Wang et al. (2019) for the case of China and this distinction may be due to different territories, regional characteristics, and amenities.

Instead, high-density settings and land-use diversity adversely affect the incentive to undertake physical activities. This result may be relevant since most cities/municipalities in Indonesia face a rapid change in the physical landscape, which heavily emphasises road construction and more buildings (UNICEF 2016). Thus, people and communities lost opportunities to engage in physical exercises, and opportunities for social interaction have been eroded as open spaces have been gradually replaced by roads, buildings, and other construction (UNICEF 2016). Nevertheless, our study cannot provide further information regarding this phenomenon, such as traffic conditions, road and sidewalks quality, and amenities quality, due to the unavailability of the data. Hence, we acknowledge this as a limitation of the current study.

4. Limitations & conclusions

Limitations

Another limitation which appear in this study is that all data regarding physical activities obtained from IFLS were in aggregate and self-reported. Since the aggregate physical activity data does not allow us to identify specific purpose and locations of where the physical activities have been carried out, there may exist some possibility that the insignificant relationship between physical activities and built-environment attributes is observed due to this matter. Forsyth et al. (2007) which also examining aggregate measure of physical activities and also observe similar conclusion that built environment characteristics are not associated with overall walking or overall physical activity, argued that there seems to be something of a zero-sum game with higher density areas having more travel walking and lower density areas more leisure walking.

Moreover, the built environment measured in this study is the built-environment at the city level of the respondent. Meanwhile as previously explained, workers who have more time-use of out-of-home activities may spend most of his/her time in the built-environment near their workplace which may be totally different from the built environment near their residential areas. Therefore, it is possible that the relationship between physical activities and the built-environment reported in this study is understated.

Regarding the self-reported data, we suggest that future studies incorporate objective or direct physical exercise measures (such as calorimetry (i.e., doubly labelled water, indirect, direct), physiologic markers (i.e., cardiorespiratory fitness, biomarkers), motion sensors and monitors (i.e., accelerometers, pedometers, heart rate monitors), or direct observation (Prince et al. 2008)) to obtain more accurate measurements. However, we acknowledge that the main limitation of these self-reported measures is that individuals may overestimate or underestimate their true energy expenditure and rates of inactivity (Epstein et al. 1976; Martins et al. 2017). For example, the finding from the researchers from Stanford University conducted by Althoff et al. (2017) shows the lowest physical activities of Indonesian people compared to other countries, which could make the self-reported physical activity data be overstated. Despite these limitations, in fact, self-reported data have general acceptance within clinical settings and large studies since they have low cost, are easy to administer, and have the potential to inform about different types of activities performed in a variety of contexts (Epstein et al. 1976; Martins et al. 2017). Self-report measures of physical activity also have been used for nearly 50 years, to determine the frequency, duration, intensity, and type of physical activity in various populations (Epstein et al. 1976; Martins
et al. 2017), which strengthens the argument for the use of self-reported measures in this study.

Concerning ArcGIS data, objective measures of built-environment attributes can only be obtained at the city/municipality level. We are unable to provide these data at a micro-scale (e.g. neighbourhood-level) since regulation does not allow the postal address of the respondents to be publicly accessible. Moreover, since our study is cross-sectional, we could not provide a causal relationship.

**Conclusions & policy recommendations**

In contrast to the existing studies, this study revealed that built-environments characteristics such as density and public-amenities diversity were adversely associated with physically activity. Therefore, these results justified the argument that the design of the built environment in Indonesia has not been able to support and encourage people to engage in physical exercise. A number of studies acknowledged that compact city paradigm characterised by high-density and mixed-use urban development pattern puts more attention on more public amenities and promote walkable neighbourhoods (Jacobs 1961; Yang 2008; Jenks and Jones 2010; Hanibuchi et al. 2012). However, these urban characteristics might be true and more suitable in the case of developed countries rather than developing countries (Arifwidodo 2012; Bardhan et al. 2015; Jedwab et al., 2020; Seong et al. 2021). Unlike developed countries, cities in developing countries already faced an intense and unplanned urban development (Arifwidodo 2012). Furthermore, conventional land use, poor transport planning and urban design are still dominated with little attention on walking (Leather et al. 2011).

To the best of our knowledge, this is the first study to investigate the link between the built environment and physical activities in the Indonesian context. Previous studies, for instance, Sulinda and Lo (2011) and Tanan and Darmoyono (2017), only focus on a specific metropolitan area (Jakarta dan Bogor). Thus, the result only apply to a limited context and cannot be generalised. Including more samples across cities/municipalities in Indonesia enabled us to analyse the result from a wider perspective. The finding in this study emphasises the importance of a good built-environment planning process by creating designs that encourage people to undertake more physical activity. Furthermore, all key stakeholders such as national government, city government, development agencies as well as private sectors face an urgent need to support initiatives and policy implementation to improve walkability and pedestrian facilities. Lastly, referring to our findings, we suggest that governments’ policies also should go beyond the provision of public amenities; instead, there should be an attempt to initiate a socio-political initiative or movement on promoting physical activities.

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Appendix. Full Model Regression Result for Table 4 Column A
During the last 7 days, did you do any [...] for at least 10 minutes continuously? [1 = Yes]

| [Main]                          | Vigorous Physical Activity | Moderate Physical Effort | Walking |
|--------------------------------|---------------------------|--------------------------|---------|
|                                | OR [95% CI]               | p-val                    | OR [95% CI]   | p-val                | OR [95% CI]   | p-val                |
| Residential Density            | 0.8750** [0.7785–0.9835]  | 0.025                    | 1.0869 [0.9671–1.2217] | 0.162          | 0.9937 [0.8697–1.1353] | 0.962 |
| Public-Essentials Density      | 1.2345* [0.9663–1.5771]   | 0.092                    | 1.1266 [0.8677–1.4628] | 0.371          | 1.1312 [0.8077–1.5844] | 0.473 |
| Commercial-Essentials Density  | 0.8761 [0.7289–1.0530]    | 0.159                    | 0.9399 [0.7758–1.1387] | 0.527          | 1.0500 [0.8399–1.3127] | 0.668 |
| Recreation-Facility Density    | 1.0204 [0.9056–1.1499]    | 0.740                    | 0.9985 [0.8898–1.1205] | 0.981          | 0.9829 [0.8612–1.121]  | 0.798 |
| Urban Status (1 = Urban)       | 0.8166** [0.6791–0.9811]  | 0.031                    | 1.0639 [0.8835–1.2812] | 0.513          | 0.7301*** [0.5891–0.9049] | 0.004 |
| [Control]                      |                           |                          |                      |                |                       | |
| Age                            | 0.9825*** [0.9763–0.9887] | 0.000                    | 0.9935** [0.9880–0.9990] | 0.022          | 1.0047 [0.9982–1.0114] | 0.155 |
| Marital Status (1 = Married)   | 1.1044 [0.9188–1.3275]    | 0.290                    | 1.1037 [0.9433–1.2913] | 0.218          | 0.9356 [0.7788–1.1238] | 0.477 |
| Sex (1 = Male)                 | 6.655*** [4.7708–6.7032] | 0.000                    | 0.8689** [0.7602–0.9933] | 0.040          | 1.0384 [0.8900–1.2115] | 0.632 |
| Education Level                |                           |                          |                      |                |                       | |
| Elementary Educ (1 = Yes)      | 0.8448 [0.5940–1.2016]    | 0.348                    | 1.3787*** [1.0142–1.8742] | 0.040          | 0.7424 [0.4931–1.1176] | 0.154 |
| Secondary Educ (1 = Yes)       | 0.6122*** [0.4219–0.8885] | 0.010                    | 1.5065*** [1.0850–2.0916] | 0.014          | 0.6296** [0.4098–0.9671] | 0.035 |
| Tertiary Educ (1 = Yes)        | 0.4272*** [0.2730–0.6686] | 0.000                    | 1.3625 [0.9393–1.9955] | 0.012          | 0.5533** [0.3422–0.8945] | 0.016 |
| Log Per Capita Expenditure     | 0.7765*** [0.6826–0.8835] | 0.000                    | 1.1337*** [1.0109–1.2713] | 0.032          | 1.0708 [0.9373–1.2233] | 0.313 |
| Perceived Health (1 = Healthy) | 0.8115** [0.6733–0.9780]  | 0.028                    | 0.9798 [0.8302–1.1564] | 0.809          | 1.0542 [0.8696–1.2778] | 0.591 |
| Constant                       | 16.3360*** [2.8096–94.9838] | 0.002                    | 0.2484* [0.0521–1.1835] | 0.080          | 1.8325 [0.2957–11.3557] | 0.515 |
| Municipality Constant          | 0.0753                    | 0.1483                   | 0.1982               | 0.00328        | (0.0439)               | (0.0528) |
| ICC, null model                | 0.0328                    | 0.0412                   | 0.0592               | 4025           | 4025                   | 4025 |
| N                              | 153                       | 153                      | 153                  | 4025           | 4025                   | 4025 |
| No. of Groups                  |                           |                          |                      |                |                       | |

Source: Fifth wave IFLS. Standard errors in parentheses, ** p < 0.05, *** p < 0.01. Observations with missing answers, especially those related to physical activity, were dropped from the sample, as were observations from those who lived in cities or municipalities where the built-environment data were not available.