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Associations of the built environment with physical activity and sedentary time in Ugandan outpatients with mental health problems

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Abstract

Background: This study investigated whether reported neighborhood variables explained variance in time spent walking, exercising and being sedentary, in addition to mental health and demographic variables among Ugandan outpatients with mental illness.

Methods: 99 outpatients (78 men; 31.1±8.6 years) of the Butabika National Referral Hospital in Uganda completed the Neighborhood Environment Walkability Scale for Africa, the Simple Physical Activity Questionnaire and the Brief Symptoms Inventory-18. Multiple regression analyses were performed.

Results: 7% of the variance in walking time was explained by the variance in anxiety/depression and an additional 13% by the variance in perceived mixed land use and the availability of roads and walking paths. 8% of the variance in exercise time was explained by variance in age, an additional 6% by the variance anxiety/depression. The availability of recreational space added 8%. 6% of variance in time spent sedentary was explained by family income while availability of roads and walking paths added another 6%.

Discussion: This study showed the relevance of availability of roads and walking paths and recreational space for more physical activity and less sedentary behavior in people with mental illness. This is particularly relevant in low-income countries where a rapid urbanization is taking place.

Introduction

Mental and substance use disorders are important and growing public health problems, particularly in low- and middle-income countries (LMICs)[1] and account for 8.8% and 16.6% of the total burden of disease in respectively low-income and lower-middle-income countries[2]. These disorders act as risk factors for the development of communicable and non-communicable diseases[3-7], contribute to accidental and non-accidental injuries[8], lead to loss of productivity, food insecurity and poverty[9,10] and ultimately result in a higher risk for premature mortality[11]. Despite the high burden, only 7% of the people in low income countries and 14 to 21% of the people in middle income countries who have mental and behavioral health disorders receive treatment [12]. From a public health perspective, it is therefore important to focus on modifiable risk factors that may play a cumulative role in preventing mental health problems in LMICs.

Robust evidence demonstrates that higher levels of physical activity have a protective effect against the emergence of mental health problems such as depression in youth (adjusted odds ratio=0.90, 95% CI=0.83, 0.98), adults (adjusted odds ratio=0.78, 95% CI=0.70, 0.87), and elderly (adjusted odds ratio=0.79, 95% CI=0.72, 0.86) across geographical regions [13]. For those with a confirmed mental illness there are multiple mental and physical health benefits from physical activity[14-17]. However many people with mental illness do not participate in physical activity sufficient to accrue health benefits[18], i.e. at least 150 min of moderate to-vigorous physical activity per week undertaken for leisure, transportation, work, play, sports, and exercise[19]. The symptoms and treatment (e.g., medication) of mental illness may impact physical activity participation by decreasing the motivation (e.g., behavioral intention), volitional capacity (e.g., ability to transform their intention into behavior) and self-efficacy to be physically active[20-23].

Whilst there has been some progress in high-income countries in understanding the psychological effects of physical inactivity in people with mental health problems, the role of environmental factors in predicting physical activity participation among this population is less understood. Previous research in people with severe mental illness in Belgium[24] indicated that outpatients living in more pleasant neighborhoods with more connected street networks and greater availability of sidewalks were more physically active. Moreover, the environmental attributes explained a much larger proportion of walking variance than in the healthy population without mental illness.

Other neighborhood characteristics, such as perception of crime safety had a much stronger association with physical activity in outpatients with a mental illness than in the general population [24].

Sedentary time defined as time spent in behaviors that involve sitting or reclining positions and low energy expenditure (≤1.5 metabolic equivalents) during waking hours [25], is also of interest. Sedentary time has, potentially independent from a person's physical activity, a range of detrimental health outcomes such as obesity, type 2 diabetes, cardiovascular disease, cancer, and an increased cardiovascular-specific and overall premature mortality, and a higher risk for feelings of anxiety and depression [26-28]. Less is known about the relationship of neighborhood environments with sedentary behavior. However a previous study among Belgian outpatients with severe mental illness[29] suggested that lower availability of infrastructure, especially bike lanes, unsafe traffic and crime safety perceptions, emotional dissatisfaction with the environment, and a lack of connectivity of the built environment was associated with more time spent sitting. Encouraging physical activity and reducing sedentary behavior through built environment-based changes might therefore be an important public mental health promotion strategy that also has well-documented physical health benefits.

To the best of our knowledge, no prior research has investigated the relationship between the characteristics of the built environment and physical activity and sedentary time of people with mental illness in LMICS. Research investigating the influence of the built environment in high-income countries cannot be readily translated into LMICs, where the built environment is likely to impact physical activity in unique ways. For example, active travel and active work may be the only alternatives for many residents in LMICs[30,31].

The aim of the current study therefore was to investigate to what extent the variance in time spent walking, in exercise or in sedentary behavior in Ugandan outpatients with mental illness could be explained by neighborhood built and social environmental variables, above and beyond the variance accounted for by demographic and clinical variables.

Methods

Participants and procedure

In a 5-month period all consecutive adult (aged 18 to 65 years) outpatients with a DSM 5 diagnosis by the treating psychiatrist of the Butabika National Referral Hospital in Uganda (Kampala) were invited to participate in this study. Individuals were included if they were able to concentrate during the interview as determined by the treating psychiatrist. Outpatients with a psychotic disorder were excluded, because they would not be expected to provide reliable responses. All questionnaires were interviewer-administered by a psychologist with three years of experience in data collection. The study procedure was approved by the ethical committee of Mengo Hospital. This ethical committee covers also the Butabika National Referral Hospital. All participants gave their written informed consent.

Socio-demographical data

Self-reported data on age, gender, marital status (living together, i.e. married or living with a partner versus alone, i.e; single, widowed, divorced or separated), educational level [lower education including no formal schooling, primary school, high school versus higher education including diploma; higher diploma, Bacherlor's degree, Graduate (Master/ PhD) or professional degree] and family income [lower than 449,999 Ugandan Shillings (UGS), i.e. about 125 US$ per month or higher] were collected.

Neighborhood Environment Walkability Scale for Africa (NEWS-Africa)

Reported attributes of neighborhood built and social environment variables were measured using the NEWS-Africa instrument[32]. A previous multi-country (i.e. Cameroon, Ghana, Mozambique, Nigeria, South Africa, and Uganda) study demonstrated that the NEWS-Africa is a reliable[32] and valid[33] questionnaire to measure built and social environment attributes with relevance to physical activity. It has been tailored to the African context through extensive local input[33]. The adult version of the NEWS-Africa consisted of 73 individual items and 13 scales that assessed the following perceived environmental characteristics: residential density (1 item), proximity to non-residential land uses (mixed land use – diversity/proximity) (27 items), ease of access to nonresidential uses (mixed land use – access to services and places) (7 items), street (roads and walking paths) connectivity (5 items), infrastructure and safety for walking and cycling (12 items), aesthetics (8 items), traffic safety (6

items), safety from crime (4 items), and personal safety (3 items). Two separate subscales were derived from the items on the mixed land use – diversity/proximity scale: proximity to diverse destinations (destinations scale [21 items]) and recreational areas (recreation scale [4 items]). Three subscales were computed from the items on infrastructure and safety for walking and cycling: (sidewalks [5 items], crossings [4 items] and path infrastructure (informal walking paths) [2 items]. All NEWS-Africa items, with the exception of residential density and land use mix-diversity items, were rated by participants using Likert-type response options ranging from 1 (strongly disagree) to 4 (strongly agree). The one question on residential density reflected common housing patterns in urban and rural areas of Africa, and responses ranged from 1 (lowest density; e.g., few residential buildings/dwellings) to 6 (highest density; e.g., densely packed small houses, settlements, slums). Land use mix-diversity/proximity was assessed by the reported time it takes to walk from one's home to various types of destinations, with responses ranging from 1- to 5-min walking distance (coded as 5) to >30-min walking distance (coded as 1). All NEWS-Africa scales were computed as the mean of responses to items in the scale, with responses coded (or reverse-coded) such that higher values indicated higher walkability of the environment.

Simple Physical Activity Questionnaire (SIMPAQ) (Rosenbaum & Ward, 2016)

The SIMPAQ (Rosenbaum & Ward, 2016) is a 5-item clinical tool to assess physical activity among populations at high risk for sedentary behavior. It uses an interview format to estimate time spent in bed (hours/day), time spent sedentary during waking hours (min/day), time spent napping (min/day), time spent walking (min/day), time spent in structured exercise (min/day), and time spent in incidental or non-structured physical activity (min/day) during the past week. For the purpose of this study we used the time spent walking (min/day), time spent in structured exercise (min/day) and time spent sedentary during waking hours (min/day). Sedentary time was defined as the time spent sitting or lying down, such as when patients are eating, reading, watching TV or using electronic devices (Rosenbaum & Ward, 2016). Patients were also prompted to consider sitting at work, transport, leisure-time or at home. The time spent walking included walking for exercise or recreation or to get to or from places while structured exercise included any activity that patients do for exercise and sport, such as jogging, running, swimming, bike riding, going to the gym etc. The SIMPAQ is a reliable and

valid questionnaire to assess physical activity and sedentary levels, also in African settings (Rosenbaum & Ward, 2016; Vancampfort et al., 2018 unpublished data).

Anthropometric assessments

For calculating the BMI, body weight was measured in light clothing to the nearest 0.1 kg using a SECA beam balance scale, and height to the nearest 0.1 cm using a wall-mounted stadiometer. Assessments were done by a trained nurse.

Brief symptoms inventory - 18 (BSI -18)

The BSI-18[34] is a self-reported screening inventory designed to assess participants' level of psychological distress on three dimensions: somatization, depression, and anxiety. The 18 items were divided equally across the three dimensions and were presented with the standard instructions asking participants to rate how much they have been "distressed or bothered" in the past 7 days, including today, by the given symptom, using a 5-point Likert scale ranging from 0 (*not at all*) to 4 (*extremely*). Each item contributes to only one subscale, which was scored by summing the scores on each of the six subscale items. The three raw subscale scores ranged from 0 to 24. The BSI – 18 was chosen as it showed a good reliability and validity before in an East-African mental health setting[35].

Smoking behavior

Whether patients smoked was self-reported (yes versus no). If they smoked the mean number of cigarettes they smoke per day was recorded.

Statistical analyses

Independent sample t tests were used to analyze differences between perceived environment variables and SIMPAQ physical activity and sedentary levels by gender, marital status, educational level, family income and smoking status. Pearson product moment correlations were used to investigate associations between environmental variables, age, body mass index (BMI), and anxiety, depression and somatization levels. All variables (demographic, clinical and environmental) with bivariate correlations with physical activity or sedentary levels ($P<0.05$) were included in a multiple regression analyses. For the bivariate correlation analysis the alpha value of 0.05 was chosen rather

than the more stringent (e.g., 0.01 or 0.001) value. This was chosen from a health promotion perspective, because all environmental variables that might have some influence on physical activity or sedentary levels are reasonable to include in the regression analyses. A multiple regression analysis for each physical activity/sedentary outcome was conducted to determine the variance explained in the three dependent variables (walking, exercise and sedentary time). Demographical variables were included as a first block in the regression analysis, followed by clinical variables in a second block and the environmental variables as a third block. This approach allowed an estimation of the independent contribution of the environmental variables above and beyond the variance accounted for by demographic and clinical variables. The tables present the semi-partial correlations after all blocks were entered, along with the adjusted r^2 values. A $P<0.05$ was chosen as the significance level for the multiple regression analysis. All analyses were carried out using SPSS version 25.0 software (SPSS Inc., Chicago, IL, USA).

Results

Participants

Out of 131 consecutive outpatients, 18 patients with psychosis were excluded. Fourteen persons (all women) declined to participate because they were not interested. In total 21 women and 78 men were included. There were no missing data. Fifty-five of the participants had a primary diagnosis of alcohol or substance use disorder, 35 patients a mood disorder and 9 an anxiety disorder. Twenty-four persons were married or living together with a partner, 35 had a lower education level and 47 persons had a family income below 500,000 UGS. The mean age was 31.1±8.6 years (range = 18-62 years) and the mean BMI was 23.2±4.0 kg/m^2 (range = 15.6 – 44.6 kg/m^2). The mean BSI – 18 somatization, depression and anxiety scores were 9.0±3.5, 12.0±4.5, and 10.0±4.3, respectively. The mean time spent sedentary, walking and exercising were respectively 479.3±196.2, 28.7±23.7 and 23.1± 21.7 min/day. Ten patients smoked and the mean number of cigarettes smoked was 4.6±3.8 per day (range = 1-12).

Relationships between demographic, clinical and environmental variables

Table 1 summarizes significant differences in environmental variables by marital status, educational level, family income, gender and smoking status. Those with a higher family income reported to live in a more pleasant neighborhood and experienced more personal safety. Older age was significantly related with the perception of less recreational facilities nearby.

Relationships between demographic and clinical variables and time spent in physical activity and sedentary behavior

Table 2 shows that higher levels of depression and anxiety were associated with lower levels of walking and exercise. A higher family income was associated with being less sedentary while older age was associated with exercising less.

Relationships between environmental variables and time spent in physical activity and sedentary behavior

Easy accessible services and the availability of roads and walking paths in the neighbourhood were associated with more time spent walking. The availability of roads and walking paths in the

neighbourhood was also associated with less time spent sedentary. The availability of recreational space was associated with more time spent exercising (see Table 3).

Variation in physical activity and sedentary levels explained by demographic, clinical and environmental variables

Results of the regression analyses are summarized in Table 4. For time spent walking, 20% of the variance was explained by clinical and environmental variables. Seven percent was explained by anxiety and depression levels and an additional 13% by access to services and the availability of roads and walking paths in the neighbourhood. Twenty-two percent of the time spent exercising was explained by our regression model. Eight percent was explained by age, an additional 6% by anxiety and depression levels and the availability of recreational space added 8% to the explained variance. Six percent of the time spent sedentary was explained by family income while the availability of roads and walking paths in the neighbourhood added another 6% to the sedentary time variance.

Discussion

To the best of our knowledge, the present study is the first to investigate environmental attributes of physical activity and sedentary behavior in outpatients with mental health problems in a low-income country in general and Uganda in particular. Our data demonstrated that in Ugandan outpatients with mental illness a range of environmental variables were significantly related to walking and exercise levels and to the time spent sedentary. An important observation, which reflects prior research in high-income settings[24,29] with potential health implications for low-income settings was that environmental variables explained substantial variance in physical activity and sedentary time above known demographic (e.g. age) and clinical (symptoms of depression and anxiety) correlates.

Regarding environmental attributes, participants who had easy access to outdoor recreation spaces, indoor recreation facilities or gathering places, reported more time spent exercising. Similarly, the availability of good quality walking paths, informal places to walk, and formally provided and well-maintained sidewalks were associated with more time spent walking and less time spent sedentary. In contrast with another study in the Nigerian general population[36], in our outpatients with mental health problems, perceived safety from crime and traffic was not associated with physical activity and sedentary time. It might be hypothesized that in people with mental health problems the formation and/or translation of behavioral intentions into physical activity participation that may result from perceiving an environment as safe for physical activity may be impeded. However, longitudinal research is needed to confirm or refute the current findings.

There is growing evidence of socioeconomic status disparities in built environment variables [37]. In our study, we only observed that those with a higher family income reported to live in a more pleasant neighborhood and experienced more personal safety. However, family income was only associated with sedentary behavior, and environmental variables did explain additional variance in sedentary time. Caution is also needed in interpreting the results as family income was self-reported.

With the rapid urbanization and progressive urban densification particularly in LMICS and the observation that physical inactivity is particularly high in urban residents in LMICs[38-40], present findings suggest that built environment strategies may be effective physical and mental health promotion strategies in LMICs. Future studies should examine whether providing improved access to outdoor recreation spaces, informal places to walk, and well-maintained sidewalks could result in more physical activity uptake, less sedentary behavior and consequently mental and physical health

improvements. Our findings in outpatients with mental illness mainly residing in Kampala echoes previous calls to make the creation of activity-supportive environments in LMICs a regular function of public health agencies working with sectors outside of public health[38,41,42]. To this end, in LMICs such as Uganda, health department staff should seek to develop collaborations, and become advocates for improved policies in city planning and parks agencies. A previous study[41] in 6822 adults aged 18–66 years from 14 cities in ten countries on five continents demonstrated that the design of urban environments has the potential to contribute nearly 90 min/week of physical activity, which is 60% of the 150 min/week recommended physical activity level.

Whilst our data shed new light on this neglected topic, some limitations need to be considered. First, the cross-sectional study design limits confidence in the establishment of causal associations. Second, our data were collected in the only National referral mental health hospital in Uganda and might not be representative for the regional referral hospitals throughout Uganda as these regional centers treat less complex cases. Third, we did not assess the potential role of physical co-morbidities which are highly prevalent in people with mental illness[43]. Fourth, we relied on self-reported physical activity, sedentary behavior and perceived environment, rather than objectively measured variables. Moreover, recall bias and imprecise assessment could dilute some of the observed associations[44]. However, present findings should be replicated and extended in other African and LMIC settings. Future studies should ainclude objective measures of physical activity and sedentary behavior by using for example accelerometers along with objectives measures of the built environment, such as geographic information systems data. Where such data are unavailable, environmental audit tools might offer an alternative measure of objective physical environment features. Future research should also differentiate between walking for recreation and walking for transport. Next, future studies should consider other relevant environmental factors that may influence physical activity and sedentary behavior in most low-income countries such as heat and humidity, air pollution, and stray animals[30]. Finally, future research should also consider cultural differences in relationships between the built environment and physical activity and sedentary behavior in more detail. The fact that we did not find any gender differences in the current study might be due to the limited number of women included, noting that all eligible persons who declined were female. The use of public spaces, attitudes toward nature, range of travel modes, and appropriate activities may vary by gender and age within specific

cultural contexts[30]. These cultural factors and others must be considered for active living research and interventions in people with mental illness residing in LMICs[45].

International data indicate that built environments play important roles in physical activity in general populations of adults[41] There are limited data showing that built environments also are relevant to physical activity in LMICs[41] and specifically in Africa[33], though there may be some distinct findings in LMICs[33]. The present study adds important evidence that recreation facilities, mixed land use, informal walking paths, and presence and quality of sidewalks are significantly related to physical activity and/or sedentary time in the heretofore unstudied population of African adults with mental or behavioral health disorders. Thus, evidence is accumulating that providing activity-friendly built environments may have broadly generalizable benefits, justifying the recent World Health Organization recommendation to provide activity-supportive built environments worldwide as one of four goals of the Global Action Plan for Physical Activity. (http://www.who.int/ncds/prevention/physical-activity/gappa).

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Table 1. t-Values for differences in perceived environment variables and Pearson correlations with age, BMI and BSI-18 scores

	Score	Diagnosis status	Marital status (t-values)	Educational level (t-values)	Family income (t-values)	Gender (t-values)	Smoking (t-values)	Age (Pearson r)	BMI (Pearson r)	BSI-18 Somatization (Pearson r)	BSI-18 Depression (Pearson r)	BSI-18 Anxiety (Pearson r)
Destinations	2.5±0.7	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Recreation	2.6±0.9	NS	NS	NS	NS	NS	NS	-0.21*	NS	NS	NS	NS
Access to services	3.1±0.6	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Roads and walking paths	2.9±0.7	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Places for walking, cycling, and playing	2.4±0.7	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Neighborhood surroundings	2.7±0.7	NS	NS	NS	2.5*	NS	NS	NS	NS	NS	NS	NS
Traffic safety	2.4±0.7	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Crime safety	2.8±0.9	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Personal safety	3.1±0.7	NS	NS	NS	2.2*	NS	NS	NS	NS	NS	NS	NS

*P<0.05. NS= not significant. Marital status (living together, i.e. married or living with a partner versus alone, i.e; single, widowed, divorced or separated), educational level [lower education including no formal schooling, primary school, high school versus higher education including diploma; higher diploma, Bacherlor's degree, Graduate (Master/ PhD) or professional degree] and family income [lower than 449,999 Ugandan Shillings (UGS), i.e. about 125 US$ per month or higher], smoking (yes vs no).

Table 2. t-Values for differences in SIMPAQ walking, exercise and sedentary levels and Pearson correlations with age, BMI and BSI-18 scores

	Diagnosis status	Marital status (t-values)	Educational level (t-values)	Family income (t-values)	Gender (t-values)	Smoking (t-values)	Age (Pearson r)	BMI (Pearson r)	BSI-18 Somatization (Pearson r)	BSI-18 Depression (Pearson r)	BSI-18 Anxiety (Pearson r)
SIMPAQ walking (min/day)	NS	NS	NS	NS	NS	NS	NS	NS	NS	-0.23*	-0.26*
SIMPAQ exercise (min / day)	NS	NS	NS	NS	NS	NS	-0.28*	NS	NS	-0.30**	-0.21*
SIMPAQ sedentary (min/day)	NS	NS	NS	-2.7**	NS	NS	NS	NS	NS	NS	NS

*P<0.05, **P<0.01. NS= not significant. SIMPAQ= Simple Physical Activity Questionnaire. Marital status (living together, i.e. married or living with a partner versus alone, i.e; single, widowed, divorced or separated), educational level [lower education including no formal schooling, primary school, high school versus higher education including diploma; higher diploma, Bacherlor's degree, Graduate (Master/ PhD) or professional degree] and family income [lower than 449,999 Ugandan Shillings (UGS), i.e. about 125 US$ per month or higher], smoking (yes vs no).

Table 3. Pearson correlations between perceived environment variables SIMPAQ walking, exercise and sedentary levels

	Destinations	Recreation	Access to services	Roads and walking paths	Places for walking, cycling, and playing	Neighborhood surroundings	Traffic safety	Crime safety	Personal safety
SIMPAQ walking (min/day)	NS	NS	0.33**	0.29**	NS	NS	NS	NS	NS
SIMPAQ exercise (min / day)	0.28**	0.27**	NS	NS	NS	NS	NS	NS	NS
SIMPAQ sedentary (min/day)	NS	NS	NS	0.27**	NS	NS	NS	NS	NS

*P<0.05, **P<0.01. NS= not significant. SIMPAQ= Simple Physical Activity Questionnaire

Table 4. Regression analyses of the contribution of demographic (Block 1), clinical (Block 2) and environmental (Block 3) variables to physical activity and sedentary behavior levels

Dependent SIMPAQ variable	Significant correlates in the univariate analyses	Partial correlations	R^2
Walking (min/day)	*Clinical*		0.07
	BSI-18 Depression	-0.06	
	BSI-18 Anxiety	-0.14	
	Environmental		0.20
	Access to services	0.26*	
	Roads and walking paths	0.20*	
Exercise (min/day)	*Demographic*		0.08
	Age (years)	-0.16	
	Clinical		0.14
	BSI-18 Depression	-0.17	
	BSI-18 Anxiety	-0.01	
	Environmental		0.22
	Destinations	0.17	
	Recreation	0.24*	
Sedentary time (min/day)	*Demographic*		0.06
	Family income	0.26*	
	Environmental		0.12
	Roads and walking paths	0.27*	

*P<0.05. NS= not significant. Only significant correlates in the univariate analyses were included in the regression analyses. SIMPAQ= Simple Physical Activity Questionnaire, family income [lower than 449,999 Ugandan Shillings (UGS), i.e. about 125 US$ per month or higher].