Emerging Evidence of the Physical Activity Transition in Kenya

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Background: Comparable data to examine the physical activity (PA) transition in African countries such as Kenya are lacking. Methods: We assessed PA levels from urban (UKEN) and rural (RKEN) environments to examine any evidence of a PA transition. Nine- to twelve-year-old children participated in the study: n = 96 and n = 73 children from UKEN and RKEN, respectively. Pedometers were used to estimate children’s daily step count. Parental perception regarding their child’s PA patterns was collected via questionnaire (n = 172). Results: RKEN children were more physically active than their UKEN counterparts with a mean average steps per day (± SE) of 14,700 ± 521 vs. 11,717 ± 561 (*P* < .0001) for RKEN vs. UKEN children respectively. 62.5% of the UKEN children spent 0 hours per week playing screen games compared with 13.1% of UKEN children who spent more than 11 hours per week playing screen games. Seventy percent of UKEN and 34% of RKEN parents reported being more active during childhood than their children respectively. Conclusions: Results of this study are indicative of a PA transition in Kenya. Further research is needed to gather national data on the PA patterns of Kenyan children to minimize the likelihood of a public health problem due to physical inactivity.

Keywords: transport, screen time, pedometers

Childhood obesity and physical inactivity are serious public health problems in most developed countries. It is suggested that this health crisis emerged as a result of the industrial and electronic revolutions, among other reasons. The industrial revolution, which started in Great Britain in the late 18th and early 19th century and later spread to North America and other parts of Europe, produced major technological, socioeconomic and cultural changes resulting in the replacement of an economy based on manual labor to one dominated by industry and mechanized manufacturing. The revolution lead to tremendous behavioral shifts including movement away from high-energy expenditure workplace environments such as mining, forestry and farming to more sedentary occupations and lifestyles. This shift from a high activity lifestyle to a more sedentary lifestyle is referred to in this article as the physical activity transition. In conjunction with the nutrition transition the physical activity transition provides a fertile environment for the development of noncommunicable (chronic) diseases whose risk factors include physical inactivity, poor diet and obesity.

Anecdotal evidence and media reports suggest that the physical activity transition is in fact emerging in many developing countries. Research findings show that childhood obesity is becoming a public health problem in sub-Saharan Africa and the problem appears to be related to urbanization and reduced lifestyle-embedded physical activity. Nevertheless, data on the physical activity transition and reduction in habitual physical activity in particular among populations in developing countries are lacking. Exacerbating the fight against the physical activity transition and commensurate rise in childhood obesity is the strong sociocultural beliefs in many developing countries that obesity, or “roundness,” is something to be revered and a sign of wealth and prestige. Kenya, like many other African nations, is experiencing these challenges. Although technologies such as computers, the internet, satellite TV, and cell phones took decades to permeate North American society, all of these ‘electronic age’ items are becoming available very quickly in Kenya. Therefore any evidence of a physical activity transition might be of particular interest to policy makers and national leaders.

Although child obesity has become a global epidemic, awareness and preventive efforts in developing
countries have been severely hampered due to a scarcity of data on child obesity and physical inactivity in countries undergoing the physical activity transition. The purpose of this study therefore was to assess the physical activity levels of Kenyan children from urban and rural environments as a possible early indicator of evidence of the physical activity transition resulting from urbanization and increased access to automobiles and sedentary leisure-time pursuits.

**Methods**

This study employed a convenience sample of one public and one private school from both rural Kenya (RKEN, Rift Valley Province) and urban Kenya (UKEN, Nairobi Province). The schools were approached based on an existing relationship with Kenyatta University as well as their representation of the rural-urban sample targeted. School children aged 9 to 12 years (n = 169) from these 4 schools participated (50% female), with 73 from Rural (n = 38 males; n = 35 females) and 96 from Urban (n = 47 males; n = 49 females) settings. Children and parents completed written informed assent and consent respectively (available in English and Swahili) before participating in the study. A verbal explanation was also given and any queries answered by study staff. The study protocol was reviewed and approved by Institutional Research Ethics Boards at Kenyatta University, Kenya and the Children’s Hospital of Eastern Ontario Research Institute in Canada.

**Anthropometry**

Height and weight measures were taken according to the procedures outlined in the Canadian Physical Activity, Fitness and Lifestyle Approach. Height was measured to the nearest 0.1 cm using a stadiometer, as the maximum distance from the ground to the highest point on the head positioned in the Frankfurt plane, without shoes, feet together, and arms by the sides. Body mass was measured using a calibrated scale (BWB-800 MA TANITA, Netherlands) and recorded to the nearest 0.1 kg. All measurements were taken twice and repeated a third time if the first 2 measurements differed by more than 0.5 cm (height) or 0.3 kg (weight). Body mass index (BMI, kg/m²) was determined from these values.

**Daily Physical Activity**

**Data Obtained From Pedometer Step Counts.** Belt clip piezo-electric pedometers (vera BFO5187 Leeds, China) were calibrated using a priori reliability standard of < 10% between monitor coefficient of variation (CV) and used to assess total daily physical activity among the children. The 10% reliability standard was chosen to allow the detection of any between-group differences that exceed 10%. Studies have suggested that research grade pedometers should detect steps/day within 10% of the ActiGraph at least 60% of the time, or be within 10% under free-living conditions.

Each pedometer had a plastic sheath which was ideal for the sites where the study took place owing to local environmental conditions (ie, dust, heavy rainfall). A sample of 6 monitors was calibrated in preliminary studies where 3 adults walked on a treadmill at 4 speeds (2.5 km/h, 3.0 km/h, 3.5 km/h, and 4.0 km/h). The number of pedometer steps per minute was 130, 122, 120, and 116 compared with 128, 120, 119, and 114 steps per minute counted by an observer. The results indicated a high reliability with between pedometers CVs of 3% to 6% compared with visually counted steps per minute. Other studies have shown that self-paced walking trials have almost complete precision of step counts per minute in relation to hand-tallied steps. Oral and written instructions, including an explanation and description of the pedometer were given to the school children by their physical education and games teachers on a Wednesday morning upon arrival at school. The pedometer was then placed on the participant’s right hip by the teacher. The student participants were instructed to wear the pedometer all day for 2 consecutive days except when sleeping, swimming, or bathing/showering. Upon arrival at school on Thursday and Friday morning, the number of steps taken by each child was recorded on a datasheet by a designated teacher and the pedometer reset to 0. The children also wore the pedometers over the weekend (Friday, Saturday and Sunday) and the total number of steps was recorded by their teacher on Monday morning. Parents and or guardians were also instructed on how to place the pedometer on the children at home, after removal for sleeping or bathing.

**Data Obtained From Sedentary Behavior Questionnaire.** Information regarding Kenyan children’s sedentary behavior, physical activity and active living was collected from one parent of participating Kenyan children (n = 172) via questionnaire. The parental questionnaire was designed by the investigators to specifically gather information related to the hypothesized physical activity transition in Kenya. Kenyan parents were asked questions about their child’s sedentary behavior and to further understand the Kenyan perceptions about physical activity, parents were also asked a set of questions regarding their beliefs about their child’s activity patterns in comparison with their own childhood patterns. The questionnaires had multiple choice and categorical questions for the parents to respond to. Parents were asked to report the average hours per week their children spent watching television, on the computer/internet, and playing video games. Results were totaled to provide an indication of total “screen time” per week. In addition, parents were also asked to rate their own physical activity levels as children compared with those of their children and were questioned about the mode of transportation they used to travel to and from school as children.
**Statistical Methods**

Using SPSS version 17.0 (SPSS Inc., Chicago, Illinois), significance testing was done for pedometer step counts using univariate General Linear Model (GLM) with main effects for sex and urban/rural status and age as a covariate. Step count results are presented as age-adjusted estimated marginal means ± standard error (SE) and confidence interval adjustment for main effects were performed using the Sidak correction. Chi-squared tests were used to compare the categorical prevalence data for overweight/obese, meeting or exceeding step count guidelines and for the questionnaire responses. Body Mass Index (BMI) cut-offs were based on the recommended international cut-offs. A \( P \)-value of <0.05 was considered statistically significant.

**Results**

**Description of the Sample**

Children from RKEN (n = 32 private, 41 public) and UKEN (n = 47 private, 49 public) schools participated in this study. Parents (n = 80 RKEN, 92 UKEN) also responded to questionnaires. The mean height, weight and BMI for the children by residence (RKEN vs. UKEN) are presented in Table 1. The average number of steps taken per day by children in rural and urban Kenya, based on 2 week days, a 3-day weekend, as well as the cumulative average, is shown in Figures 1a, 1b, and 1c, respectively. Differences between rural and urban environments as well as sex differences are identified. Figure 2 illustrates the step count comparison between public and private schools within RKEN and UKEN.

Figure 3 shows the children’s average screen time as reported by parents in hours per week. A large fraction (50%) of the urban children spend over 2 hours per week on screen time compared with <10% of rural children. Chi-squared analysis indicated a significant association between rural vs. urban dwelling and screen time (\( P < .0001 \)). Although the data are not shown, low levels of sedentary behavior were shown to be associated with meeting the step count recommendations (\( P < .001 \)).

Figure 4 illustrates the mode of transport used by children in rural and urban Kenya to and from school.

**Discussion**

The purpose of this study was to assess the physical activity levels of Kenyan children from urban and rural environments as a possible indicator of evidence of a physical activity transition. The study found that children in rural Kenya (both male and female) are more physically active than their urban Kenya counterparts as measured by pedometer counts. On average rural Kenya children took more steps on weekdays and over the weekend than their urban Kenya counterparts. This is typical of children in rural communities who are still living a largely hunter-gatherer lifestyle. The findings of the current study agree with other reports which show that children in less mechanized societies have higher levels of physical activity than modern-living children, despite less participation in organized competitive sports. Collectively, our observations show that Kenyan children...
Figure 1 — (a) Average number of steps per day made by children in rural and urban Kenya based on 2 week days. * Denotes significant differences between rural and urban age-adjusted estimated marginal means ($P < .0001$). No sex differences within rural or urban Kenyan groups. (b) Average number of steps per day taken by children in rural and urban Kenya over a weekend (Friday, Saturday, Sunday). * Denotes significant differences between rural and urban age-adjusted estimated marginal means ($P < .0001$). No sex differences within rural or urban Kenyan groups. (c) Average number of steps per day taken by children in rural and urban Kenya over the 5-day period (Wednesday, Thursday, Friday, Saturday, and Sunday). * Denotes significant differences between rural and urban age-adjusted estimated marginal means ($P < .0001$). No sex differences within rural or urban Kenyan groups.
Figure 2 — Average number of steps per day made by children in rural and urban, public and private schools based. * Denotes significant differences between private and public school age-adjusted estimated marginal means ($P < .0001$), † Denotes significantly different from rural public school.

Figure 3 — Amount of screen time (hours per week) spent by children in both rural and urban Kenya including television, DVDs, Videos or playing screen games (video games, cell phone games, or internet to e-mail or chat online). Chi-square analysis identified a significant difference between RKEN vs. UKEN screen time ($P < .0001$).
Figure 4 — Mode of transport used by children in rural and urban Kenya to get to and from school. Chi-squared analysis identified a significant difference in mode of transport between rural vs. urban dwelling ($P < .0001$). The numbers represent estimated marginal means for weekday step counts ($\pm$ standard error) adjusted for age. No mean is provided for the 1 observation for UKEN and run as mode of transport.

Figure 5 — Mode of transport used by parents in rural and urban Kenya to get to and from school when they were young. Chi-squared analysis identified a significant difference in parental mode of transport between rural vs. urban dwelling ($P < .001$).
residing in urban areas participate in more sedentary behavior (ie, screen time) and are less active than children from rural communities, providing supporting evidence of a physical activity transition.

In 2008 a study examined the physical activity levels of Old Order Amish children and adolescents living a traditional agrarian lifestyle and found that the number of steps per day was 17,525 ± 4,443 (measured for 4 weekdays), 10,661 ± 4,208 (measured over Friday, Saturday, and Sunday), and 15,563 ± 3,702 (measured for the same 2 weekdays in this study). Comparatively, children from rural Kenya are more active than the Old Order Amish children, however, the urban Kenya children generally accumulate fewer steps. It is noted that Kenyan children made higher number of steps per day than the Amish children who in turn more active than those from contemporary-living, developed countries. This is further supportive of a physical activity transition. Recent work comparing physical activity levels of contemporary-living Portuguese youth to children living in rural Mozambique provide additional support for such a transition.

The majority of children in rural Kenya who participated in this study used a mode of active transport to get to and from school with most of them walking or running. This is in contrast to the situation in urban schools where 64% of the children used motorized transport to travel to school. Nearly all parents (99%) in rural Kenya and most (89%) living in Urban Kenya reported using an active form of transport to get to and from school during their childhood. The dramatic changes in active transportation across one generation, especially in urban Kenya, provides some insight into the emerging physical activity transition and may be useful for future intervention strategies to maintain physical activity levels.

Using an accelerometer, Moore et al determined the relationship between physical activity levels of parents and those of their young (4–7 years) children. Children of active mothers were found to be 2.0 times as likely to be active as children of inactive mothers and the odds ratio of being active for the children of active fathers was 3.5. When both parents were active, the children were 5.8 times as likely to be active as children of 2 inactive parents. Possible examinations for this relationship between parents’ and child’s activity levels include the parents’ serving as role models, sharing of activities by family members, enhancement and support by active parents of their child’s participation in physical activity, and genetically transmitted factors that predispose the child to increased levels of physical activity. Further research is required in developing countries to understand the relative contribution of changes in adult role-model behaviors in comparison with, or in combination with, technological changes allowing for, or even promoting, physical inactivity.

The current study also found that many more children in urban Kenya accumulate more screen time (over 2 hours per week) than their rural counterparts who report limited screen time exposure. Research suggests that viewing television and other screen time are at least partly to blame for increased patterns of inactivity among children. Excessive screen time has also been associated with poor eating habits and an increase in ill health. Further, spending too much screen time has been implicated in increasing child obesity by displacing physical activity and increasing calorie intake, perhaps caused by the effects of advertising and reducing resting metabolism. In Kenya, unlike many developed nations, there is no recommended limit for screen time or television...
viewing while exposure to and opportunities for screen time appear to be increasing.

A large fraction (70%) of parents in urban Kenya reported being more physically active than their children when they were young. This is further evidence indicating the physical activity transition in urban areas of Kenya. Most children in rural Kenya used some form of active transport (walking or running) to get to school while a significantly greater proportion of their counterparts in urban Kenya used some form of motorized transport to get to school. Collectively these findings suggest that a physical activity transition is underway in Kenya and is accelerated in urban settings.

In both rural and urban areas, more parents reported that they used active transport during their childhood to get to and from school than is the case with their children. This lends further support for the physical activity transition theory—changing lifestyles from one generation to another.

**Limitations of the Study**

This study had some limitations worth noting. First, it included only a relatively small, convenience sample, so cannot be interpreted as representative. Second, no formal validity or reliability testing was done on the questionnaire items used to gather information from parents. Third, pedometer step counts were only obtained at 1 time point for 2 consecutive weekdays as well as over the weekend (Friday, Saturday and Sunday) and may therefore not have been representative of habitual physical activity patterns. Lastly, the authors did not perform a sample size calculation for this study. Despite these limitations, there is supporting evidence from the pedometers and the questionnaire responses that a physical activity transition is underway in Kenya and that more substantial population representative research should be performed.

**Conclusion**

This research provides preliminary support of the emergence of the physical activity transition in Kenya. Further research is needed to obtain national data on the physical activity patterns of Kenyan children to monitor this threat to public health and athletic success, and to assess future interventions to reduce sedentary behavior and preserve habitual physical activity levels.

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**References**

17. IRIN. Africa struggles with the double burden of obesity and under nutrition. *The Daily Nation.* October 10, 2009.


