

Physical Activity and Nutrition Among Youth in Rural, Suburban and Urban Neighbourhood Types

Cindy Shearer, PhD,¹ Chris Blanchard, PhD,² Sara Kirk, PhD,³ Renee Lyons, PhD,⁴ Trevor Dummer, PhD,⁵ Robert Pitter, PhD,⁶ Daniel Rainham, PhD,⁷ Laurene Rehman, PhD,³ Chris Shields, PhD,⁶ Meaghan Sim, MSc³

ABSTRACT

Objectives: Physical activity and nutrition are essential to healthy living and particularly important during youth, when growth and development are key. This study examined rates of physical activity (PA) and diet quality (DQ) among youth in grades 7 to 9 in Halifax, Nova Scotia, during the 2008/09 school year and tested differences among students in rural, urban and suburban neighbourhood types of high and low socio-economic status (SES).

Methods: Youth in grades 7 through 9 (aged 12-16; 53% male) from six schools (N=380), stratified by neighbourhood type (urban, suburban, rural) and SES, wore accelerometers for up to 7 days (mean=4.14, standard deviation=1.49) and completed a nutritional survey.

Results: The findings suggest important differences in PA and DQ across SES and neighbourhood type. Specifically, rates of moderate to vigorous physical activity among youth from schools in lower socio-economic areas were higher in urban than in suburban or rural settings. Furthermore, DQ was better among youth in higher than in lower socio-economic urban settings.

Conclusions: Understanding these differences in PA and DQ across rural, urban and suburban environments of high and low SES may highlight subgroups and targeted geographic areas for the design of interventions to improve rates of PA and health nutrition.

Key words: Physical activity; nutrition; youth; built environment; socioeconomic status

La traduction du résumé se trouve à la fin de l'article.

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Promoting physical activity (PA) and diet quality (DQ) during the adolescent years is particularly important, as research suggests that behaviours formed in adolescence extend into adulthood^{1,2} and carry consequences for long-term health. Past research has revealed that less than 30% of 7th grade students in Nova Scotia met the recommended level of PA (60 minutes per day, 5 days per week) to achieve health benefits,³ and their diets did not meet Canada's Food Guide (e.g., more than 70% did not fulfill the daily requirement of 6-8 servings [depending on age and sex] of fruits and vegetables),⁴ making these two behaviours an important focus for health promotion and intervention efforts.

Extant research has highlighted important socio-economic and neighbourhood differences in PA and DQ. For instance, youth from higher socio-economic backgrounds have been found to engage in more PA⁵ and to have better DQ (diets that have variety, adequacy, moderation and balance)⁶ than youth from lower socio-economic backgrounds. However, the findings with regard to differences in neighbourhood type (urban/suburban/rural) in PA and DQ are somewhat mixed. Some studies of youth obesity have demonstrated higher rates of overweight and obesity in rural than urban and suburban areas.⁷ Other studies have revealed lower rates of PA among youth from urban neighbourhoods than those from rural and/or suburban environments,⁸ whereas others have reported no differences across neighbourhood types,^{9,10} and some have demonstrated higher rates of PA among urban than rural youth.¹¹ Suburban contexts are often neglected in extant research. Suburban

neighbourhoods have characteristics of both rural and urban environments in that they are better connected to urban centres than rural environments, yet they may sit at a distance from points of interest that are not walkable.

With regard to DQ, Veugelers et al.¹² reported a linkage between rural environments and higher dietary fat and calorie consumption among Canadian children. Yet, convenience and "fast-food"

Author Affiliations

1. Atlantic Health Promotion Research Centre, Dalhousie University, Halifax, NS
2. Department of Medicine, Dalhousie University, Halifax, NS
3. School of Health and Human Performance, Faculty of Health Professions, Dalhousie University, Halifax, NS
4. Bridgepoint Collaboratory for Research and Innovation, Bridgepoint Health, University of Toronto, Toronto, ON
5. Population Cancer Research Program, Department of Pediatrics, Dalhousie University, Halifax, NS
6. School of Recreation Management & Kinesiology, Acadia University, Wolfville, NS
7. Environmental Science Program, Faculty of Science, Dalhousie University, Halifax, NS

Correspondence: Dr. Cindy Shearer, Atlantic Health Promotion Research Centre, Dalhousie University, 1535 Dresden Row, Halifax, NS B3J 3T1, Tel: 902-494-2604, Fax: 902-494-3594, E-mail: cindy.shearer@dal.ca

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outlets – key features of obesogenic environments^{13,14} – are more prevalent in urban areas. Thus, the urban environment may expose youth to more unhealthy options and contribute to poor diet quality.¹⁵ The nutrition environment in the suburban context is also unique in that the density of fast-food outlets may be much less than in urban environments, but because of location outside the urban core more frequent commuting may be required through areas where unhealthy foods are readily available.

Better DQ has been shown in previous research to be associated with improved health outcomes in adults,¹⁶ but there is a paucity of data on DQ and health in children.¹⁷ A recent publication has demonstrated an independent association between overall DQ and academic performance in children,¹⁸ suggesting that improving DQ may have impacts beyond health outcomes alone. Given that few studies have considered the potential influence of socio-economic status (SES) and neighbourhood type on PA and diet in youth,¹⁹ further research is needed to clarify their potential importance for this population. Understanding differences in DQ and PA for subgroups of this population is important for the development of interventions aimed at improving the health behaviours of youth.^{12,20}

The purpose of the present study was to compare PA and DQ among youth from schools of higher and lower SES in rural, suburban and urban neighbourhood types. It was hypothesized that PA and DQ would be more favourable in higher versus lower SES environments. It was also hypothesized that SES and neighbourhood type would interact when influencing PA.²¹

METHODS

Recruitment

This research protocol was approved by the principal investigators' institutional review board as well as the review panel in place at the school board from which schools were recruited. Schools in the Halifax Regional Municipality, NS, were eligible for inclusion if they 1) enrolled students in Grades 7 through 9, and 2) did not offer a French immersion program (as these schools draw a greater proportion of students from areas outside the school's eligible neighbourhood). Within the Halifax Regional School Board, 38 schools fit these criteria; 5 were located in rural areas, 24 in suburban areas and 9 in urban areas. Six public schools were stratified by school-level SES and neighbourhood type.

School-level SES was determined by the median household income of the school's census dissemination area (a term used by Statistics Canada to refer to a small area composed of one or more neighbouring blocks, with a population of 400 to 700 persons), based on 2006 census data. Urban, suburban and rural categories were designated through a two-step process. The first step distinguished rural from urban using the Statistics Canada population-based definition of an urban area.* The Halifax Regional Municipality municipal planning guidelines† were then used to subdivide urban areas into urban and suburban categories according to urban development patterns, including housing density and a mix of commercial, institutional and recreational uses. Urban areas had a mix of high-density residential, commercial, institutional and recreational uses, whereas suburban areas had a mix of low- and medium-density commercial,

* >1,000 persons per km²; see <http://www.statcan.gc.ca/pub/92f0138m/92f0138m2008001-eng.pdf>

† See <http://www.halifax.ca/districts/dist17/documents/RegionalPlan.pdf>

institutional and recreational uses and a pattern of established neighbourhoods with low- to medium-density residential uses. Eligible schools in each neighbourhood type were organized by SES and divided into tertiles. One high and one low SES school was randomly selected from the higher and lower tertiles. Only one school that was approached declined to participate.

Participating urban schools were located in areas that had high residential density and street connectivity, high sidewalk availability, more mixed land uses and greater population density. Suburban schools were located in areas with lower residential density and street connectivity, and land uses that were spatially segregated. Finally, rural schools were in areas that were automobile reliant, with low residential density and street connectivity, no sidewalks, and schools placed far from residential land uses.

Recruitment took place in one school at a time during the 2008 and 2009 school years. Students were recruited through presentations in each 7th to 9th grade classroom. Information packages, including consent forms, were distributed to obtain parental consent; 27% of these forms were returned for participation in the study. In addition to completing surveys of dietary intake and health behaviours, students were asked to wear an accelerometer and GPS (Global Positioning System) device (to measure their geospatial footprint, which is not a focus of the current report) for a period of one week. All participants were entered in a prize draw for a gift card for participating. Furthermore, cash incentives were provided to encourage participants to wear the equipment (\$20 for 6 or fewer days of wear, \$30 for 7 days). All surveys (diet and health behaviours) and measurements (height/weight) were collected prior to distributing the accelerometers to students.

Measures

Demographic Features

Students reported their ethnicity (identified from a list of options, including "other" and space to describe) and sex within the survey of health behaviours and dietary intake.

Body Mass Index (BMI)

Students had their weight and height measured by trained research assistants in a private area of the school. These measurements were used to calculate BMI.

Physical Activity

PA was assessed objectively using the Actigraph GT1M (Actigraph: Pensacola, FL) accelerometer (placed on the right hip) for seven consecutive days. This accelerometer has documented evidence of concurrent validity and inter-instrument reliability in several studies of children and adolescents.²² Students were asked to wear the device for all waking hours of the day and to remove it for water-based activities and contact sports. At least one valid day (i.e., ≥8 hours of valid data) was required to be included in analyses; 92.7% of those who wore an accelerometer met this requirement. Students averaged 4.14 (SD=1.49) days of valid data. Raw accelerometer counts were converted to minutes per day of moderate (i.e., activities that cause youth to sweat a bit and breathe harder) to vigorous (i.e., activities that cause youth to sweat and be out of breath) physical activity (MVPA) using age-specific count thresholds developed by Freedson and colleagues.²³

Table 1. Sample Characteristics by School-level Socio-economic Status and Urban, Suburban and Rural Built Environments (N=380)

Demographic Characteristics	High SES (School-level)			Low SES (School-level)		
	Urban n=45	Suburban n=25	Rural n=4	Urban n=63	Suburban n=97	Rural n=86
Median income of census dissemination area, \$	54,827	62,834	50,325	26,641	47,821	30,527
Season of data collection	Oct/Nov	May/Jun	May/Jun	Nov/Dec	Mar/Apr	May/Jun
Age, %						
<12	53.3	12.0	20.3	31.7	14.4	11.6
13	40.0	56.0	35.9	36.5	36.1	33.7
14	6.7	16.0	32.8	25.4	37.1	38.4
15	0.0	16.0	9.4	6.3	11.3	15.1
16	0.0	0.0	1.6	0.0	1.0	1.2
Male, %	60.0	52.0	45.3	52.4	55.7	52.3
Grade, %						
7	55.6	64.0	34.4	39.7	33.0	33.7
8	40.0	24.0	34.4	39.7	35.1	39.5
9	4.4	12.0	31.3	20.6	32.0	26.7
White, %	88.9	80.0	95.3	60.3	85.6	93.0
Mean (SD) BMI	19.0 (2.9)	20.8 (3.6)	22.5 (4.5)	21.9 (4.5)	22.8 (5.4)	22.5 (4.8)

SES=socio-economic status (school-level).

Table 2. Moderate-to-Vigorous Physical Activity (MVPA) Per Day and Diet Quality by School-level Socio-economic Status and Urban, Suburban and Rural Built Environments

	Minutes of MVPA/Day		Diet Quality	
	Mean (SD)*	Median	Mean (SD)*	Median
High SES				
Urban	71.52 (23.00)	69.83	67.29 (8.12)†	69.76
Suburban	69.62 (41.90)	60.08	65.12 (8.27)	63.96
Rural	48.39 (32.41)	41.23	63.98 (8.02)	64.84
Low SES				
Urban	82.50 (39.13)‡	73.13	59.75 (7.06)‡	59.28
Suburban	55.00 (31.03)‡	48.00	63.02 (7.60)	63.55
Rural	58.81 (30.63)‡	49.83	64.20 (7.67)	64.34

* Means with different superscripts were significantly different, p<0.05. SES=socio-economic status (school-level).

Diet Quality

Nutritional intake was assessed by means of the Harvard Youth/Adolescent Questionnaire (YAQ),²⁴ a validated food frequency instrument suitable for adolescents in this age group. As DQ is best represented in a composite measure, data from the YAQ were used to calculate a Diet Quality Index (DQI)²⁴ for each student. DQI values encompass dietary variety (i.e., overall variety and variety within protein sources, to assess whether intake comes from diverse sources both across and within food groups), adequacy (i.e., the intake of dietary elements that must be supplied sufficiently to guarantee a healthy diet), moderation (i.e., intake of food and nutrients that are related to chronic diseases and that may need restriction) and balance (i.e., the overall balance of diet in terms of proportionality in energy sources and fatty acid composition). Scores ranged from 0 to 100, the higher scores reflecting better DQ. The DQI has been useful in cross-national comparisons of diet quality²⁵ and has demonstrated important associations with other measures of healthy eating.¹⁸

Analytical plan

Demographic and descriptive statistics were generated, and a series of zero-order correlations and between-subject ANOVAs were conducted to identify potential covariates (sex, grade, ethnicity and BMI) for the main analyses. Once identified, a series of 2 (SES: high vs. low) × 3 (neighbourhood type: urban, suburban, rural) analyses of covariance (ANCOVA) were conducted on the MVPA per day and DQ variables.

RESULTS

Demographic data are presented in Table 1. Of the 380 students recruited, 53% were male and 84% were white. Participant age ranged from 12 or less to 16 years, with somewhat greater participation among younger students. This was reflected in the distribution by grade, which revealed lower participation by grade 9 students at most schools.

Preliminary analyses showed that MVPA per day was significantly related to sex (F[1,344]=23.64, p=0.00), grade (F[1,344]=5.34, p=0.01) and BMI (r=-0.16, p=0.00), whereas DQ differed by ethnicity (F[1,330]=6.02, p=0.02). Therefore, these were controlled for in subsequent analyses.

Physical activity

With regard to MVPA per day, the ANCOVA showed a significant school-level SES × neighbourhood type interaction (F[2,343]=4.56, p=0.01) (see Table 2). Follow-up between-subject ANCOVAs were conducted for high and low SES groups separately and showed that the effect of neighbourhood type was only present for low SES schools (F[2,225]=14.49, p=0.00). Least significant difference post-hoc analyses showed that low SES urban students engaged in significantly more MVPA per day than low SES suburban (p=0.00) and rural (p=0.00) students; however, MVPA per day was similar for low SES suburban and rural students (p=0.71).

Diet quality

With respect to DQ, the ANCOVA showed a significant school level SES × neighbourhood type interaction (F[2,330]=4.21, p=0.02) (see Table 2). Follow-up between-subject ANCOVAs were conducted for urban, suburban and rural groups separately and showed that high SES urban students had significantly better DQ scores than their low SES counterparts (F[1,85]=14.41, p=0.00); however, there were no school-level SES differences for suburban or rural students.

DISCUSSION

Physical activity

The health benefits of PA are well known, yet PA rates tend to decline during the adolescent period.²⁶ Understanding how PA rates vary for subgroups during this phase of the lifespan can highlight possible avenues for targeted interventions to improve youth

health. Consistent with our hypotheses, analyses revealed an interaction between SES and neighbourhood type. Higher rates of PA were found among youth who attended school in a low SES urban setting than among those who attended school in low SES rural or suburban settings. The rural schools in our study had larger catchment areas and required bussing of most or all students, whereas bussing was less common in urban schools. Therefore, active transportation to school may account for some of the difference in MVPA in the urban and rural settings. Otherwise, there were few differences noted among the low SES schools in their physical education programming or the availability of facilities for use outside of school time (e.g., all low-SES schools had a gymnasium with change rooms on site as well as outdoor paved areas for PA, fields and running tracks available to them either on or off school grounds; all reported that students would have the option to participate in intramural programs that involved physical activity five days per week).

This finding is consistent with previous research of adult PA, which has typically found higher rates of PA in urban than rural areas.²⁷ However, it is inconsistent with some research on children and youth. In a review of studies examining the PA levels of children living in different built environments, Sandercock et al.⁸ found that most studies either reported no difference among urban, rural and (when examined) suburban environments or that children in rural and/or suburban environments had higher PA levels than those in urban environments. Most of the studies reviewed by Sandercock et al.⁸ employed either self- or parent-reports of child/youth PA, which are vulnerable to overreporting, social desirability influences and difficulty in recall.²⁸ Our study improves on the literature by using objectively measured PA across three distinct neighbourhood types. Furthermore, greater PA among rural children is often attributed to outdoor play, which is more likely to occur in younger age groups than the one studied here.²⁹

Typically, explanations for rural-urban differences in adult PA highlight the limited availability and accessibility of venues for leisure-time PA and poor walkability of rural areas.^{30,31} This disparity is likely exacerbated when financial resources are lower. Indeed, Parks et al.²¹ found that rural, lower-income adults were less than half as likely as suburban, higher-income adults to meet PA recommendations. Canadian data indicate that parents from smaller communities are less likely to report the availability of public and private opportunities for PA and less likely to report that those opportunities meet their children's needs;³² the data also indicate that youth perceive a lack of opportunities close to home as a barrier to physical activity.³³ Lower socio-economic regions are even less likely to have venues for leisure-time PA than higher socio-economic regions, and where they do exist the limited financial resources of residents may preclude their use.³⁴ In a qualitative examination, low SES Canadian youth were more likely than their high SES counterparts to report the proximity and cost of facilities as factors that determined their participation in PA.³⁵

The inclusion of a suburban comparison category represents a further novel aspect of the current study, as few studies have gone beyond the examination of simple urban/rural differences.⁸ A pattern of higher PA levels in children in suburban environments has emerged when this category is considered.³⁶ In our study, however, rates of youth PA were similar in suburban and rural settings regardless of neighbourhood SES. This discrepancy may be rooted

in differences in measurement (our study measured PA objectively by accelerometers, whereas Springer et al.³⁶ employed self-report measures). Developmental differences may also play a role, in that Springer et al. studied high school students. These older adolescents may have the autonomy to drive to nearby centres for PA, whereas younger adolescents may not. Suburban environments, by definition, are located outside of the urban core. Therefore, opportunities for physical activities of interest to this age group (at facilities such as rinks, skate parks and recreation centres) may not be within walkable distance in either rural or suburban neighbourhoods.

Diet quality

Consistent with our hypothesis, DQ was found to be poorer among youth who attended school in the low SES setting than among their counterparts who attended school in the high SES setting. However, this pattern was found only for urban schools. Differences in the nutrition environment and programming at these urban schools were few: the high SES school had a vending machine for drinks whereas the low SES school did not, and the low SES school offered a breakfast program whereas the high SES school did not. Yet, neither of these offers a clear explanation for the pattern of findings that emerged. Socio-economic differences in DQ have been highlighted quite consistently in the literature: 80% of articles reviewed by Hanson and Chen⁵ revealed an association between higher SES and greater DQ. Explanations for the association between low SES and poor nutrition often highlight unsafe or impoverished living environments with limited access to healthy foods and/or limited knowledge of healthy eating practices.⁵ Further exploration of this phenomenon in this sample is ongoing, with preliminary qualitative analysis suggesting that accessibility of healthy foods plays an important role in food choice (data not shown).

Much less research has focused on neighbourhood-type differences in DQ. There is some indication that dietary fat and calorie consumption is higher among rural youth and families.^{12,37} Yet, research examining the impact of the built environment features on youth health has suggested that the accessibility of fast-food restaurants, which is greater in urban than rural environments, is an important predictor of obesity.¹⁵ Although the current study did not find differences across neighbourhood type, the low SES urban environment emerged as a setting with particularly poor DQ. Perhaps by combining the economic and geographic accessibility of unhealthy foods (especially fast food), urban environments in lower socio-economic areas may be particularly obesogenic.³⁸

CONCLUSION

Several limitations need to be considered in interpreting the findings of the current study. As in all correlational research, it is important to acknowledge that the relations between neighbourhood type, SES, PA and DQ presented here are not causal. Thus, we cannot conclude that living in a low SES urban environment causes youth to engage in greater PA or to eat foods that result in a lower DQ. Self-selection of individuals and families into particular neighbourhoods may play an important, albeit immeasurable, role in our findings. If neighbourhood self-selection could be taken into account, differences found between the six settings might be attenuated. Further self-selection into the study is another limitation.

Although the schools were randomly selected from identified strata, only one school was chosen to represent each stratum, limiting the generalizability of our findings. Furthermore, the recruitment rate was somewhat low, likely because of the greater extent of participant involvement (e.g., wearing and charging study equipment) than in other studies, and grade 9 students may be somewhat under-represented in comparison to students in grades 7 and 8. Also, because schools were recruited one at a time, seasonal changes may have affected different rates of PA across the six schools. With regard to measurement, because accelerometers were required to be removed during water and contact sports, the measure of MVPA did not include these activities. Finally, because household income was not self-reported, variations among students within the same school area are not taken into account in these analyses.*

Despite these limitations, the current study contributes to an improved understanding of the variation in PA and diet in adolescents from more or less urbanized neighbourhoods in several ways. First, by employing accelerometers to measure PA, this paper improves upon earlier descriptive work that has used primarily self-report indices. Second, investigations rarely consider both PA and dietary intake – i.e., both sides of the energy balance equation – within the same study,¹⁹ which is critical to a greater understanding of the role of the built environment in obesity and other chronic diseases. This work provides detailed descriptive information on youth PA levels and dietary intake for concurrent consideration and reveals important differences in the patterning of these health-related behaviours across school-level income levels and neighbourhood types. Finally, studies that consider neighbourhood types often include only rural and urban categories. By considering the suburban environment, this study advances the current understanding of health behaviours among youth in these geographic areas. It suggests that neighbourhood type and SES interact and should both, therefore, be carefully considered in identifying both areas of risk (e.g., rural vs. urban areas) and target behaviours (e.g., diet quality vs. physical activity) in the development of initiatives aimed to promote PA and DQ among youth.

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* A separate analysis not included in the current article controlled for home-level SES using a proxy measure that included measures of income, education and unemployment based on the census dissemination area of participants' home address. The inclusion of this control variable had no impact on our findings but complicated the report and thus was omitted.

RÉSUMÉ

Objectifs : L'activité physique et la nutrition sont essentiels à un mode de vie sain et particulièrement importantes durant la jeunesse, en pleine période de croissance et de développement. Nous avons examiné les taux d'activité physique (AP) et la qualité du régime (QR) d'élèves de la 7e à la 9e année à Halifax (Nouvelle-Écosse) durant l'année scolaire 2008-2009 et évalué les écarts entre les élèves des quartiers ruraux, urbains et suburbains, de statut socioéconomique (SSE) faible et élevé.

Méthode : Des jeunes de la 7e à la 9e année (de 12 à 16 ans; 53 % de garçons) fréquentant six écoles (N=380) stratifiées selon le type de quartier (urbain, suburbain, rural) et le SSE ont porté des accéléromètres pendant 7 jours ou moins (4,14 jours en moyenne, écart type de 1,49) et rempli un questionnaire sur la nutrition.

Résultats : Les constatations de l'étude laissent entrevoir d'importants écarts dans l'AP et la QR selon le SSE et le type de quartier. En particulier, les taux d'activité physique modérée à vigoureuse chez les jeunes des écoles de zones socioéconomiquement faibles étaient plus élevés en milieu urbain qu'en milieu rural ou suburbain. De plus, la QR était meilleure chez les jeunes des quartiers urbains de SSE élevé plutôt que faible.

Conclusion : La connaissance de ces écarts dans l'AP et la QR entre les environnements ruraux, urbains et suburbains, de SSE élevé ou faible, peut faire ressortir des sous-groupes et des zones géographiques à cibler pour concevoir des interventions qui améliorent les taux d'AP et de saine alimentation.

Mots clés : activité physique; nutrition; jeunesse; milieu bâti; statut socioéconomique