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The impact of dietary habits and practices during adolescence on the risk of obesity: the birth to twenty cohort

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Changes in dietary habits and eating practices in adolescents living in urban South Africa: The birth to twenty cohort

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ABSTRACT

Objective: To assess changes in the dietary habits and eating practices of a longitudinal cohort of adolescents over a 5-y period living in Soweto and Johannesburg.
Methods: An interviewer-assisted questionnaire was used to gather data on the dietary habits and eating practices across three environments: in the home, in the school, and in the community. Participants ($n = 1451$, 49.1% male, 89% black, and 11% with mixed ancestry) 13, 15, and 17 y old with complete data were included in the analyses.
Results: The weekday breakfast consumption decreased over the 5-y period, from 76% to 65% ($P < 0.001$); participants consumed breakfast during the weekend more regularly but this also decreased with age. Snacking while watching television increased with age, from 3.6 ± 4.6 to 6.7 ± 5.9 snacks/week, with female subjects consistently consuming more snacks than male subjects ($P < 0.01$). Two-thirds of participants ate their main meal with their families on most days at all three ages. Fast-food consumption increased by half a portion/week over the 5 y and confectionery consumption stayed the same, around 9 items/week in male subjects and 10 items/week in female subjects ($P < 0.02$). Lunch box usage decreased with age; conversely, the number of tuck shop purchases increased.
Conclusion: Poor eating habits in all three environments were found; the participants' propensity for foods that were energy dense and micronutrient poor was high. This study also found that dietary patterns are well established by 13 y of age.

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Introduction

Dietary patterns that develop in childhood often are maintained into adulthood [1]. It is well established that adolescents consistently do not meet healthy eating guidelines and there is a tendency to consume large amounts of energy-dense foods and consume low quantities of fruits and vegetables [2]. This nutritional inadequacy results from a complexity of socioeconomic and psychosocial factors [3–5]. One conceptual framework combines social cognitive theory with an ecologic approach [2] and highlights the importance of the individual, the household, the school environment, and the community as some of the domains that influence adolescents' food choices.

Typical adolescent eating behaviors in high-income countries include snacking (usually energy-dense foods), skipping meals (particularly breakfast), a high consumption of fast food and sweetened beverages, and a low intake of fruit, vegetables, and dairy products; such behaviors have been found to be associated with poor nutritional quality [6–11]. However, little research has been undertaken in low- and middle-income countries [12–15], where the pace of transition is much greater than in developed nations, and, in consequence, the environmental exposures that affect eating behaviors may be different [16]. In South Africa, for example, individuals have a high exposure to fast foods because these foods are available from formal (commercial franchises) and informal (such as street vendors) outlets.

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Because adolescents acquire their food from several sources (home, school, and in the community), there is a risk of developing poor eating habits in all these environments. To date, there has been no longitudinal study in South Africa that has assessed the dietary habits and eating practices across all three settings. The aim of this study was to track the dietary habits and eating practices over a 5-y period of urban adolescents living in Soweto Johannesburg. We hypothesized that poor dietary habits and eating practices would increase with age and there would be gender differences.

Materials and methods

Study population, history

The Birth to Twenty (Bt20) cohort monitors children's health and well-being [17] and is comprised of all singleton children ($n = 3273$) born from April through June 1990, resident for at least 6 mo in the Soweto–Johannesburg municipality after birth, and whose parents gave consent to be enrolled into the study. The cohort, demographically representative of long-term residents in Soweto–Johannesburg, has been followed up 16 times from birth through 20 y of age [18,19]. The attrition over two decades has been comparatively low (30%), mostly occurring during the children's infancy and early childhood. Approximately 2200 participants remain in contact with the study [20]. The primary caregivers gave written informed consent for their child to participate in the research at each assessment visit and the child provided written assent. Confidentiality has been maintained by the allocation of an identification number for each participant, which was used on all questionnaires. Ethics clearance was obtained from the Witwatersrand University committee for research on human subjects (M080320).

Assessment of dietary habits and eating practices, questionnaire development

The questionnaire was administered by an interviewer to the participants during their visit to the data collection site. The questionnaire was developed and guided by a literature review to formulate questions around the dietary habits and practices within three key settings (home, school, and community), which have been shown to be associated with poor nutritional outcomes [3–5,10,11]. The questions determined if participants engaged in a particular eating practice, and, if they did, we enquired about which foods they ate (from a predetermined list based on focus-group findings) and how often they ate these foods in the previous week. The questionnaire is somewhat similar to a non-quantified food-frequency questionnaire approach, where the frequencies of certain food items consumed over the recall period are recorded. Therefore, the questionnaire captured the eating behavior engagement and, where applicable, what foods were consumed and their frequency.

The questionnaire used was translated into local languages (including Sesotho and IsiZulu), piloted, and modified in fieldwork debriefing sessions to ensure the meaning equivalence of the questions. Piloting was carried out in a convenient group of adolescents to ensure the questions were understood and to test for an appropriate translation to the local vernacular. Reliability was assessed by using the test–retest design method, administering the questionnaire to the pilot participants ($n = 20$) twice, 1 wk apart. To determine the retest reliability, κ-coefficients for nominal data were used. The κ-coefficients showed a very strong agreement between the first and second test responses, ranging from 0.89 to 1.00 for the different question items.

The questions

In the home environment, we enquired about how regularly breakfast was eaten during the week (coded as irregular, i.e., ≤2/wk, or regular, i.e., 3–5/wk) and during the weekend (coded as irregular, i.e., 1 weekend day, or regular, i.e., both weekend days), how often the participants ate snacks while watching television (0, 1, 2, 3, 4, or >5/wk), and what snacks were eaten. We enquired about how frequently participants ate their main meal with their family (coded as "never/some days" or "most/everyday).

In the community environment, we asked about the number (0, 1, 2, 3, 4, or >5 times/wk) of fast foods, confectionery (for this study, "confectionery" included items such as chocolate, crisps, sweets, ice cream, cake, and doughnuts), and sweetened beverages (soft drinks, diet drinks, and squash/cordials) consumed.

In the school environment, we enquired about the foods purchased from the tuck shop (TS) and how many days during the previous week a lunchbox (LB) was used (coded as irregular, ≤2/wk, or regular, 3–5/wk). Socioeconomic status indicators of the household were assessed at the birth of the cohort child and included maternal education, the availability of household electricity, and ownership of a television, a car, and a refrigerator in the home [21]; these latter variables were used to assess the differences between the analytic sample and the remaining Bt20 participants.

Analytical sample and statistical analyses

Dietary habits data were collected during cohort assessments at ages 13 y ($n = 1923$), 15 y ($n = 1981$), and 17 y ($n = 1985$). However, only participants with complete data at all three ages and who were black (89%) or of mixed ancestral origin (11%) were included in the analytic sample ($n = 1451$, 49.1% male). To assess how representative the analytic sample was of the Bt20 cohort (black and mixed ancestral participants only; excluding white and Indian participants [$n = 359$] because of the low study retention in these ethnic groups), demographic and socioeconomic variables were compared between the two groups (analytic sample, $n = 1451$; Bt20, $n = 1463$). All analyses were carried out in STATA 10 (STATA Corp., College Station, TX, USA). Descriptive statistics were performed for the analytic sample. For continuous variables, means and standard deviations were calculated and frequency weighting determined the most popular foods. Repeated measures analysis of variance was used to examine differences over time. Sphericity assumptions were first tested for all analyses (Huynh-Feldt test, $P > 0.9$; Greenhouse-Geisser test, $P > 0.9$; and the Box conservative ε, $P > 0.5$; time, $P < 0.0001$). The Friedman test was used when the sphericity assumptions were violated. Paired t tests were used to identify between which age groups there were differences; differences between continuous variables confirmed the normality of their distributions. Gender differences were assessed using independent t tests. Frequencies were presented for categorical variables and the McNemar tests were used to examine differences among age groups. Gender differences were assessed with chi-square tests. Change over time for "eat main meal with family" was assessed using the Wilcoxon sign test.

Results

Descriptive statistics

When we compared the analytical sample with those black and mixed ancestral participants not included in the study, the remaining Bt20 cohort, the analytic sample was slightly better off in terms of access to electricity (95.4% versus 87.1%) and a larger proportion had a television (78% versus 64%) and a refrigerator (74% versus 60%, $P < 0.001$). Maternal education also was slightly better in the analytic sample (46% versus 42%, $P < 0.04$), achieving standard 9 (schooling to 16 y of age). Within the analytical sample, we found no ethnic differences in the dietary habits between black and mixed ancestral participants, so we pooled the data.

Dietary patterns at home

Breakfast

Overall, regular weekday (at least three times) breakfast consumption during the previous week decreased across the age groups (76.4%, 63.8%, and 65.3% for the 13-, 15-, and 17-y-old groups, respectively). The differences between ages 13 to 15 and ages 13 to 17 were statistically significant ($P < 0.001$). Male subjects consumed breakfast more regularly than female subjects at all ages ($P < 0.001$; Fig. 1A), and the regular weekday breakfast decreased with age for male and female subjects. For the entire cohort, regular weekend breakfast consumption was higher than on weekdays but also decreased with age (86.8% to 79.8% to 67.3%, respectively).

Snacking while watching television

Snacking while watching television increased with age (mean 3.6 ± 4.6, 4.8 ± 6.1, and 6.7 ± 5.9 snacks/week, respectively, $P < 0.001$). Female subjects consistently consumed more snacks while watching television than male subjects (age 13 y, 4.0 ± 4.8 versus 3.3 ± 4.5; age 15 y, 5.4 ± 6.6 versus 4.1 ± 5.6, age 17 y, 7.3 ± 5.9 versus 6.0 ± 5.8, $P < 0.01$).

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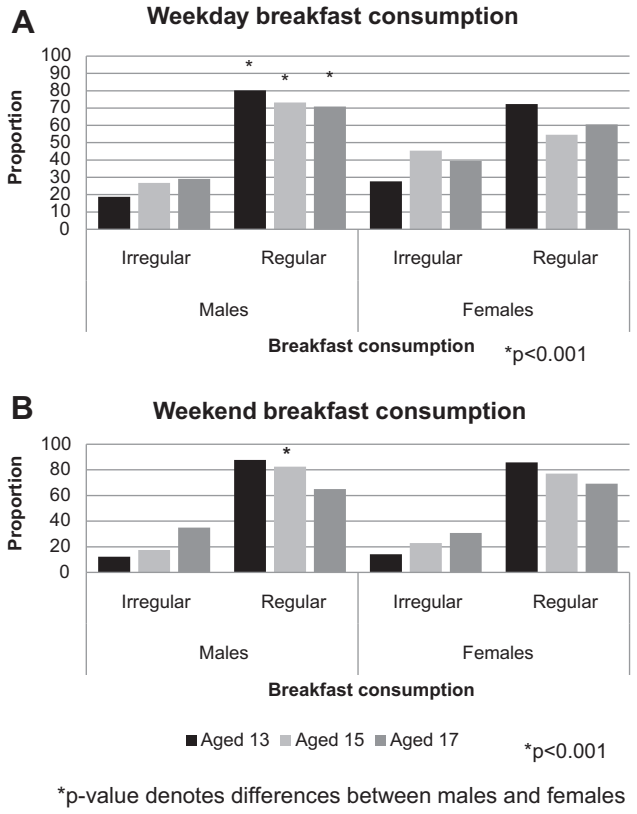


Fig. 1. (A, B) Frequency of breakfast consumption in the previous week.

The five most popular snacks, consistent at all ages, included bread (sliced) or crisps (deep fried potatoes with salt/flavorings added), fruit (e.g., an apple), sweet biscuits, and chocolate, which accounted for more than 80% of snacks consumed (Fig. 2). There was with age a small increase in the consumption of chocolate, cakes, fried chips, and fruit and, conversely, a slight decrease in crisps, bread, and popcorn (made with fat and salt added) consumption.

Family meal

For male and female subjects, two-thirds of participants stated that they ate their main meals with their family on "most or every day" at each age. However, there was a trend toward eating less often with the family (27%, $P = 0.098$) and a gender stratification showed that this behavior was actually in female subjects. With increasing age, there was a 28% decrease in eating

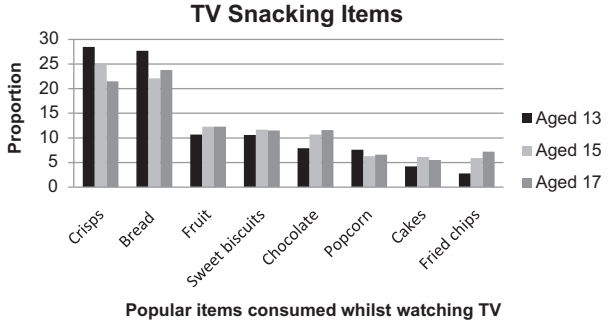


Fig. 2. Snacks consumed while watching television during the previous week.

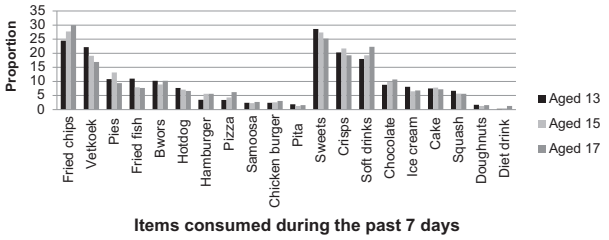


Fig. 3. Popular food items (fast food, confectionary, and beverages) in the community consumed in the previous week.

this meal with the family compared with 22% who increased eating this meal with the family ($P = 0.018$).

Community-based dietary patterns

Fast food, confectionery, and beverages

Fast-food intake during the week increased with age, from 4.8 ± 3.9 to 5.1 ± 4.8 and to 5.3 ± 4.2, for each age group, respectively ($P = 0.001$). There were no gender differences in fast-food consumption except at 17 y of age, with male subjects consuming slightly more fast-food items (5.6 ± 4.2 versus 5.1 ± 4.2, $P = 0.04$). Fast-food preferences were the same for male and female subjects, with the five most popular foods being fried chips, *vetkoek* (fried dough balls), fried fish (battered), pies (pastry with a filling, usually meat), and *boerewors* (local sausage) rolls accounting for more than 74% of total fast foods consumed (Fig. 3).

Confectionery and beverage consumption were analyzed separately but are presented with the fast foods (Fig. 3). For the entire cohort, confectionery consumption per week changed little over the 5 y (from 9.4 ± 4.8 to 9.6 ± 5.3 and 9.5 ± 4.9). Girls consistently ate more confectionery than boys in each age group (9.6 ± 4.9 versus 9.1 ± 4.6, 10.2 ± 5.2 versus 8.9 ± 5.2, 10.1 ± 5.1 versus 8.9 ± 4.7, $P < 0.02$). Mean beverage consumption increased with age across the entire cohort, from 3.1 ± 2.5 at 13 y to 4.0 ± 2.5 at 17 y ($P < 0.001$). Sweets, crisps, and soft drinks were the three most popular confectionery/beverage items, accounting for more than 65% of the total items consumed at all time points. With age, there was an increased preference for soft drinks and chocolate and a decreased preference for sweets, ice cream, and squash (cordial).

School dietary patterns

Lunch boxes. Regular LB use was not common at any age, decreasing from 17.4% to 12.3% and to 8.6% for each age group, respectively ($P < 0.001$), but its use was significantly higher in female subjects ($P < 0.04$; Fig. 4).

For the entire cohort, the mean number of foods per week contained within LBs increased over time in each age group (from 6.6 ± 3.8 to 8.4 ± 4.9 and 10.0 ± 4.8, $P < 0.02$). When assessed by gender, girls consistently had more items per week in their LBs than boys (age 13 y, 6.9 ± 3.8 versus 6.2 ± 3.7, $P < 0.001$; age 15 y, 9.1 ± 4.7 versus 6.9 ± 4.7, $P < 0.001$; age 17 y, 10.3 ± 4.8 versus 9.0 ± 4.7, $P = 1.327$). The most popular LB foods (accounting for >50% of foods) at each age included cheese, bread (white or brown), fruit, and fruit juice (Fig. 5).

TS purchases. More than 85% of participants bought food from the school TS, with a mean increase with age from 12.4 ± 7.8 to 12.9 ± 9.0 to 13.5 ± 10.2 purchases per week, respectively ($P = 0.03$). The difference between ages 13 and 17 y only was

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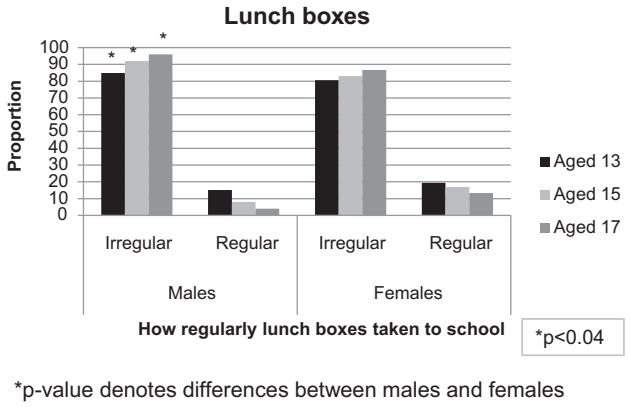


Fig. 4. Lunch box usage during the previous week.

statistically significant ($P < 0.001$). When stratified by gender, girls bought more items than boys at each age, but the difference was significant only at 13 y of age (12.9 ± 7.6 versus 11.9 ± 7.8, $P = 0.01$).

The five most popular TS purchases at all ages included sweets, crisps, cold drink, fried chips, and white bread, accounting for 62% of purchases. With increasing age, there was a decrease in the purchase of sweets, crisps, fruit juice, white bread, and pies but an increase in the purchase of cold drinks, cake, and fried chips.

Discussion

This study evaluated the longitudinal changes in adolescent dietary habits and eating practices over a 5-y period. We demonstrated that eating practices are well established by the 13 y of age, with poor dietary practices persisting with increasing age and irregular breakfast consumption, television snacking, and fast-food consumption increasing over time. Similarly, the TS purchases increased with age, but more so in female subjects. Regular LB use was low. Interestingly, a large proportion of the cohort consistently over the 5 y ate their main meal regularly with their family.

Dietary patterns at home

Previous South African studies have reported that skipping breakfast by adolescents ranges from 13% to 22% depending on the ethnicity and geographic location [12,15]. In the USA, similar proportions of boys (11%) and girls (14%) ate breakfast zero to twice per week [22]. Furthermore, 31% of 14- to 18-y-old boys and girls skipped breakfast in the previous week [23]. Our study showed higher levels of breakfast skipping, particularly by 17 y of age.

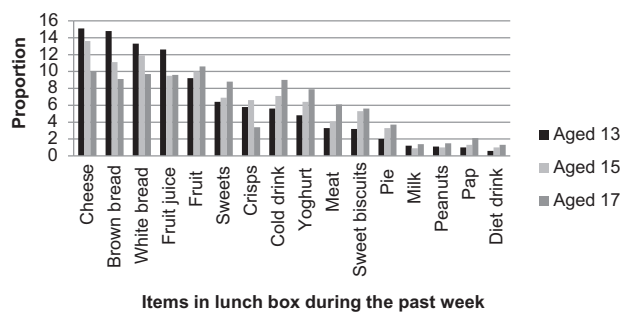


Fig. 5. Lunch box items consumed during the past week.

For boys and girls, the number of snacks consumed while watching television increased by 86% over the 5-y period. In the USA, the mean daily snack intake while watching television was 2.5 ± 1.4 and 2.2 ± 1.1 for male and female subjects, respectively ($P < 0.001$) [24], which is greater than twice the amount found in the present study. Although the association between television viewing and obesity is partly mediated by the lower physical activity, it can also influence food intake and diet quality [25]. One study found that for each hour of television viewing, an additional 653 kJ/d was consumed [26].

A higher frequency of participating in family meals has been associated with a lower prevalence of obesity and has been associated with other behaviors important in adolescent development [8]. An American study of more than 90 000 adolescents found that 20% of participants rarely ate their main meal with their family (0–1 d/wk), whereas 45% frequently ate this meal with their family (5–7 d/wk) [8]. Another U.S. study found that with increasing age, adolescents ate their main meal with their family less often (from 8.9% at 11–13 y to 15.4% at 16–17 y) [7]. Thus, contrary to this research, two-thirds of our respondents ate their main meal with their family on "most or every day" at each age. This emphasizes that the potential influences on adolescent eating practices (at least for the important main meal of the day) by their family is still strong at 17 y of age; thus, the notion of this influence decreasing with age, as found in U.S. adolescents, is currently not so in a South African urban black population.

Community dietary patterns

Overall, fast-food consumption increased by 10.4% and male subjects ate slightly more than female subjects at 17 y of age. However, girls consistently ate more confectionery than boys. The beverage consumption increased by 29% over time for boys and girls. In a cross-sectional study of 17-y-olds living in Soweto ($n = 655$), we found that the mean fast-food item intake was 7.6 ± 4.6/wk [27], which is larger than the findings in the present study, possibly because of the sample size differences. Larson et al. [28] found that 22.5% of U.S. adolescents consumed fast food on at least 3 d/wk, which is lower than the present findings. For soft drinks, Ludwig et al. [29] found that 11- to 12-y-old boys and girls consumed 1.4 and 1.1 servings/d, respectively, higher than in the present study. Indeed, snacking (which includes confectionery and soft drinks) has been shown to be increasing in the USA and may be associated with obesity. Since 1989, child snack consumption in the USA has increased to three times per day, with 27% of energy intake attributed to snacking [9].

The availability and access may be reasons why the fast-food intake was relatively high in the present cohort. In a developing country such as South Africa, fast foods are obtained from commercial outlets and informal outlets (e.g., street vendors and community TSs), whereas in developed countries, fast foods are available almost exclusively from commercial outlets. Informal outlets in Soweto sell a single *vetkoek* for 60c (US$0.09) and portion of chips for R8 (US$1.19), whereas an equivalent-sized portion of chips from a commercial outlet costs R15 (US$2.22). The lower prices from informal vendors make fast foods more accessible and affordable to those on lower incomes. The availability of confectionery and beverages is also widespread at school (TSs in or outside school grounds) and in the community (street vendors, TSs, and commercial outlets). Indeed, Temple

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and Steyn [30] reported that in South Africa the cost of a healthier diet can increase food spending by 69% and that cost acts as a barrier by preventing the consumption of a healthier diet.

School dietary patterns

Regular LB usage was low and decreased with age in this cohort. However, the results showed a mean increase with age in the LB food items, which is possibly a reflection of the older adolescent's higher energy requirements. In a cross-sectional survey of U.S. adolescents ($n = 1088$), 72% did not use an LB in the previous week, whereas 31% reported purchasing snack foods from school vending machines [31]. The school TS in South Africa is probably an equivalent source of snacks to vending machines in the USA; such purchases increased by 8.8% over 5 y. Another study in South African adolescents found a higher LB usage, with 50% of study participants bringing food to school. TS purchases were also high, with 73% adolescents purchasing two or more unhealthy items per day [12].

The differences in the study design and questionnaire prevent us from making direct comparisons between our study and other international research. However, our data indicate that we ought to be as concerned about dietary habits in adolescents as health professionals are in high-income countries. Our data show that poor dietary habits and practices increase with advancing age. Whether the desire for such food is a result of choice, environmental exposures, or a part of personal development in which adolescents exert their individuality by eating away from home and with their peers is not known [2]. Qualitative work on the meanings of food terms showed that *junk food* was associated with pleasure, being with friends, independence, affordability, and convenience; conversely, a healthy meal was associated with family, meals, and being at home [32]. Certainly, Soweto is still undergoing a rapid transition particularly in the area of economic uplift, which drives lifestyle changes including food behaviors. Perhaps the increase in these poor habits is a reflection of the context in which these adolescents live.

This study identified future research questions: How do these dietary habits and eating practices contribute to total energy intake and affect body composition? How do these patterns relate to dietary diversity [33]? Do the dietary habits and eating practices described here differ in adolescents of higher socioeconomic status living in other suburbs of Johannesburg? A better understanding of the preparation and composition of the main family meal could guide potential interventions because parental influence in this regard is still strong in most of this population. In South Africa, the food available in schools is unregulated; another possible intervention could therefore focus on schools because these settings are more contained than within the wider community. Also, educating parents and adolescents about the importance of correct eating patterns to encourage more LB usage could be considered, especially because we found that the five most popular LB foods were relatively healthy.

A limitation of this study is that the analytical sample represents slightly better-off black and mixed ancestral families residing in Soweto–Johannesburg and does not cover severely disadvantaged families. Also, because the questionnaire assessed the frequency of foods consumed, these figures should be viewed as estimates and not absolute values because such methods are known to overestimate intake. We were unable to determine the contributory role these eating patterns have on overall energy intake. However, this study is unique in that it assessed the longitudinal dietary habits and eating practices over a 5-y period in adolescents living in an urban setting undergoing transition. There is a need for such data in middle- and low-income countries, especially amid the increasing prevalence of obesity [34]. This study was based on a large sample of subjects; thus, we feel confident that these dietary patterns and eating practices are indicative of adolescent behavior within this urban setting. However, what drives these patterns is unclear. Are these behaviors a result of increases in advertising, pocket money, or the nutrition transition, which are affected by complex interactions among demographics, environment, and economics [35]?

Conclusion

This study identified poor eating habits in three environments of risk, and in all the environments, the participants' propensity for energy-dense, micronutrient-poor foods was high. A noteworthy outcome of this study was that dietary patterns were well established by 13 y of age.

Acknowledgments

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