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Abstract

Objectives: To investigate whether active school transport was associated with fast food consumption, and to examine differences across racial/ethnic groups.

Methods: Adolescent data (n=3,194) from the 2009 California Health Interview Survey were analyzed with logistic regression models to examine the association between active school transport (AST) and fast food intake across racial/ethnic groups.

Results: In the overall sample, AST during 1-2 days in the past week was associated with greater likelihood of fast food intake (OR: 1.58; 95%CI: 1.03-2.43), compared with zero days of AST, controlling for demographic and other factors. The association between AST and fast food intake differed significantly by race/ethnicity ($p<0.01$). Among Latino adolescents, greater frequency of AST was significantly associated with greater likelihood of fast food intake (1-2 days OR, 2.37, 95%CI: 1.05-5.35; 3-4 days OR, 2.78, 95%CI: 1.04-7.43; 5 days OR, 2.20, 95%CI: 1.23-3.93). Among White and Asian adolescents, there was a curvilinear pattern: relative to adolescents who reported zero days of AST, those who did AST 1-2 days/week had greater likelihood of fast food intake, but AST of 3-4 days and 5 days/week was associated respectively, with higher and lower likelihood of fast food intake among both groups.

Conclusions: AST appears to be a risk factor for fast food intake, and may expose some ethnic groups more than others to increased opportunity to purchase and consume fast food. Programs and policies to promote AST among adolescents should incorporate efforts to encourage healthy eating and discourage concentration of fast food outlets near schools.

Introduction

Active school transport (AST; e.g., walk to or from school) has received considerable attention as a strategy to improve physical activity and prevent childhood obesity in the United States (Faulkner et al., 2009; Institute of Medicine, 2013; National Center of Safe Routes to School, 2010). Children who use AST are more likely to be physically active than their peers who do not use AST (Active Living Research, 2009; Cooper et al., 2005; Cooper et al., 2003; Denstel et al., 2015; Faulkner et al., 2009; Institute of Medicine, 2013; Larouche et al., 2014; Mendoza et al., 2011). In addition to contributing to physical activity, AST may be associated with unfavorable dietary behaviors such as fast food intake. Prior research has observed that fast food outlets tend to cluster near schools (Austin, 2005; Davis and Carpenter, 2009; Sánchez et al., 2012; Sturm, 2008) and that fast food availability near schools was positively associated with adolescent fast food intake (Babey et al., 2009; Forsyth et al., 2012). Active school transport is likely to increase exposure to varying food environments near schools, including fast food outlets and related advertisements, which in turn may influence children's food choices. Little is known about the association between AST and fast food consumption.

Children from disadvantaged and racial/ethnic minority backgrounds are more likely to use active school transport than their White counterparts (Babey et al., 2009; Martin et al., 2007; McDonald, 2008), and schools attended by Black and Latino students tend to have a greater concentration of fast food outlets nearby compared to schools attended by mostly White children (Forsyth et al., 2012; Grier and Davis, 2013; Kwate and Loh, 2010; Sánchez et al., 2012; Sturm, 2008). Racial/ethnic differences in fast food environments near schools may lead to greater consumption of fast food among racial minority children who engage in active school transport. However, to our knowledge, racial/ethnic variations in the relationship between active school transport and fast food intake have not been systematically investigated. Using the adolescent sample of the 2009 California Health Interview Survey (CHIS), this study examined whether active school transport was significantly associated with fast food intake, and whether this association varied by race/ethnicity.

Materials and Methods

Data

CHIS is a population-based telephone survey of civilian households and has been previously found to be comparable to National Center for Health Statistics surveys, such as the Behavioral Risk Factor Surveillance System (California Health Interview Survey, 2003, 2005, 2007). A biennial survey from 2001-2009, CHIS has been conducted annually since 2011. Using random digit dialing, with oversampling of Asians, Blacks, and Hispanics/Latinos, one adult per household was randomly selected and asked to give verbal consent. In selected households where there were adolescents (12-17 years of age) or children (under 12), one adolescent and/or one child was randomly selected to participate. Adolescents were interviewed directly. Interviews were conducted in multiple languages. The adolescent overall response rate was 7.9% accounting for screener response, adult response, parent permission, and teen response; detailed response rate calculations have been published elsewhere (CHIS 2009 Methodology Report Series, 2011). CHIS 2009 is designed to be representative of the state's non-institutionalized population living in households, and to provide population-based estimates for California's overall population and its major racial/ethnic groups, including Asian and Latino subgroups (California Health Interview Survey, 2011). CHIS data are weighted to adjust for differential non-response. A total of 3,379 adolescents participated in the 2009 CHIS survey (California Health Interview Survey, 2011). After excluding adolescents with missing data on covariates (n=185), the analytic sample for this study is comprised of 3,194 youth (1,648 White, 784 Latinos, 367 Asian Americans, 113 African Americans and 282 Pacific Islander/other groups). This secondary data analysis study was exempted from IRB review by the authors' institutions.

Measures

Outcome variable: *Fast food intake*, measured as the number of times respondents consumed fast food in the past week, and based on the question: "In the past 7 days, how many times did you eat fast food?" Responses included fast food eaten at school, at home or at fast food restaurants, carryout or drive thru. We used fast food intake as a dichotomous outcome, classifying consumption as one or more times versus none. We used this classification because a typical fast food order for adolescents averages between 725 and 1,038 calories (Elbel et al., 2011; Lesser et al., 2013) and adolescent consumption from fast food restaurants has been associated with a

310kcal net increase in daily total energy intake, and greater intakes of total fat, saturated fat and sugar (Powell and Nguyen, 2013). Thus, even one fast food meal can substantially contribute towards exceeding the daily caloric intake recommendations for adolescents (1,600 – 3,200 calories) based on dietary guidelines for Americans (U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2010).

Primary predictor variables*: Active school transport (AST)* was based on the question: "How many days in the past week did you walk, bicycle, or skateboard home from school?" Responses were categorized as never, 1-2 days, 3-4 days and 5 days.

Race/ethnicity: Was measured based on the race/ethnicity that respondents most identified with at the time of the survey. Respondents were asked "which of the following do you most identify with"? with response options including: White, African American, Latino, Asian, two or more races, or other.

Other covariates: We selected covariates based on a priori identification in the literature as known or suspected, plausible risk factors for fast food consumption and for active school transport; they included demographic (age, gender), socioeconomic (family income, derived from adult household income information, and defined as the total pre-tax annual household's income from all sources during the prior calendar year and categorized relative to family size as ≤100%, 101-200%, 201-300%, 301-400%, or >400% of the federal poverty level; and highest levels of education of the adolescent's main care giver categorized as did not finish high school, high-school graduate or GED, some college, college graduate and graduate school or higher); region of residence, defined as whether the adolescent lived in a census tract that was located in an urban, second city, rural, or suburban area; frequency of bringing a homemade lunch to school, and fruit and vegetable consumption measured as whether adolescents consumed five or more fruit and vegetables a day (yes vs. no).

Statistical Analysis

We compared the prevalence of fast food intake and distributions of other variables among all adolescents, according to active school transport, and for each racial/ethnic group, using chi-

square statistics to assess the statistical significance of observed differences. Initially we constructed logistic regression models to examine the relative likelihood of fast food intake by the total sample and across categories of active school transport. To formally test whether AST and fast food intake varied by race/ethnicity, we added an interaction term that included AST and race/ethnicity. In an unadjusted model, we examined the association between active school transport and fast food intake, modeled as a dichotomous outcome. We subsequently adjusted for demographic, socioeconomic, urban location, whether adolescents brought a homemade lunch to school and fruit and vegetable consumption. In sensitivity analyses, we used active school transport as a predictor classified as, 0; 1-4 days and 5 days and modelled fast food intake as a count outcome using Poisson regression to determine if results differed. Stata version 14's suite of survey commands was used for all analyses, and incorporated CHIS sampling weights, which took into account the CHIS complex sampling design. All effects, including interactions, associated with p-values less than 0.05 were considered to be statistically significant. The analyses were conducted in 2015 and 2016.

Results

Table 1 displays characteristics of the overall sample, and differences between racial/ethnic groups. Prevalence rates of AST in the past week were higher among Latinos, African American, and Pacific Islander/other youth, compared with Asian and White adolescents. Similarly, Latinos and the PI/other adolescent groups reported higher prevalence and frequent consumption of fast food, lower prevalence of reporting consumption of 5 fruits and vegetables a day, and lower prevalence of reporting that they brought a homemade lunch to school as compared with White and Asian youth. Relative to White and Asian adolescents, Latinos, African Americans and PI/other groups generally reported less favorable socioeconomic characteristics. White adolescents reported the lowest, whereas African Americans and Latinos reported the highest proportions of residence in urban environments. Prevalence estimates for African Americans should be interpreted with caution, given their small sample sizes.

[insert Table 1]

Table 2 displays the characteristics of the sample according to reported number of days of active school transport. Relative to adolescents who reported using AST less frequently, those who

reported AST five days per week had lower rates of five fruit and vegetable consumption, and lower prevalence of bringing lunch to school from home; they reported lower rates of family income above 300% of the federal poverty level and higher prevalence of residence in urban areas.

[insert Table 2]

Table 3 displays the relative likelihoods of reporting fast food consumption across levels of AST for the total sample and stratified by race/ethnicity. In the overall sample, the unadjusted model shows that those who engaged in AST 1-4 days in the past week had significantly elevated odds of fast food consumption (OR for 1-2 AST days: 1.66, 95% CI: 1.11-2.48; OR for AST 3-4 days, 1.69, 95%CI 1.06-2.69) relative to those who reported zero days of AST. Engaging in AST five days was not statistically associated with fast food intake. After adjustment for covariates, the effect sizes reduced slightly, and only AST of 1-2 days remained significantly associated with fast food intake.

The association between AST and fast food intake varied significantly by race/ethnicity (*p* for interaction in the crude and fully adjusted models <0.01) (Table 3; Figure 1). Among Asian adolescents AST of 1-2 and 3-4 days was associated with higher fast food intake relative to no AST, though the association was not significant; AST of 5 days per week was significantly associated with lower likelihood of fast food intake. A similar pattern was observed among the White population, though the association was borderline significant and only among those who engaged in AST 1 or 2 days in the past week (OR: 1.69, 95% CI:0.99 – 2.85; unadjusted model, Table 3) and lost significance in the adjusted model. Among Latino youth, AST was positively and significantly associated with fast food intake, before and after adjustment for covariates. Compared with those who reported zero AST days, Latino adolescents who engaged in AST in the past week had significantly elevated likelihoods of fast food intake (OR for AST 1-2 days/week: 2.37, 95% CI: 1.05-5.35; OR for AST 3-4 days/week: 2.78, 95% CI: 1.04-7.43; and OR for AST 5 days/week: 2.20, 95% CI: 1.23-3.93). The AST-fast food intake association was not-significant and variable among African American youth, though the sample was small. Among the Pacific Islander/other group, the likelihood of fast food intake was higher only

among AST users of three or more days, although the association was not significant. Using AST as a three category predictor in sensitivity analysis yielded patterns that appeared generally similar to those described above. When fast food intake was used as a count outcome, the interaction between AST and race/ethnicity in unadjusted models was statistically significant (p=.0002) and borderline significant (p=.05) in adjusted models (not shown), and, importantly, the patterns of the estimated point estimates for each race/ethnicity appeared similar to those in Figure 1, though the confidence intervals included one for many of the racial/ethnic groups.

[insert Table 3]

Figure 1 presents the adjusted predicted probabilities of fast food consumption by frequency of AST and race/ethnicity. There appears to be a curvilinear pattern in the relationship between AST and fast food consumption across racial/ethnic groups, although it is more clearly seen for White and Asian adolescents. Engaging in AST 1 or 2 days in the past week was positively associated with greater consumption of fast food, but the strength of the association decreased for youth engaging in AST 3 to 4 days in the past week, and changed direction for adolescents who engaged in AST 5 days. Among Latino youth, the AST-fast food intake association was always positive. Among adolescents who reported zero AST days, the predicted probability of fast food consumption was similar among Latinos and Whites, but among those who used AST three days or more in the past week, there were larger differences in fast food intake across racial/ethnic groups, with Latinos having the highest probabilities. Among African Americans there was no clear pattern in the association. Among Pacific Islanders/others who used AST 3 or more days, the predicted probability of fast food intake was higher than non AST users.

[insert Figure 1]

Discussion

In the sample as a whole, youth who used AST one to two days in the past week had elevated odds of reporting fast food intake. Specifically, this group had a 58% greater likelihood of consuming fast food at least once in the past week than those who reported zero days of AST. AST three or more days was positively though not significantly associated with fast food intake. Importantly, we found evidence of a differential association of AST to fast food intake according

to race/ethnicity. Latino youth who engaged in AST had significantly elevated likelihoods of fast food intake relative to their co-ethnic peers who reported zero days of AST, with adjusted odds ratios ranging from 2.20 to 2.78. Among White adolescents, those who used AST 1 or 2 days in the past week reported 68% greater likelihood of fast food consumption compared with peers who reported zero days of AST, though the association was borderline significant in the unadjusted model; the association was positive though smaller in magnitude and not significant among those who reported AST 3 -4 days and was protective against fast food intake among those who reported 5 days of AST. Among Asian American adolescents, the AST-fast food intake association appeared to have a quadratic pattern, with AST of 1-2 days per week associated with elevated, non-significant likelihood of fast food intake (OR 3.8) and AST of 5 days a week with significantly lower likelihood of fast food intake (OR, 0.37; 95%CI 0.15-0.96). The associations were highly variable and non-significant for African Americans (possibly due to small sample sizes) and Pacific Islanders/others.

Past research has observed beneficial influences of AST on children's physical activity (Active Living Research, 2009; Institute of Medicine, 2013; Larouche et al., 2014). The association between AST and body weight has been less consistent (Institute of Medicine, 2013; Larouche et al., 2014). Some of the inconsistent findings may be in part related to exposure to various food environments during the trip to/from schools, and subsequent influences on eating behavior. Our study adds to this body of evidence by examining the association between AST and fast food intake across racial/ethnic groups.

The positive and significant association between AST and fast food intake among Latino adolescents is of concern. Fast food restaurants tend to be more concentrated near schools attended by Latino youth, and fast food availability near schools has been associated with greater fast food intake (Babey et al., 2009) and higher BMI among Latino and Black youth (Grier and Davis, 2013; Sánchez et al., 2012). Prior research has observed greater fast food consumption among Latino children than other race/ethnic groups (Taveras et al., 2010). However, the present study found that Latino youth who reported zero days of AST were significantly less likely to consume fast food than their co-ethnic peers who used AST. This implies that AST may expose some ethnic groups more than others to increased opportunity to purchase fast food by

differentially exposing adolescents to less-healthy food environments near schools. It must be considered that the results were not always significant for some race/ethnic groups. Our findings from sensitivity analyses suggest that treating fast food intake as a count outcome is less sensitive in detecting AST-fast food intake associations across racial/ethnic groups. Thus, it remains important to examine the binary outcome because this helps identify factors associated with health promoting behaviors (i.e., no fast food intake at the lower tail of the distribution). Additionally, the measure of zero vs. at least some fast food consumption may be less prone to recall errors compared to reporting the continuous measure. Future research should use larger samples of racial/ethnic youth, and examine the effects of AST interventions on dietary behaviors and why and how AST use influences food choices particularly among some racial/ethnic groups whose food environments offer greater opportunity to purchase fast food. Potential mechanisms include targeted marketing, living in neighborhoods with greater concentrations of fast food outlets, and fewer options for affordable healthy foods.

The variability in the association between AST and fast food intake across racial/ethnic groups may be related to multiple interrelated factors, including urbanicity, socioeconomic resources, exposure to differential school neighborhood food environments, and parental supervision after school across AST users. Among White and Asian American adolescents, active school transport may have some detrimental dietary effects among those who use limited AST e.g., 1-2 days in the past week, but not among never or more frequent AST users. In our sample (data not shown), White adolescents who reported no AST and those who did 3-5 days a week had higher family incomes than those who used AST 1-2 days. Further, compared to frequent AST users, a higher proportion of White adolescents who reported zero days of AST lived in semi-urban and non-urban areas. Among Latinos, a larger proportion of those who reported zero days of AST had high family incomes (300% of the FPL) relative to more frequent AST users. Further, higher proportions of Latinos and African Americans who reported AST 3 or more days lived in urban and semi-urban areas. White and Asian American adolescents who used AST five days in the past week may be exposed to healthier food environments in school neighborhoods compared with their co-ethnics who use AST 1-2 days per week. Alternatively, greater fast food intake among those engaging in AST 1-2 days a week may reflect a novelty effect whereby occasionally buying fast food while walking home from school is appealing.

It is plausible that active school transport increases exposure to the food outlets near schools, and this exposure may in turn increase the likelihood of unhealthy food consumption. These pathways may be particularly salient among youth who are more vulnerable to unhealthy food exposure. Future research should examine the possibly competing risks and benefits of AST by conducting fine grained analyses of active school transport patterns, more specific markers of school neighborhood environments and food purchasing and consumption during AST, within and across racial or ethnic groups.

This study could not identify the source (e.g., store, school) or the location where fast food was consumed, nor the time sequence in which fast food intake occurred in relation to active school transport (e.g., on the way to and from school); these questions were not available in the CHIS. Physical activity benefits from AST related to energy balance may be partly or completely offset by the energy-dense caloric content of fast food consumed if adolescents purchased and consumed fast food on their way to or from school. A study involving 19 California public schools found that group-level rates of student active commuting were associated with higher BMIz scores, and active commuters were significantly more likely than passive commuters to purchase food while in transit to school (Madsen et al., 2009); as such, the association between active school transport and BMIz lost statistical significance after controlling for food purchases while in transit. The observational, cross-sectional nature of the data precludes causal inferences, and to rule out reverse causation; for instance, the desire or motivation to consume fast food may trigger active school transport. While the data are self-reported, population-based data (such as CHIS) involving adolescent samples that include active school transport, fast food intake and race/ethnicity variables are rarely available.

AST is an important strategy to increase children's physical activity and obtain a wide variety of health benefits, including obesity reduction. AST may also increase exposure to obesogenic environments and opportunities for unhealthy eating behaviors. Reducing racial/ethnic childhood obesity disparities requires improving food environments, especially in racial minority neighborhoods near schools, and greater attention to potentially different drivers of fast food intake within as well as across racial/ethnic groups.

This study observed that AST is associated with fast food intake, but the relationship depends on AST frequency and race/ethnicity. The AST and fast food intake association was more pronounced among Latino youth than among other race/ethnic groups. These results suggest that a more nuanced understanding of the effects of AST on children's health and obesity-related behaviors is needed. One implication of the present findings is that programs promoting AST should consider incorporating efforts to encourage healthy eating, advocate for healthier food environments, and limit marketing of unhealthy foods around schools. Combining healthy eating interventions with AST promotion may be important across all students, particularly among children who walk and/or bike to school through unhealthy food environments.

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Conflict of Interest Statement

The authors declare that there are no conflicts of interest.

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