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Separating boys and girls and increasing weight? Assessing the impacts of single-sex schools through random assignment in Seoul

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Abstract

A growing body of research reports associations of school contexts with adolescents' weight and weight-related behaviors. One interesting, but under-researched, dimension of school context that potentially matters for adolescents' weight is the gender composition. If boys and girls are separated into single-sex schools, they might be less concerned about physical appearance, which may result in increased weight. Utilizing a unique setting in Seoul, Korea where students are randomly assigned to single-sex and coeducational schools within school districts, we estimate causal effects of single-sex schools on weight and weight-related behaviors. Our results show that students attending single-sex schools are more likely to be overweight, and that the effects are more pronounced for girls. We also find that girls in single-sex schools are less likely to engage in strenuous activities than their coeducational counterparts.

Keywords

Single-sex schools; Random assignment; Body mass index; Overweight; Korea

1. Introduction

Schools are venues not only for academic learning but also for "social" learning or socialization through which adolescents learn attitudes, values, and behaviors of others. Schools are important contexts in which adolescents interact with their friends and form adolescent cultures with specific perspectives and preferences that are likely to affect behaviors. Several studies have demonstrated that school contexts influence adolescents' risky behaviors such as smoking, drinking, and other substance use (Kumar et al., 2002; Lovato et al., 2010; West et al., 2004). However, the role of school contexts in influencing weight and weight-related behaviors has received relatively little attention. Moreover, studies that have explored the role of school contexts in influencing adolescents' health behaviors have mostly limited their focus to whether the proportion of students in a school with a certain behavior (e.g. smoking, drinking, or dieting) or a certain characteristic (e.g.

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overweight) was associated with the behavior or characteristic of an adolescent in that school (e.g., Carrell et al., 2011; Fletcher, 2010; Clark and Lohéac, 2007; Eisenberg et al., 2005).

An important aspect of school contexts that has received little attention regarding adolescents' weight and weight-related behaviors is the gender composition of school - single-sex versus coeducational schools. Physical attractiveness, popularity, appeal to the opposite sex, and dating are likely to influence adolescents' weight and weight-related behaviors. These have long been considered important components of adolescent culture in coeducational schools (Coleman, 1961), which are the dominant form of schooling in the United States and a number of other countries. Unfortunately, the dominance of coeducational schooling in many countries makes it difficult to ask the following questions: What would happen if boys and girls were separated into single-sex schools? Without opposite-sex peers, would boys and girls feel less pressure and be less concerned about their physical appearance and body size and shape, which may affect their weight-related behaviors and ultimately their weight? There are several countries, including South Korea, New Zealand, and Israel, that have relatively balanced compositions of single-sex and coeducational schools (Wiseman, 2008). These single-sex schools offer an interesting setting in which to examine how the gender composition of a school might affect the weight and weight-related behaviors of adolescents.

There is also growing interest in many countries in single-sex schooling as a way to improve overall academic achievement. For instance, the number of single-sex schools and single-sex classrooms within coeducational schools has increased dramatically in the United States after amendment of Title IX of the US Education Act in 2006, which gave school districts more flexibility to provide single-sex education (Doris et al., 2013). Along with this interest in the United States, numerous studies have recently examined the effects of single-sex schools on educational outcomes in various countries (e.g., Doris et al., 2013; Jackson, 2012; Park et al., 2012, 2013; Sullivan et al., 2010). However, little research has explored the impact of single-sex schooling on health and health behaviors, and, in particular on weight and weight-related behaviors, of adolescents.

Our study of the causal effects of single-sex schools on students' overweight and obesity may have important policy implications. The prevalence of childhood overweight and obesity has risen rapidly in many countries. For example, over the last few decades, overweight and obesity rates among American children have increased substantially (Cawley, 2010). Although the overweight and obesity rates in Korea are relatively low compared to those of other OECD countries, they have been increasing steadily. About 4% of the adult population in Korea is obese, and about 30% are overweight (including obese). OECD projections indicate that overweight rates will increase by a further 5% within 10 years (OECD, 2013). In addition, child obesity rates are increasing in Korea. According to statistics released by the Ministry of Education and Science Technology, obesity rates of Korean children have been increasing steadily from 11.2% in 2008 to 14.3% in 2011. At the same time, the proportion of severely obese children is on the rise from 0.8% in 2006 to 1.3% in 2011 (Ahn, 2012). Considering that overweight or obese children are more likely to become overweight or obese adults (Singh et al., 2008) and that overweight and obesity in childhood have negative associations with premature mortality and physical morbidity in adulthood (Reilly and Kelly, 2011), increasing obesity among Korean adolescents raises social and economic concerns, as it is an important risk factor for long-term health outcomes. In addition, there is evidence that obesity is associated with lower self-esteem and maladjustment, and adversely affects concentration in learning, which could result in lower academic achievement and more behavioral problems in school (e.g., Cawley and Spiess, 2008; Levy et al., 2011). For these reasons, identifying potential contributors to overweight and obesity among school-aged children has definite policy relevance in many countries, including Korea.

2. Background

2.1. How Do Single-Sex Schools Affect Students' Weight?

In Figure 1, a diagrammatic representation of the processes by which single-sex schools may affect students' weight is provided. Physical attractiveness and appeal to the opposite sex are important components of adolescent culture, and can influence adolescents' weight and weight-related behaviors (Coleman, 1961). The importance of physical attractiveness, norms about ideal body shape and pressure to comply with these norms may vary across schools depending on their gender compositions (Spencer et al, 2012). These differences can influence the degree of engagement in weight-control behaviors, physical activities, and dietary habits. Different behavioral responses between students attending single-sex schools versus coeducational schools can therefore potentially cause differences in students' weight. In addition, a growing body of literature on social interactions suggests that the gender compositions of schools are important factors that can influence students' health outcomes not only as direct sources of information and role models, but also as channels to multiply these direct differences. In a systematic review of studies that addressed the influences of friends on body weight, Cunningham et al. (2012) reported that the majority of studies concluded that the mean weight of friends was significantly associated with the weight of an adolescent, even after controlling for various demographic and socioeconomic characteristics of individuals and families (e.g., Carrell et al., 2011; Christakis and Fowler, 2007, 2012; Trogdon et al., 2008). Recent studies also found that when their friends engaged in sports, exercise, and fast food consumption, adolescents were more likely to do so, and that adolescents exhibited similar patterns of healthy eating behaviors as their friends (Ali et al., 2011; Bruening et al., 2011). The significant associations of weight and weight-related behaviors of friends with those of an adolescent highlight the possible roles of contexts, in which adolescents interact with and are influenced by peers, in establishing social norms, expectations, and cultures regarding weight and weight-related behaviors.

2.2. Challenge of Evaluating the Impacts of Single-Sex Schools

The major challenge faced when evaluating the impacts of single-sex schools on any outcomes, including weight and weight-related behaviors, is the selection of students into different types of schools. In most countries students and families select into single-sex versus coeducational schools. Those students who decide to attend single-sex schools rather than coeducational schools probably differ from those attending coeducational schools in both observed and unobserved characteristics, which makes it difficult to estimate unbiased effects of single-sex schools (Booth and Nolen, 2012a, 2012b). Although the concern about selection bias for single-sex schools has been raised mainly in relation to educational outcomes, selection bias is equally a concern in estimating the effects of single-sex schools on health and health behaviors. In addition to potential bias due to students' selection into single-sex schools, another possible source of bias in estimating the impact of single-sex school is potential differences in school characteristics between single-sex and coeducational schools. Those school characteristics are often difficult to measure and thus a single-sex school effect may be confounded with the effects of unobserved school characteristics (Jackson, 2012).

As indicated by the dotted lines in Figure 1, students' unobserved characteristics could impact the various processes that could determine a student's weight. If students or parents can choose single-sex schools versus coeducational schools, their decisions likely depend on unobserved preferences or interests in both academics and non-academics, which are likely to be correlated with each other. For instance, students who select into single-sex schools may have unobserved preferences or interests more in academics and less in non-academic activities, which could have an impact on weight and other dimensions of appearance. In addition, depending on the unobserved characteristics of students attending different types of schools, the degree to which students react to stimuli or pressures could differ in their consequences in perceptions of body shapes, weight-related behaviors, and weight itself. However, if students are randomly assigned to single-sex versus coeducational schools, then students would be expected to have identical distributions of preferences and responsiveness upon entry to each type of school. Effectively the dotted arrow in Figure 1 from the box for observed and unobserved individual characteristics to the box for single-sex versus coeducational schools is broken. Therefore, random assignment of schools allows estimation of the causal effects of single-sex schools on weight and weight-related behaviors. In this study, we assess the causal effects of single-sex schools on weight and weight-related behaviors by utilizing the unique setting in Seoul, South Korea (Korea, hereafter) where elementary- and middle-school graduates are randomly assigned into single-sex or coeducational schools by lottery.

2.3. Random Schooling Assignments in Seoul

Before 1973, Korean high schools could select their students based on students' performance on entrance examinations administered by individual high schools. This selection process caused sorting of students into schools hierarchically ranked by students' academic performance and their family backgrounds along with severe competition to be accepted by prestigious high schools. Out of concerns about between-school inequality and academic pressure on students to do well on high school entrance examinations, the Korean government introduced a national educational reform known as the High School Equalization Policy. Under this policy middle-school graduates have been randomly assigned to academic high schools within their school districts in most urban areas, beginning in 1974 in Seoul (capital and largest metropolitan area with a population of about 10 million) and Busan (second largest metropolitan area). Along with the earlier implementation of the No Middle School Entrance Examination Policy in 1968, these two major governmental policies have limited school choice in secondary education and created a de facto experiment, in which students after elementary school graduation are randomly distributed into middle and then high schools within school districts regardless of whether schools are single-sex or coeducational and private or public (Kim, 2003). Private schools are heavily subsidized by the Korean government and the government imposes a national common curriculum and uniform tuition on public and private schools. Thus, differences between public and private schools in Korea are not as great as in other countries such as the United States.

Although the equalization policies are still maintained, other metro areas with the exception of Seoul loosened the equalization policy starting in the mid-1990s to respond to growing demand for school choice. In those districts with the modified version of the equalization policy, students are allowed to list the 2–3 high schools that they prefer. Then, 30 – 40% of enrollments in a school are ‘randomly’ selected among those students who show preference for that school, while the remaining enrollments are selected by lottery without considering students’ preferences. Therefore we focus on Seoul in this study, as this city maintained its original assignment rule for high school entrants until 2009 and still applies the original rule for middle-school entrants.

As of 2012, there were 594 elementary schools (1st – 6th grades, all coeducational schools), 379 middle schools (7th – 9th grades, 24.5 percent single-sex schools), and 224 academic high schools (10th – 12th grades, 58.2 percent single-sex schools) in Seoul. The high school equalization policy is applied only to academic high schools (which are the major form of high schools), not vocational and special-purpose high schools. There were 73 vocational high schools and 19 special-purpose high schools in Seoul, which we exclude in the analyses. There were 11 high-school districts in Seoul, and each high-school district was divided into 3 to 6 geographically smaller middle-school districts. In total, there were 46 middle-school districts in Seoul. According to revised article 8 of the Enforcement Rule of the School Health Act in 2008, students should be assigned to middle schools and high schools within a half-hour distance from home by public transportation, which basically includes almost all schools within school districts, considering the size of Seoul. Before 2008, even the half-hour distance rule did not exist in the Enforcement Rule of the School Health Act. The assignment formulas for middle and high schools are not known to the public, and the assignment process includes random draws performed using computer software developed for this specific task. Educational stakeholders’ perceptions, including those of students, parents, and educational administrators, are that distance from a student’s home to school is likely to be considered to some extent for middle-school assignment to reduce exposure to risk factors while commuting to school. However, in a study that examined the effect of single-sex schooling on students’ competitiveness among middle-school students, Lee et al. (2014) find no statistical difference between single-sex schools and coeducational schools among middle-school students in Seoul. Using another dataset called the Seoul Educational Longitudinal Study (SELS), which is a representative sample of elementary-school students in Seoul and has followed 4th graders in 2010 until their 7th grade in 2013, we investigated how elementary-school graduates were allocated to different middle schools when they finished their 6th grade in 2012. We found that 3,645 students in 107 elementary schools were assigned to 300 middle schools with 571 elementary-middle schools combinations. On average, there were 5.3 middle schools (standard deviation of 2.1) to which an elementary school sent their graduates. Considering that there are on average about eight middle schools (standard deviation of 3.3) in the 46 middle-school districts in Seoul, these statistics provide indirect evidence that middle-school assignments are random. Furthermore, several other studies have also concluded that student assignment into high schools, which occurs within much larger high-school districts than middle-school districts, is approximately random (Choi et al., 2014; Park et al., 2013).

Non-compliance with the initial school assignment is not a major concern of this study. In the case of high schools, if students move their residences to a new school district for any reason including dissatisfaction with their assignment, they are subject to another random assignment in the new district. Therefore, changing district of residence provides no guarantee that a student can attend a single-sex or coeducational high school in the new district. Moreover, Park et al. (2013) showed that the actual percentage of households that move into different school districts during the ages for transition to high schools is very small.

In the case of middle schools, if students move their residences to a new school district, they are assigned to a school among the set of closest schools that have vacancies at the time of the move based on a matching table that links the residential block to which a student's new address belongs and a list of candidate schools. However, there is variation in school vacancies, and the matching table is not open to the public and is updated constantly according to changes in population composition and the establishment of new schools. Hence, non-compliance is not likely to seriously distort our estimates of the causal effect of single-sex schools. In short, although the assignment of students into Korean middle and high schools is not an experiment purposely designed to estimate the causal effect of an intervention, it provides an excellent opportunity for estimating the effect of single-sex schools on a variety of outcomes without the likely selection bias inherent in studies based mostly on observational data.

3. Data and Measures

3.1. *Data*

We rely on two datasets for Korean adolescents. For school-level analysis, we use a school-level database on health outcomes of middle- and high-school students compiled by the Korean government, as reported by each school in accordance with educational law. The compiled data are publicly available online (www.schoolinfo.go.kr). Starting with elementary school students, the Korean government mandates school-level physical examinations and release of information on a yearly basis. In 2009, physical examinations were conducted for elementary-school students. In the following year, middle schools started to conduct the same physical examinations and finally beginning in 2011 physical examinations for high-school students were initiated. These physical examinations are conducted for every student in the 5th to 12th grades in the second semester (during the fall; the Korean school year starts in March). The results are released in April of the following year. Hence, results for three years (2010, 2011, and 2012 examinations) were available for middle schools while results for two years (2011 and 2012 examinations) were available for high schools as of the writing of this paper. If a school is coeducational, each item is reported by gender. With regard to the weight-related measure, each school reports school mean body mass indices (BMI) for each grade level by gender.

An important advantage of these school-level data for this study is that we can track cohorts of 6th-grade students in 2009 until their 9th grade in 2012. Through this cohort, we can investigate whether there was a prior BMI gap before entering middle school and how the BMI gap between single-sex and coeducational schools evolved during the 3 years in middle school. Importantly, this dataset includes every middle school in Seoul. We use 3,295 middle school-grade-year combinations, which are grade-year specific observations of schools over 3 years, in our analyses. For high schools, out of 224 academic high schools in 2012, we first exclude 10 high schools that were founded since 2010. We further exclude two high schools to which the High School Equalization Policy is not applied and eight high schools for which BMI information is not provided on the website. Hence, our final sample for high-school analysis includes 204 high schools with BMI information available for 12th graders in 2011. This is the only cohort whose data are available and who entered high schools in 2009 before Seoul modified its high-school assignment rule to expand school choice in 2010 (see Table A1 in the appendix). Distributions of middle schools and high schools by school type and their mean BMIs are presented in Panel A in Table 1.

In addition to the school-level analysis of students in Seoul, we also conduct individual-level analysis using data from a nationally-representative sample of Korean high-school students (10th - 12th grades corresponding approximately to ages of 16–18 years), the Korea Youth Risk Behaviors Web-Based Survey (KYRBWS). KYRBWS is a cross-sectional survey of secondary-school students conducted every year. It first started with the 7th – 11th grades in 2005, and has included the 12th grade since 2006. KYRBWS uses two-stage cluster sampling, first randomly sampling schools and then randomly sampling one class per grade within selected schools. All students in the selected class are invited to participate in the survey (MEST, 2011). Participating students in the selected class are taken to a computer lab in the school where each student uses a computer connected to the Internet. Using an individual identification number given by the survey team, each student logs into a website where he/she can respond to the questionnaire.

As noted earlier, there are 46 middle-school districts in Seoul. Although KYRBWS is nationally-representative, in each wave, sampling 40–50 middle schools from 46 middle-school districts appears to result in some unbalanced measures among middle school-cohorts. (Girls attending all-girls middle schools are more likely to live with both parents compared to girls in coeducational middle schools. On the other hand, boys attending all-boys middle schools have mothers with lower education and are more likely to report being in the lower categories of perceived economic status compared to boys in coeducational middle schools.) Hence, we focus on the high-school cohort for individual-level analyses. However, although we do not report them here, the findings from the middle-school cohort are consistent with those from the high-school cohort and also from the school-level analyses. We further exclude 10th graders in 2010 and 10th and 11th graders in 2011 because they were assigned to high schools after the change of the assignment rule in 2010 (see Table A1 in the appendix). As a result, our final sample includes 16,544 students in 227 high schools in Seoul, covering seven waves from 2005 to 2011. Panel B in Table 1 shows student and school distributions by gender and school type.

3.2. Weight Status in KYRBWS

In the survey, students were asked to report their height and weight. Using their self-reported height and weight, we calculated the respondents' BMI as weight in kilograms divided by height in meters squared (kg/m^2). To classify respondents into different categories of weight status, we used the gender-age-specific growth chart specifically devised for Korean children and adolescents by the Korea Center for Diseases Control and Prevention. It provides BMI cut-off values corresponding to the 3rd, 5th, 10th, 25^{h}, 50th, 75th, 85th, 90th, 95th, and 97th percentiles in the sex-age-specific distributions of BMI (Lim et al., 2009). Following the standard classification used by health researchers in Korea, we classified adolescents whose BMI was below the 5th percentile as underweight, those in the 5–84th percentile as normal, and those in the 85th percentile or above as overweight.

3.3. Physical Activities and Weight-Control Behaviors in KYRBWS

KYRBWS asked students the number of days they engaged in strenuous activities for more than 20 minutes a day during the last week. The response was reported in six ordinal categories from 1 to 6 with 1 indicating that students did not perform any strenuous activities during the last week and with 6 indicating that students engaged in strenuous activities more than 5 days during the last week. In addition, since 2007, KYRBWS asked students to indicate whether they have made weight-control efforts during the last 30 days by selecting one of the following responses: 1) they did not make any efforts; 2) they made efforts to lose weight; 3) they made efforts to gain weight; and 4) they made efforts to maintain the same weight. Following the study by Mueller et al. (2010) on a similar variable for US adolescents, we coded those who tried to lose weight as 1 and coded others as 0. This weight-control behavior measure is not available for the 2005 and 2006 data. Therefore, the sample for the analysis of the weight-control variable is smaller than the total sample used for the analysis of BMI and weight status.

4. Results

4.1. Results from Analyses Using School-Level Data

4.1.1. OLS Regression of School Mean BMI by School Type—Columns 1 – 8 in Table 2 present the results of ordinary least squares regressions predicting school mean BMI by school type using school-level data for middle-school students in Seoul from 2010 to 2012. First, in Model 1 we estimate school-district fixed-effects models by including 45 dummies for school districts separately for girls and boys. Then in Model 2 we additionally control for the proportion of students receiving subsidized lunch support to control for possible differences in average socioeconomic status across schools and an indicator to denote private school status. The first six columns in Table 2 show estimates based on a cohort that started middle school in the 7th grade in 2010. For this cohort, school-level mean BMIs by gender are available for three years: 2010 (7th grade), 2011 (8th grade), and 2012 (9th grade). We can see that all-girls schools have a school mean BMI higher by 0.456 than girls in coeducational schools in the 7th grade, about 7 to 8 months after their entrance into schools in March, and the gap increases to 0.55 in the 9th grade in Model 1. Although not statistically significant in the 7th grade among boys of the same cohort, the BMI gap between boys in all-boys schools and boys in coeducational schools grows across grades and differs significantly by 0.44 in the 9th grade.

Columns 7 and 8 in Table 2 present estimation results for the combination of all nine available groups - three grades (7th-9th) across three years (2010–2012) - with additional dummy variables for the 8th and 9th grades as compared to the reference category of the 7th grade, and dummy variables to capture year fixed effects. All-girls middle schools have a 0.42 higher school mean BMI than coeducational middle schools for girls, and all-boys middle schools have a 0.34 higher school mean BMI than coeducational middle schools for boys in Model 1. Given that one standard deviation of BMI at the student level is 2.61 for middle school girls and 3.23 for middle school boys among the student sample in the KYRBWS (Panel B in Table 1), the effect of single-sex middle schools on BMI is equivalent to 0.16 standard deviations for girls and 0.11 standard deviations for boys. Considering that the average height of Korean middle-school girls is about 160cm, an increase of BMI by 0.42 amounts to an increase in mean weight by about 1.08 kg. For comparison, Davis and Carpenter (2009) investigate the impact of proximity of fast-food restaurants to schools on adolescent obesity in the U.S. and find that attending a school within one half mile of a fast-food establishment is associated with a 0.1-unit increase in BMI, translated to 0.56 pounds given a mean height of 5 feet 3 inches, compared with youths whose schools were not near a fast-food restaurant. Our estimated magnitude of 1.08 kg for attending single-sex schools, thus, is over four times as large as what Davis and Carpenter report for the effect of attending a school within half a mile of a fast-food establishment.

When we additionally control for two school-level characteristics in Model 2, the effects of single-sex schools are attenuated, and to a greater extent for boys. We find that including the proportion of students receiving lunch support as an additional covariate only has a marginal influence on the estimates. Most of the attenuation is due to inclusion of the private school indicator as a covariate. As mentioned earlier, because private schools are subject to the same random assignment as public schools, and the Korean government imposes uniform curriculum and tuition on public and private schools, the differences between public and private schools in Korea are not as marked as in other countries, especially with regard to factors that may possibly influence students' BMI. Park (2010) finds that students attending private and public high schools do not differ significantly in terms of socioeconomic backgrounds. One possibly relevant difference between private schools and public schools is the gender composition of teachers. Due to different teacher hiring policies, there are higher proportions of same-gender teachers in private single-sex schools (Park et al, 2013). If the gender composition of teachers influences students' weight and weight-related behaviors, the inclusion of private versus public schools would result in attenuation. However, given the age gaps between students and teachers, especially in middle schools, this channel seems unlikely to be important. Instead, we think that the attenuation may simply be due to the private school dummy being in part a proxy for being a single-sex school since the correlations are high between being a single-sex school and being a private school (correlation coefficient *r* = 0.76 for middle schools and *r* = 0.60 for high schools).

The last two columns in Table 2 show the results for the 12th grade in 2011. We find that boys in single-sex high schools relative to boys in coeducational high schools show a higher mean BMI by 0.333 in Model 1. Although not statistically significant at the 10% level, girls attending single-sex high schools also tend to have a higher BMI by 0.149 in Model 1. In the 12th grade Korean students are highly focused on preparation for college entrance. This may lead them to pay less attention to their appearance and spend less time on other social and physical activities. For instance, when we investigate weight-control behaviors to lose weight using the KYRBWS, we find a dramatic decrease in students' effort to control weight when they progress from the 11th grade to the 12th grade, especially for girls, from 43.5% to 25.1% (compared to boys from 25.7% to 19.0%). This could be one of the reasons for the decrease in the BMI gap according to school type among girls in the 12th grade. Actually, we have school mean BMI information at the high-school level for six groups (three grades over two years; all groups except for the 12th grade in 2011 entered high schools after modification of assignment in 2010). When we use high-school data for all six groups, we also find a significant difference in BMI: 0.260 for girls and 0.335 for boys. Because of the recent modification of the assignment rule for high-school entrants for the other five groups, we only report our findings for the 12th grade in 2011.

4.1.2. Is BMI Gap among Middle-School Students due to a Prior Gap in 6th Grade?—

As discussed earlier, although this is not known for certain, distance from home to school has been perceived to be a factor considered in the middle-school assignment process. This raises the possibility that the BMI gaps noted in Table 2 might be due to differences before entering middle schools. To address this concern, we investigate BMI in the 6th grade, prior to middle school, by gender; results are shown in Table 3. For this analysis we use 554 public elementary schools after excluding 40 private elementary schools. Public elementary schools in Korea are tuition-free and students are assigned to public schools based on their home addresses. In contrast, private elementary schools select their students among applicants without any restriction on residence. Students attending private elementary schools are more likely to have better family backgrounds to cover tuition and other expenses.

We first calculate mean BMI of 6th graders, separately for boys and girls, attending neighboring elementary schools within a 1km radius from each middle school i at time t, (y_{it}^{6th}). Then we regress the corresponding mean BMI of each gender on the variable to indicate whether the middle schools are single-sex or not, SSS_{it+1}^{7th}:

$$y_{it}^{6th}=\alpha+\beta\cdot SSS_{it+1}^{7th}+\Phi X_{it+1}+\gamma_t+\varepsilon_{it} \quad (1)$$

We control for an indicator that distinguishes private schools from public schools and the proportion of students who received lunch support, X_{it+1}, to consider potential differences across schools which may have influences on average BMI of entering students. When we use multiple cohorts for estimation, we include cohort fixed effects, γ_t, to consider potential differences across cohorts. The average number of elementary schools matched to a middle school within a 1km radius is 4.1. Results are robust when we use alternative radii between 0.8 and 1.6 km (results not shown).

Columns 1 and 3 in Table 3 show regression results using a cohort that was in the 6th grade in 2009. This cohort is the same cohort as the one for which we examined BMI changes over 3 years during middle school in Table 2. There is no significant difference in prior BMI in the 6th grade before entering middle school for boys or girls. Columns 2 and 4 in Table 3 show the results for when we combine all available information from the four cohorts who were in the 6th grade in elementary school between 2009 and 2012. These results further confirm that there is no prior BMI difference between girls (boys) in coeducational middle schools and girls (boys) in single-sex middle schools. Hence, these results provide more confidence that the BMI gap observed at the middle-school level reflects differences that appear after starting middle school.

4.2. Results from Analyses Using Individual-Level Data, KYRBWS

4.2.1. Testing Random Assignment to High Schools—We first check balance on some major family background measures as a way to verify the extent to which student assignments into single-sex and coeducational schools are random. If these assignments are indeed random, there ought to be no significant difference in observed family background measures between students attending single-sex schools and their counterparts attending coeducational schools. Our individual-level data from KYRBWS do not have many family background measures but they do contain the father's schooling attainment, mother's schooling attainment, family structure, and students subjective perceptions of economic status from 1 (lowest) to 5 (highest). The schooling levels of fathers and mothers are divided into four categories: 1) middle school or less; 2) high school; 3) college or above and 4) (respondents) do not know or missing. We distinguish between students living with two biological parents and all others (including missing cases).

Table 4 shows the results of logit models examining the relationship between attending a single-sex school (vs. a coeducational school) and father's and mother's schooling, family structure, and perceived economic status, respectively. Each panel represents logistic regression results in which the dependent variable is an indicator of attending single-sex schools, and independent variables are family-background variables and dummy variables for students' grades and survey years for boys and girls, separately. For high-school students in Seoul, the family-background measures are not significantly associated with the likelihood of attending a single-sex school for either girls or boys. Although we could only consider these four measures of family background, these results are consistent with the claim that student assignment to Seoul high schools is random. In addition, in earlier studies of educational outcomes based on different datasets, Park et al. (2012, 2013) found evidence of balanced prior achievement and family-background measures such as household income, home ownership, and the number of books at home between students attending single-sex high schools and those attending coeducational high schools.

4.2.2. Ordinary Least Squares (*OLS) Regression of BMI*—In Table 5, we present the result of OLS regressions predicting adolescents' BMI by school type using data for high-school students in Seoul from 2005 to 2011. As mentioned earlier, we exclude data for 10th graders in 2010 and 10th and 11th graders in 2011 who entered high schools after modification of the school assignment process in Seoul. We estimate two different models. Models 1 in columns 1 and 4 include only dummy variables for single-sex schools and a student's grade level (two dummy variables for 11th and 12th grades as compared to the reference category of 10th grade, and dummy variables to capture year fixed effects). Models 2 in columns 2 and 5 add family-background measures to Model 1 to see how the coefficient of single-sex schools changes after controlling for family background. In Models 1, attending a single-sex high school is significantly associated with a 0.20 increase in BMI for girls and a 0.16 increase in BMI for boys. Given that one standard deviation of BMI is 2.51 for high school girls and 3.18 for high school boys (see Table 1), the effect of single-sex high schools on BMI is equivalent to 0.08 standard deviations for girls and 0.05 standard deviations for boys. The impact of single-sex school on BMI for girls (boys) is comparable to the BMI gap of 0.173 (0.142) between girls (boys) whose father is a middle school graduate and girls (boys) whose father has a college degree. In Model 2, as expected given random assignment, the coefficients of single-sex schools hardly change after controlling for family-background measures.

4.2.3. Is the BMI Gap Spurious?—As a falsification test, we examine whether there is any significant difference by school type in height, which is supposedly insensitive to school context, using KYRBWS data. In column 3 for girls and column 6 for boys in Table 5, we investigate whether we can find an effect of single-sex schools on students' height in centimeters. We do not find any significant relationship between attending single-sex schools and students' height. This result increases confidence in our finding that the BMI gap by school type results from a gap in weight, which is more sensitive to school context.

4.2.4. Analysis of Weight Status and Weight-Related Behaviors—We now turn to a multinomial logit analysis of weight status (underweight, normal weight, and overweight). In Table 6, column 2 pertains to the likelihood of being overweight as compared to normal weight as the reference, while column 1 indicates comparisons of underweight and normal weight. Similar to the result for BMI, students attending single-sex schools are more likely to be overweight than their counterparts attending coeducational schools. Specifically, we find that if girls attended all-girls high schools rather than coeducational high schools, the relative risk for being overweight compared to being normal would be expected to increase by a factor of 1.20 (=exp(0.18)), holding the other variables constant. Although not significant at 10%, the relative risk of being overweight compared to being normal would be expected to increase by a factor of 1.08 (=exp(0.078)) if boys attended all-boys high schools rather than coeducational high schools.

To identify potential channels that generate BMI gaps between students in single-sex schools and coeducational schools, we investigate whether there is a difference in weight-related behaviors by comparing physical activities and weight-control behaviors for students in single sex schools to those of students in coeducational schools. For physical activities, we examine whether there is any difference in the frequency of performing strenuous activities using OLS regressions after controlling for individual BMI, grade and year fixed effects, and family background characteristics. As shown in column 3 of Panel A in Table 6, we find that girls in single-sex schools engage in strenuous activities less frequently than those in coeducational schools. For the weight-control behavior, we conduct logit analysis and find that if girls attended all-girls high schools rather than coeducational high schools, the odds of engaging in weight control to lose weight would be expected to decrease by a factor of 0.92 (=exp(-0.085)) (although this is not significant at the 10% level) (column 4 of Panel A). Because this weight control behavior measure is not available for 2005 and 2006, our results for the weight-control behavior are based on 2007–2011 data. Note that results in Tables 5 and 6 on the basis of 2005–2011 data are similar when we use samples from 2007–2011 data only.

5. Discussion

A growing body of research reports associations of school contexts, in which adolescents interact with their peers and react to adolescent culture, with weight and weight-related behaviors of adolescents, independent of the effects of individual and familial characteristics (Cunningham et al., 2012). In this study, we examine one specific school context, single-sex schools vs. coeducational schools, which potentially matters for adolescents' weight. We conjecture that when boys and girls are separated into single-sex schools without opposite-sex peers, boys and girls feel much less pressure and are less concerned about physical appearance and body size and shape, which could increase their weight. Utilizing the unique setting of Seoul, Korea, where students are randomly assigned into single-sex and coeducational schools within school districts, we estimate causal effects of single-sex schools on weight and weight-related behaviors. Consistent with our hypothesis, our results show that students attending single-sex schools are more likely to be overweight as reflected by a higher BMI than those in coeducational schools, and that these effects are more pronounced for girls than boys. We also find that girls in single-sex schools are less likely to engage in strenuous activities than girls in coeducational schools.

There are some limitations to our study. First, this study uses self-reported measures of height and weight in individual level analysis using the KYRBWS. Using the 2008 wave of KYRBWS, Bae et al. (2010) showed that self-reported weight tended to be understated and self-reported height tended to be overstated, and obese adolescents tended to underreport their weight and overstate their height more than non-obese adolescents. This tendency is also confirmed in our study when we compare mean BMI for both boys and girls from the KYRBWS and School Information data, which was obtained through physical examinations at school. The relatively smaller effects of single-sex schooling on BMI we find from the KYRBWS may be partially due to this bias in self-reported measures. For instances, students in coeducational schools might over-report height and under-report weight in comparison with students in single-sex schools because they are more self-conscious about their appearance. However, strict confidentiality maintained through the entire survey process would help reduce the bias from reporting error. On the other hand, due to privacy concerns, the KYRBWS does not provide school-district information so we could not control for school-district fixed effects in the individual-level analysis. As a sensitivity check, however, we conducted an analysis by not controlling for school-district fixed effects using school-level data. This analysis reveals that failure to control for school-district fixed effects results in a marginal increase in the estimated effects of single-sex schools on BMI for high-school girls and virtually no change for high-school boys without changing our earlier findings when we control for school-district fixed effects.

Single-sex schooling has been suggested as a way of increasing academic performance, especially in math and science, and of enhancing opportunities to study in the areas of Science, Technology, Engineering, and Mathematics (STEM) for girls. However, given the recent trend that boys lag behind girls in many dimensions of academic outcomes, notably for low-performing students (OECD, 2015), the potential of single-sex schooling as a way to improve academic performance of boys has received an increasing attention (Kleinfeld, 2006). Although the findings on the impact of single-sex schooling on academic outcomes are mixed based on study designs and, countries studied (Pahlke et al, 2014), studies using Seoul high school students find that single-sex schools have positive causal impacts for both boys and girls on college entrance exams scores (Choi et al., 2014; Park et al., 2013). As to behavioral outcomes, Riordan et al. (2008) find more positive behavioral interactions between students and teachers and favorable social-emotional outcomes in single-sex schools than in coeducational schools. In addition, girls attending all-girls schools are more likely to adopt more competitive behaviors and report less exposure to and engagement in peer victimization compared to their counterparts attending coeducational schools (Booth and Nolen, 2012a, 2012b; Gee and Cho, 2014). However, our study on students' weight suggests that there can be a potentially negative consequence of single-sex schooling for health outcomes due to the increased risk of obesity, especially for girls. We argue that the potentially negative impact on health should be an important aspect to be considered when assessing the overall cost and benefit of implementing single-sex education. We consider this more balanced view on single-sex schooling to be particularly important, given the growing interest in single-sex education in countries like the United States (Signorella and Bigler, 2013).

Although we show that single-sex schools have a causal effect on students' weight and find suggestive evidence to show that there are differences in physical activities and weight-control behaviors among girls in single-sex schools and coeducational schools, further research is needed to investigate more extensively the mechanisms underlying these effects of single-sex schools and to explain the observed gender differences. Because our individual-level analysis relies on repeated cross-sectional data without information on students' previous height and weight, we are not able to identify the impacts arising from social interactions. However, given the accumulated evidence on the importance of peer effects on academic and health outcomes, more thorough investigation to verify this channel would be a particularly fruitful direction. Next, Korean schools, especially within Seoul, are relatively homogeneous in their characteristics compared to school systems in other countries due to the imposition of strong government regulations and substantial governmental supports to even private schools, which would result in minimal systematic differences, if any, in school characteristics between single-sex schools and coeducational schools. However, there still can be possible idiosyncratic differences in commuting distance, school meals, local food availability, and school facilities such as elevators and a school store. Further controlling for these potential differences in future research would help us precisely estimate the impact of single-sex schooling on health and health related outcomes and impacts of those dimensions would be of interest in themselves.

Finally, it would be desirable to extend this research to examine other behavioral outcomes such as smoking, drinking, and romantic relationships beyond our focus on weight and weight-related behaviors. Furthermore, we still need more systematic investigations of the impacts of single-sex schools on gender stereotypes, sex-typed behaviors, and communication skills with the opposite sex, which would have long-term consequences for later outcomes including marriage, divorce, and social life. This potential research agenda will help us better assess the impact of single-sex schooling on the life trajectories beyond the discussion on academic outcomes that the majority of academic research and public discourses on single-sex schooling has been mainly focused on.

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Appendix

Table A1

Datasets Used by Year and Grade Level

Year \ Grade	Elem. School	Middle School			High School		
	6th	7th	8th	9th	10th	11th	12th
2005	N/A	Xm	Xm	Xm	IND	IND	N/A
2006 – 2008	N/A	Xm	Xm	Xm	IND	IND	IND
2009	SCH	Xm	Xm	Xm	IND	IND	IND
2010	SCH	SCH, Xm	SCH, Xm	SCH, Xm	Xh	IND	IND
2011	SCH	SCH, Xm	SCH, Xm	SCH, Xm	Xh	Xh	SCH, IND
2012	SCH	SCH	SCH	SCH	Xh	Xh	Xh

Note: SCH: School Information, IND: KYRBWS, Xm: KYRBWS for middle school students that we used only for supplementary analyses, Xh: Both datasets are available; however, we exclude students who were assigned to high schools after the change of assignment rule in 2010.

Research Highlights

- Random school assignment allows estimation of causal effects of single-sex schools
- Single-sex schools result in weight gains for adolescents
- These weight-gain effects are relatively larger for girls

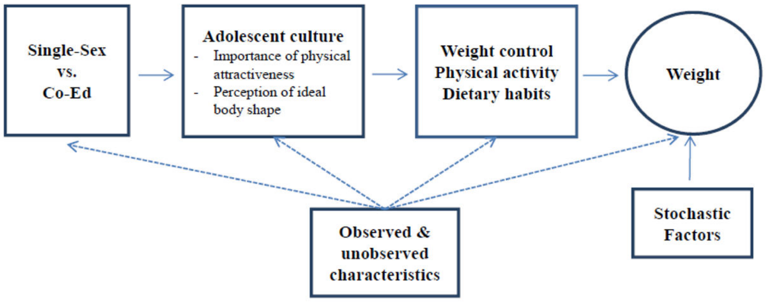

Figure 1.
How Do Single-Sex Schools Affect Students' Weight?

Table 1

Descriptive Statistics (School Information Data and KYRBWS).

	Middle School	High School
Panel A. School Information Data	N = 3,295 (3 Years*3 Grades)	N = 204 (1 Year*1 Grade)
School Type (%)		
All-boys schools	12.7	32.3
All-girls schools	11.8	27.9
Coed schools	75.5	39.7
School Level Mean BMI		
Girls	20.6 (0.72)	21.6 (0.63)
Girls in coed schools	20.6 (0.71)	21.5 (0.64)
Girls in all-girls schools	21.0 (0.66)	21.7 (0.61)
Boys	21.3 (0.69)	22.9 (0.5)
Boys in coed schools	21.2 (0.68)	22.7 (0.49)
Boys in all-boys schools	21.6 (0.69)	23.1 (0.46)
Panel B. KYRBWS (2005 – 2011)		
Students	N = 29,225	N = 16,544
School Type (%)		
Girls in coed schools		16.5
Girls in all-girls schools		30.8
Boys in coed schools		19.6
Boys in all-boys schools		33.1
BMI		
Girls	19.7 (2.61)	20.7 (2.51)
Girls in coed schools	19.6 (2.61)	20.5 (2.46)
Girls in all-girls schools	19.9 (2.63)	20.7 (2.53)
Boys	20.3 (3.23)	21.7 (3.18)
Boys in coed schools	20.3 (3.2)	21.6 (3.13)
Boys in all-boys schools	20.5 (3.32)	21.8 (3.2)
Height (cm)		
Girls	159.4 (5.45)	161.7 (4.98)
Boys	166.5 (8.28)	174.4 (5.46)
Family Background		
Household income		3.1 (0.92)
Father’s grades of schooling attainment		14.0 (2.3)
Mother’s grades of schooling attainment		13.3 (2.26)
Weight control to lose weight (%)		28.7
Number of days of doing strenuous activities per week		2.5 (1.6)
Schools		N =227
School Type (%)		
All-boys schools		33.0
All-girls schools		29.1

	Middle School	High School
Coed schools		37.9

Note: In the KYRBWS, economic status was reported in 5 categories based upon student reports (lowest=1, lower middle=2, middle=3, upper-middle=4, highest=5). Parental education level is grades of schooling attainment. Number of days of doing strenuous activities was reported in 6 categories (from none=1 to more than 5 days=6). Values in parentheses are standard deviations.

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Table 2

OLS Regression of School Mean BMI by School Type.

	2010: 7th		2011: 8th		2012: 9th		All (7th–9th)		2011: 12th	
	Model 1 (1)	**Model 2 (2)**	**Model 1 (3)**	**Model 2 (4)**	**Model 1 (5)**	**Model 2 (6)**	**Model 1 (7)**	**Model 2 (8)**	**Model 1 (9)**	**Model 2 (10)**
Panel A. Girls										
Single-sex school	0.456*** (0.099)	0.308** (0.134)	0.441*** (0.120)	0.330** (0.155)	0.548*** (0.118)	0.427*** (0.162)	0.415*** (0.062)	0.294*** (0.079)	0.149 (0.110)	0.197 (0.131)
% of receiving lunch suppots		0.006** (0.003)		0.021*** (0.004)		0.003 (0.002)		0.006*** (0.002)		0.004 (0.007)
Private school		0.170 (0.113)		0.106 (0.129)		0.111 (0.139)		0.120* (0.066)		−0.066 (0.130)
8th grade							0.574*** (0.020)	0.575*** (0.020)		
9th grade							0.890*** (0.021)	0.891*** (0.021)		
Constant	20.086*** (0.198)	20.058*** (0.197)	20.214*** (0.237)	19.992*** (0.232)	20.771*** (0.234)	20.736*** (0.236)	19.926*** (0.037)	19.892*** (0.043)	21.469*** (0.155)	21.436*** (0.184)
N	317	317	318	318	320	320	2,868	2,868	137	137
Adj-R^2	0.252	0.270	0.229	0.295	0.210	0.217	0.377	0.389	0.175	0.180
Panel B. Boys										
Single-sex school	0.142 (0.096)	−0.072 (0.126)	0.344*** (0.110)	0.159 (0.148)	0.444*** (0.099)	0.255* (0.133)	0.344*** (0.051)	0.144** (0.061)	0.333*** (0.085)	0.379*** (0.105)
% of receiving lunch suppots		0.002 (0.004)		0.006 (0.004)		0.004* (0.002)		0.004** (0.001)		0.001 (0.004)
Private school		0.289*** (0.107)		0.263** (0.126)		0.210* (0.119)		0.256*** (0.049)		−0.068 (0.102)
8th grade							0.494*** (0.021)	0.495*** (0.021)		
9th grade							0.875*** (0.023)	0.876*** (0.023)		
Constant	21.571*** (0.192)	21.563*** (0.191)	21.886*** (0.226)	21.818*** (0.228)	22.257*** (0.211)	22.203*** (0.211)	21.316*** (0.109)	21.297*** (0.113)	22.706*** (0.116)	22.706*** (0.128)
N	317	317	322	322	326	326	2,888	2,888	146	146
Adj-R^2	0.202	0.223	0.231	0.249	0.231	0.254	0.363	0.377	0.162	0.166

Note: In Model 1 we examine the relationship between school mean BMI and attending single-sex schools with dummy variables for 46 middle school districts and 11 high school districts. In Model 2 we additionally control for the proportion of students receiving lunch supports and an indicator to denote private school status.

*** $p<0.01$,

** $p<0.05$,

* $p<0.1$.

Table 3

Comparison of BMI of 6th Grade Students Attending Nearby Elementary Schools.

	Girls		Boys	
	2009 (1)	**2009–2013 (2)**	**2009 (3)**	**2009–2013 (4)**
Single-Sex MS	−0.001 (0.069)	0.012 (0.024)	−0.025 (0.066)	0.001 (0.024)
Constant	19.419*** (0.000)	19.451*** (0.090)	20.972*** (0.000)	20.717*** (0.084)
N	323	1,493	328	1,493
R^2	0.447	0.322	0.348	0.255

Note: Nearby elementary schools are selected within a 1km radius from each middle school.

*** p<0.01,

** p<0.05,

* p<0.1.

Table 4

Relationship between Attending Single-Sex Schools and Family Background.

	Girls (N=7,822)	Boys (N=8,722)
	Attending all-girls schools (vs. coeducational)	Attending all-boys schools (vs. coeducational)
Panel A. Father's education (ref: middle school graduate)		
High school graduate	0.171 (0.119)	−0.046 (0.101)
College graduate	0.093 (0.187)	0.057 (0.157)
Do not know/Missing	0.116 (0.161)	0.038 (0.124)
Panel B. Mother's education (ref: middle school graduate)		
High school graduate	0.035 (0.125)	0.136 (0.110)
College graduate	−0.087 (0.202)	0.077 (0.185)
Do not know/Missing	−0.188 (0.141)	−0.012 (0.124)
Panel C. Family structure (ref: single or no parent at home and missing cases)		
Both parents at home	−0.145 (0.124)	0.039 (0.104)
Panel D. Economic status (ref: lowest)		
Lower middle	0.129 (0.125)	0.053 (0.120)
Middle	0.113 (0.131)	−0.019 (0.122)
Upper middle	−0.063 (0.168)	−0.012 (0.148)
Highest	−0.220 (0.234)	−0.102 (0.163)

Note: Each panel presents results from a logit model in which the dependent variable is an indicator of attending single-sex schools and independent variables are family-background variables and dummy variables for students' grades and survey years. We examine association between attending single-sex schools and each category of father's education in Panel A, each category of mother's education in Panel B, having both parents at home in Panel C, and economic status in Panel D, respectively. The coefficients of students' grades and survey years are not presented. Values in parentheses are robust standard errors adjusted for clustering at the school level.

*** p<0.01,

** p<0.05,

* p<0.1.

Table 5

OLS Regression of Student's BMI and Height by School Type.

	Girls			Boys		
	BMI Model 1	**BMI Model 2**	**Height Model 2**	**BMI Model 1**	**BMI Model 2**	**Height Model 2**
Single-Sex school (vs. coed)	0.203** (0.084)	0.197** (0.082)	0.087 (0.118)	0.163** (0.070)	0.167** (0.069)	0.001 (0.116)
Student's grade (ref: 10th grade)						
11th grade	0.225*** (0.078)	0.214*** (0.079)	0.683*** (0.148)	0.493*** (0.091)	0.497*** (0.090)	1.193*** (0.172)
12th grade	0.492*** (0.087)	0.488*** (0.088)	0.534*** (0.172)	0.858*** (0.088)	0.856*** (0.089)	1.785*** (0.182)
Father's education (ref: middle school graduate)						
High school graduate		−0.117 (0.154)	0.329 (0.321)		0.339** (0.169)	0.133 (0.266)
College graduate		−0.173 (0.167)	0.490 (0.333)		0.142 (0.182)	0.132 (0.277)
Do not know/Missing		0.098 (0.182)	−0.246 (0.409)		0.387* (0.212)	0.417 (0.327)
Mother's education (ref: middle school graduate)						
High school graduate		−0.029 (0.154)	0.238 (0.272)		−0.154 (0.153)	0.293 (0.275)
College graduate		−0.002 (0.171)	0.156 (0.309)		0.134 (0.174)	0.524* (0.316)
Do not know/Missing		−0.231 (0.207)	0.490 (0.365)		−0.364* (0.198)	−0.299 (0.348)
Family structure (ref: single or no parent at home and missing cases)						
Both parents at home		−0.075 (0.139)	−0.333 (0.284)		0.071 (0.121)	−0.121 (0.239)
Economic status (ref: lowest)						
Lower middle		−0.053 (0.163)	0.019 (0.318)		−0.092 (0.160)	−0.165 (0.305)
Middle		−0.291* (0.163)	0.244 (0.309)		−0.080 (0.145)	0.184 (0.300)
Upper middle		−0.275 (0.173)	0.533* (0.310)		−0.032 (0.162)	0.452 (0.312)
Highest		−0.487** (0.225)	1.217*** (0.417)		−0.009 (0.187)	1.230*** (0.354)
Constant	20.414*** (0.130)	20.938*** (0.280)	160.570*** (0.492)	21.478*** (0.120)	21.305*** (0.283)	172.937*** (0.534)
N	7,822	7,822	7,822	8,722	8,722	8,722
Adj-R^2	0.008	0.010	0.006	0.010	0.012	0.024

Note: In Model 1 for BMI analysis, we control for an indicator for single-sex schools and dummy variables for grade levels and survey years. In Model 2 we additionally control for educational attainment of father and mother, subjective economic status, and an indicator to denote whether there are both parents at home. Values in parentheses are robust standard errors adjusted for clustering at the school level.

*** p<0.01,

** p<0.05,

* p<0.1.

Table 6

Analyses of Overweight and Underweight Compared to Normal Weight and Behavioral Differences

	Multinomial Logit		OLS	Logit
	Underweight vs. Normal (1)	Overweight vs. Normal (2)	Strenuous Activities (3)	Weight Control (4)
Panel A. Girls				
Single-sex school (vs. coed)	−0.096 (0.101)	0.180** (0.084)	−0.081* (0.045)	−0.085 (0.062)
BMI			0.036*** (0.007)	0.183*** (0.010)
Student's grade (ref: 10th grade)				
11th grade	0.316*** (0.110)	0.135 (0.111)	−0.008 (0.046)	−0.064 (0.082)
12th grade	0.465*** (0.119)	0.245** (0.101)	−0.382*** (0.049)	−0.999*** (0.096)
N	7,822	7,822	7,822	5,812
Panel B. Boys				
Single-sex school (vs. coed)	−0.137 (0.100)	0.078 (0.060)	−0.063 (0.053)	0.059 (0.069)
BMI			0.010* (0.005)	0.293*** (0.012)
Student's grade (ref: 10th grade)				
11th grade	0.309** (0.132)	0.272*** (0.076)	−0.088 (0.060)	−0.048 (0.086)
12th grade	0.414*** (0.133)	0.399*** (0.078)	−0.629*** (0.065)	−0.592*** (0.087)
N	8,722	8,722	8,722	6,484

Note: We control for dummy variables for survey years, educational attainment of father and mother, subjective economic status, whether there are both parents at home. Values in parentheses are robust standard errors adjusted for clustering at the school level.

*** p<0.01,

** p<0.05,

* p<0.1.