Article

Universal Welfare May Be Costly: Evidence from School Meal Programs and Student Fitness in South Korea

Deokrye Baek ¹, Yongjun Choi ^{2,*} and Hong Lee ¹

¹ Raj Soin College of Business, Wright State University, Dayton, OH 45435, USA; deokrye.baek@wright.edu (D.B.); hong.lee@wright.edu (H.L.)

² College of Business Administration, Hongik University, Seoul 04066, Korea

* Correspondence: yongjun.choi@hongik.ac.kr; Tel.: +82-2-320-1735

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Abstract: The Free School Meal Program (FSMP) initiated in 2011 in South Korea allows participating schools to provide free lunches to all students regardless of their household income. This paper examines how universal free school meal programs are associated with student health outcomes. We empirically show that FSMP reduces the share of students with high fitness grades by up to 1.5% of the student population. We also find that expenses for physical education decrease in schools that adopt FSMP. These results suggest that FSMP could crowd out investments in student physical activities, and student fitness could be negatively impacted. The paper sheds light on the importance of budgetary balance between universal welfare programs and other educational programs.

Keywords: school meal program; physical fitness; universal welfare; educational funds; school budget

1. Introduction

Organization for Economic Cooperation and Development (OECD) countries spent 5.55% of their gross domestic product (GDP) on schooling in 2012 [1] in response to the faith of the general public in education as a major tool for sustainable economic growth. This translates to about 10,000 US dollars in average expenditure per student. For countries like the United States that spend more than the global average by a large margin, education spending usually exceeds hundreds of billions of dollars. A large portion of these educational funds is allocated to school meal programs due to their implications on students' dietary habits as well as the quality of education [2–4]. School meal programs are mostly designed to address nutritional deficiencies in pupils because child undernutrition can lead to the long-term impairment in that it is detrimental for the formation of human capital, such as lower economic status and educational achievement [5], which is critical for determining resource productivity and sustainability in our society [6]. Furthermore, early undernutrition may lead to more adult health problems [7] increasing healthcare expenses for the public. In developed countries, school meal policies also try to address nutritional imbalance followed by obesity. The United States provided about 169,444 lunches and 77,778 breakfasts per school day through the National School Lunch Program (NSLP) and the School Breakfast Program (SBP) in 2015 (annual aggregate numbers are divided by 180 school days) [8]. Pupils in the United Kingdom took 185,293 school meals on the census day in the same year [9]. In South Korea, the school meal uptake level was more than 99% for 6.09 million primary and secondary school students.

Since one of the major goals of these worldwide school meal programs is to fight food insecurity, meals are typically provided for free or at reduced prices, mostly to students from low-income

households. A total of 72.13% and 85% of students enrolled in the NSLP and the SBP, respectively, in 2015 benefited from these meal supports in the United States. Every student is eligible for free school meals in Sweden and Finland. Korea has gradually expanded the share of free school meal beneficiaries from 46.8% in 2011 to 67.6% in 2016 through the Eco-Friendly Free School Meal Program (FSMP).

Free meal eligibility varies across countries due to different evaluations of the effects of price support. Most school meal programs in place are based on a means-tested scheme where benefits are limited to those who are financially disadvantaged. Universal free school meals, however, are recently gaining increasing support. Under the Healthy, Hunger-Free Kids Act of 2010, schools in the US with a free-meal eligibility rate higher than 40% are allowed to switch from selective to universal provision of free school meals. A transition from multiple means-tested benefits to Universal Credit in England allowed a dramatic expansion of free meal eligibility among low-income students [10]. FSMP, introduced in 2011, enables Korean schools that adopt the program to expand free-lunch eligibility to relatively wealthy students above the poverty line.

Despite the recent policy attention, relatively few studies have examined the effects of universal free school meals [11–13]. These papers show a positive association between universal provision and the take-up rate of school meals focusing on nutritional changes such school meal policies caused; however, improvements in student outcomes were not found. In contrast, Altindag et al. [14] (hereafter ABLM) pay attention to a unique feature of FSMP in Korea where the quality of school foods has not meaningfully improved but the transition from selective to universal provision of free meals reduces the stigmatization for beneficiaries. They empirically show that FSMP reduced student misbehavior in Korean schools. Taken together with another finding of increased fights in relatively poor school districts, they posit that universal free school meals mitigate the likelihood of students identifying the socioeconomic status of peers and having intergroup conflicts.

Our paper contributes to the discussion on the effectiveness of universal free school meals with a focus on student fitness outcomes. Relying on ABLM's Korean school data and empirical strategy [14], we present empirical evidence from annual fitness evaluations that unconditional and free provision of school lunches reduces the share of students with top grades. When the adoption of FSMP is defined as a single treatment, the program has mixed influences on the share of high-fitness students. However, in the framework of event study, where a set of time dummies are introduced around the year of FSMP implementation and all available school and regional characteristics are controlled, the high-fitness group decreases by 0.9 and 1.5 students per 100 students, respectively, one and two years after the start of the program. These results are based on a transparent difference-in-difference specification whose causal identification strategy satisfies the parallel trend assumption.

Our student fitness results, however, do not imply that selective free school meal programs are superior to their universal counterparts or vice versa. For example, Finland was not successful in implementing its universal basic income policy [15]. Rather, we show that FSMP reduces the frequency and amount of withdrawals from school development funds for physical education (PE). The event study we employ suggests that the investment in PE decreases at least three years from FSMP adoption. Given these findings, we postulate that the rapid expansion of free school meal eligibility in Korea crowded out PE investment. The decline in the quality of and exposure to school physical activities could negatively impact student fitness. A sacrifice in fitness, however, can hardly be comparable to the mitigation in school violence, which is closely related to the recent rise in suicides among children and adolescents [16]. Rather, our paper suggests that it is important to fully understand the interconnectedness of various educational programs and procure sufficient funds prior to enforcing costly social programs such as universal free school meals.

The rest of the paper is structured as follows. Section 2 briefly surveys the existing academic literature on school meal policy and student fitness. Section 3 provides the institutional background for school meals, student fitness evaluations, and the structure of educational finance in Korea. Data and major variables of interest are discussed in Section 4. The empirical strategies and results are presented in Section 5. Section 6 provides a conclusion.

2. Literature Review

In this section, we briefly review the literature on the effects of free school meal programs and school meals in general on a wide range of student outcomes. It is noteworthy that the institutional backgrounds of countries (or states and/or cities even in the same country) may differ a great deal. For example, most previous studies suggested that students' free school meal entitlement can serve as a proxy for social deprivation (i.e., parents on income support) [17] or socioeconomic status [18]. However, although children who are eligible for free school meals are likely to be from low-income households, a recent study using a sample in Northern Ireland showed that among those, only about one-quarter to one-half were in the lowest-income households, mainly due to the unique institutional background of Northern Ireland [19]. Thus, although it seems reasonable to take a student's eligibility for free school meals as a proxy for social deprivation or socioeconomic status, depending on the institutional background, it may not always be the case. Accordingly, in this section, rather than focusing on the unique institutional backgrounds, we aim to provide a general review of the effects of free school meal programs and school meals in general on student outcomes.

2.1. School Meals and Academic Performance

Regular nutritional intake is vital for students' physical and intellectual development. Kim et al. [20] showed that the regularity of three meals is positively related to students' academic performance in Korean schools. It is well established in the literature that quality school meals have a positive effect on students' academic performance. Indeed, a lot of studies provide support for a positive link between the quality of school meals and students' academic performance [3,21–25] because nutrition is essential for cognitive functioning [22,23,26,27]. For instance, Anderson et al. [26] showed that students who consume healthy school lunches are likely to obtain high scores on tests. In regard to the effects of school meal programs on academic performance, Frisvold [3] demonstrated that the availability of an SBP increases low-income students' cognitive achievement in subjects such as math, reading, and science. However, regarding the effects of universal school meals on academic performance, the empirical results are not that promising. For example, ABLM [14] found that the expansion of free school meal eligibility was not statistically associated with Korean, English, and math scores. Leos-Urbel et al. [11], using New York City data, showed that universal free school breakfast had only a limited impact on academic outcomes. Supporting this, the switch from universal to eligibility-based school meal programs in North Carolina, USA, did not harm students' test scores, either [28]. Thus, judging from the limited empirical findings, the effects of school meals on academic performance are likely to be more significant for students from low-income households.

2.2. School Meals and Nonacademic Performance

Previous studies provide empirical support for the importance of healthy food consumption during childhood to various nonacademic outcomes as well. Regularity of meals for adolescents is beneficial for physical as well as psychological development [29]. For instance, food-insufficient children are likely to experience health problems such as stomachaches and colds more frequently [7]. For reliable and nutritious food for children, school meals play a significant role [30], especially for students from low-income households. For example, empirical results show that the SBP improves the nutritional outcomes of students from low-income households [4]. In addition, beyond the SBP, universal free school meal programs—such as Community Eligibility Provision (CEP) in Georgia, USA—lead to reduced average body mass index (BMI) and an increased percentage of healthy-weight students [30]. Beyond students' health, school meal programs also have a positive effect on students' behavior at school. For instance, Murphy and colleagues [31] demonstrated that increased participation following the implementation of a universal free breakfast program in Baltimore, Maryland, USA, decreased student absences and tardiness. ABLM [14] also showed that a universal free school meal

program in Korea reduced student violence, because the program minimized the possibility that students from low-income households would become potential targets of school bullies.

2.3. School Meals and Physical Fitness

Beyond the aforementioned academic and nonacademic outcomes, another important factor that should be considered in primary and secondary education is students' physical fitness. There is a general consensus that high-quality physical education followed by improved physical fitness reduces long-term health care expenses and related social costs [32,33]. Even in the short-term, previous studies showed that physical fitness is important for academic achievement. For example, in the United States, student performance on fitness tests is positively related to academic performance, such as math and English test scores [24]. Although the effect was fairly small, the positive relationship between physical fitness and academic performance holds true in the Korean context as well [27]. Thus, it seems important to provide students with more access to physical activity facilities, as it can increase their health-enhancing physical activities [34], resulting in increased abdominal strength, physical endurance, and cardiorespiratory endurance [35]. However, studies on the effects of school meals on physical fitness are somewhat limited. Among them, a recent study showed that eating breakfast regularly decreases BMI and increases physical activity and cardiorespiratory fitness [36]. Another study suggested that school meals serve as school-based obesity intervention. Specifically, the extent to which students are enrolled in free or reduced-price meal programs might be indicative of high-risk student populations that are in need of nutrition and physical activity interventions [37].

3. Institutional Background

3.1. Education System in Korea

The public education system in Korea, which is 12 years long, consists of three parts: six years of elementary school, followed by three years of middle school and three years of high school. Spring and Fall semesters that start respectively in March and August make up the academic year. There are also Summer and Winter breaks between semesters. Pupils typically start their primary education (i.e., elementary school) at the age of eight. It is noteworthy that the Korean age system is different from the international age system. For example, whereas Americans start their age clock at birth and add one year for each birthday, Koreans are one-year-old at birth and gain another year on January 1. For example, a baby born on 31 December 2018, in South Korea turns two-year-old on 1 January 2019, whereas the same baby is still zero-year old in the United States. Accordingly, the birth year is more important than birth date for social purposes including their education in Korea.

3.2. School Meals in Korea

In the ruins of the Korean War and widespread starvation in 1953, the United Nations International Children's Emergency Fund (UNICEF) and the United States Agency for International Development (USAID) provided students with 40 million pounds of powdered milk and soybeans. School meal programs were dramatically expanded so that bread was distributed to more than half of elementary students (2.8 million) by 1966. The School Meals Act of 1981 steered the direction of Korean school meal programs from addressing hunger to providing balanced nutritional assistance. Providing lunches to all elementary school students started in 1997. That year, the share of schools that provided student meals was 65.4%, and the share of students who took up school meals was only 38.5%. However, by 2004, school meals were offered to almost every student in primary and secondary schools [38–40].

School meals were mostly provided on a means-tested basis, and about one-fifth of students below or near the poverty line were eligible for free lunches at schools [41]. However, progressive civic groups and opposition parties in Korea went after universal free school meals that were available to every student regardless of financial status, which gained increasing public support. The pursuit of universal free school meals was eventually institutionalized as the Eco-Friendly Free School Meal

Program (FSMP) due to heavy defeat of the conservative ruling party in the 2010 election for mayors, governors, local councils, and superintendents. However, officials affiliated with the ruling party who managed to get elected strongly opposed the FSMP [42–44]. As shown in ABLM [14], those school districts governed by conservative superintendents almost exactly coincide with regions where the ratio of free school meal beneficiaries is less than 70%. In this political landscape, the program's adoption was determined based on the party membership of mayors, governors, superintendents, and council members. For example, if a progressive superintendent tried to enforce the FSMP, it could be easily discouraged by the conservative mayor or a municipal council that refuses to provide the necessary funds [14]. However, public pressure for universal free school meals kept getting stronger, thus the FSMP has rapidly expanded. The number of schools that adopted the FSMP increased from 1812 (16.2%) in 2009 to 8351 (72.7%) in 2014 [45].

3.3. Student Fitness Evaluation System in Korea: Physical Activity Promotion System

The Physical Activity Promotion System (PAPS), developed by the Korean Ministry of Education (MOE), is a comprehensive web-based system designed to enhance students' physical activities and manage physical strength [46]. It became available for elementary schools in 2009 and then expanded to high schools in 2011. In PAPS, students in elementary, middle, and high schools are tested for five basic physical elements: cardiorespiratory endurance, muscular strength and endurance, flexibility, quickness, and body fat. Each element covers 20 points, for 100 total points. Based on total points earned, students are classified into five grades ranging from grade 1 (0–19 points) to 5 (80–100 points). Students (or their parents, for elementary school students) can access their evaluation results online and compare them to those of their peers. Most importantly, they have access to the activities or eating habits they need to address to improve their physical fitness. In addition, schools provide students with appropriate, customized physical activities during physical education classes and after-school activities and encourage parents to help their kids stay physically fit. PAPS has been serving as the Korean Youth fitness criteria.

3.4. Educational Finance and School Development Funds for School Meals in Korea

The school accounting system introduced in 2001 allows monetary resources to be pooled and distributed through a single channel. As depicted in Figure 1, local offices of education serve as conduits through which individual schools receive educational funds from MOE and metropolitan and local governments [47,48]. In this budgetary structure, the expansion of a certain educational program often leads to contraction of the others, making all programs closely interconnected. The total educational budget in Korea ranged from 48.5 to 60.5 trillion KRW during our sample period from 2010 to 2014. MOE budget accounts for 16–21% of the national budget (93 to 369 trillion KRW) between 2000 and 2018, and education subsidies and categorical grants from MOE accounted for 67% to 72% of school budgets [49]. During the same period, 16–21% of school revenues were tax transfers from local governments [50]. FSMP expenditure has been one of the largest parts of school budgets. For example, Korean schools spent 28 trillion KRW in 2014, for which MOE and local governments provided 17 and 11 trillion KRW, respectively [51].

Figure 1. Flow of education funds.

School development funds (SDFs) are a supplementary resource combined with public funds from education offices in the school accounting system. SDFs are raised from parents' gifts and donations. The school operation council at each school manages the SDF so that budgets can be autonomously drafted and enforced [47,52]. The SDF plays an important role in the FSMP. Despite parents' demand for universal free school meals, implementation of the FSMP may be challenged by the unwillingness of conservative superintendents, governors, and mayors to provide subsidies. Given a limited budget for FSMPs due to political conflicts, schools tend to allocate a larger portion of their SDF to expand eligibility for free school meals [38,53]. Figure 2 presents how much SDF accounts for FSMP expenses based on MOE annual reports from 2010 to 2014. A rapid escalation in SDF usage for FSMPs in 2012 can be explained by a substantial increase in the portion of FSMP schools between 2011 and 2012: 79% to 95.6% for elementary schools, 33.2% to 71.6% for middle schools, and 11.4% to 18.3% for high schools.

Figure 2. School development funds spent on the Free School Meal Program (FSMP).

4. Data and Summary Statistics

To explore how the FSMP impacts the investment in physical education and student health outcomes in Korea, we used Edudata Service System (EDSS) data. The Ministry of Education and local education agencies have been constructing EDSS data since 2009 for all Korean primary and secondary schools. EDSS provides annual information on key variables in our analysis: school meals, fitness test scores, and school development funds. EDSS also contains school-level information about education, learning, and managerial activities for students, teachers, and facilities.

Our study employed panel data extracted from EDSS for 7893 schools. We restricted our sample period to 2009 to 2013, for which all our key variables were available. Detailed descriptions of the variables are provided in Appendix A. The treatment group in our model was identified based on school meal information. EDSS provides the total number of students and free lunch beneficiaries per school, from which we determined when each school started the FSMP. During our sample period,

the average share of free meal beneficiaries monotonically increased from 13% to 68% between 2009 and 2013. As shown in Table 1, FSMP was implemented on average at 43% of primary and secondary schools in each year of the sample period.

Table 1. Summary of statistics.

Variable	Mean	Std. Dev.
FSMP	0.43	0.50
High Fitness Rate	40.51	15.74
Medium Fitness Rate	48.09	11.62
Low Fitness Rate	11.39	8.86
Number of School Development Fund (SDF) Uses for Physical Education (PE)	3.42	16.04
Amount of SDF for PE	3,129,627	22,800,000
Amount of SDF for PE per Student	5774.19	39,819.34
Number of Students per School	649.36	479.38
Class Size	25.55	9.12
Males	0.52	0.19
Age	10.86	2.74
Club Activity	0.43	0.48
Teachers	31.55	19.73
Dorms	0.07	0.26
English Rooms	0.00	0.01
Administration Rooms	0.09	0.04
Wellness Rooms	0.02	0.02
Books	12,154.87	6966.39
Income per capita	14,381.05	1611.60
Multiracial Families	10.04	4.00
Pro-FSMP Mayors	0.46	0.50
Pro-FSMP Superintendents	0.55	0.50
Pro-FSMP Council Seats	0.49	0.34

Note: There are 27,407 school-year observations in the sample for student fitness and 31,648 observations for school development funds.

Our first outcome variable was designed to measure overall student fitness at the school level. EDSS annually reports the number of students in each of five grades set for physical fitness evaluation by PAPS. As detailed in Section 3, each grade level is determined according to total scores on five physical fitness criteria. We calculated and used the share of students in the top two grades (1 and 2) to examine the relationship between FSMP and student health. Table 1 shows that there were 41.19, 47.81, and 11 students per 100 students in the high (1 and 2), medium (3 and 4), and low (5) fitness groups, respectively.

To examine whether FSMP crowded out investment in physical education, we used the amount of expenses for physical school activities as the second dependent variable. As detailed in Section 3.2, educational funds consist of: (1) public funds the government provides through education offices in the form of grants and subsidies, and (2) SDFs raised from parents' donations and gifts. EDSS only specifies how much school development funding, not public funding, is spent on student physical activities. Although public funds account for the majority of local education finances, their allocation to physical education is not necessarily useful for our model, because they are determined based on a set of formulae that stayed constant during the sample period. In contrast, reallocation is more frequent with SDFs, whose uses can be autonomously adjusted at the school level. Given that the FSMP has been prioritized since 2011, we hypothesized that average schools tend to spend a greater portion of SDFs for FSMP at the expense of investments in physical education. Table 1 shows that the average SDF withdrawal for PE is 3.42 per school. The total amount of SDF used for PE is 3.13 million KRW per school. SDF expenses per student are 5774 KRW.

Our outcome variables (student fitness and investment in physical education) may be associated with school characteristics including student demographics and number of facilities. For example,

students in male-dominated and more mature classes are expected to engage more in athletic activities (soccer, basketball, etc.) during break times, which helps their physical development. The number of facilities (dorms, as well as rooms for foreign language classes, administration, student wellness, etc.) and educational resources (teachers, library books, etc.) may be correlated with how much of the SDF is allocated for physical education.

Table 1 shows that there are 26.02 students per classroom, 53% of whom are male; average age is 11.18 years; 46% of students are members of extracurricular clubs. There are 32.12 teachers and 12,398 books per school; 8% of schools have their own dorms; 2% and 9% of rooms are dedicated to administration and student wellness, respectively.

Income has been documented to determine individual health [54–56]. Households with high income can make more investments in nutrition for their meals, which is expected to improve children's fitness. To control for income effects on student fitness, average income per capita was retrieved at the county level from the Korean Labor Income Panel Study (KLIPS), which has surveyed the same 5000 random households over 18 years until recently. Between 2009 and 2013, income per capita was 14.60 million KRW in the city where the sample school is located.

As explained in Section 3.1, adoption of the FSMP has relied heavily on the political interactions of elected officials in local governments and education offices. There are 17 school districts and 226 counties and cities in Korea. We hand-collected information on whether those 17 superintendents and 226 mayors were affiliated with progressive parties that support the FSMP. We also calculated the share of pro-FSMP seats in each of 226 municipal councils. Pro-FSMP superintendents, mayors, and council members account for 55%, 46%, and 49% of our sample, respectively.

5. Empirical Analysis

5.1. FSMP Effects on Student Physical Fitness

The association between FSMP and student fitness is specified with a fixed effects model

$$Fitness_{sct} = \beta FSMP_{sct} + \gamma X_{sct} + \delta R_{ct} + \mu_s + \tau_t + \varepsilon_{sct} \quad (1)$$

where $Fitness_{sct}$ is the number of students with the top two grades (1 and 2) from annual PAPS fitness evaluations per 100 students in school s , city c , and year $t = 2009, \dots, 2013$.

Our fixed effects regression model in Equation (1) is inherently a difference-in-difference (DID) model where treatment groups (schools that took up the FSMP) and control groups (schools that did not adopt the FSMP) are compared before and after treatment (implementation of FSMP), although two school groups are not mutually exclusive. That is, our model is different from traditional DID specifications because every school initially belongs to the control group. Schools treated earlier (early adopters of FSMP) become members of the treatment group, while late adopters stay in the control group (see ABLM [13] for details). The model in Equation (1) where a treatment indicator and other control variables are linearly added “can be sensitive to minor changes in the specification because of their heavy reliance on extrapolation” particularly when “covariate distributions differ substantially by treatment status” [57]. Hence, using the step-wise procedure illustrated in Imbens and Rubin [58], we find an optimal set of covariates that best explain the likelihood of treatment (i.e., the propensity score). Following Crump et al. [59], schools with extreme values of propensity scores are dropped. Treated schools that adopt FSMP are weighted with the inverse of propensity scores while schools in the control group are weighted with the inverse of $1 -$ propensity scores. This propensity score weighting procedure dramatically improves the covariate balance. After the sample is trimmed and weighted with propensity scores, 47,407 school-year observations are available from EDSS for student fitness information. Our empirical strategy exploited variations in when and where the FSMP was adopted to estimate its effects on student fitness.

We followed ABLM [14] to identify whether a certain school took up the FSMP. The treatment event was identified as an indicator variable FSMP, which equals 1 if 90% or more students in a school benefit from free meals. Since the poverty rate typically does not exceed 20% in Korea, it is safe to assume that the FSMP has already been adopted at schools with a 90% or higher free meal beneficiary rate. Our results are robust to thresholds of 80% and 70%.

A rich set of time-varying school and student attributes were controlled in vector X in Equation (1). X contains student demographic information including the share of males and the average age. The quality of a school may also explain the likelihood of FSMP implementation, which is controlled with class size, number of teachers, club activity, and amount of educational resources, including library books and rooms for English education, student wellness, and administration.

Vector R_{ct} contains several important regional characteristics measured in year t for city c where the school is located. Household income, expected to influence student health outcomes, was measured with average annual income per capita. R_{ct} also includes political affiliations of superintendents, mayors, and council members, whose interactions determine FSMP implementation. An indicator variable is defined to equal 1 if a school belongs to a school district with a superintendent from a pro-FSMP party. Another indicator takes the value of 1 if a school is located in a city whose mayor is affiliated with a progressive party that favors the FSMP. The information for political support from the municipal council is controlled with the share of council members who support the FSMP.

Unobserved and time-invariant individual school characteristics are controlled with the vector μ_s , which contains a set of school dummies. Vector τ_t contains dummies for year fixed effects.

Columns 1 to 3 in Table 2 present the regression results of Equation (1). Standard errors in parentheses are clustered at the school level. To check whether estimates are sensitive to different specifications, Equation (1) was modified to have three set of controls. In column 1, we controlled only for school and year fixed effects. In column 2, school and student characteristics were added. In column 3, a whole set of control variables were considered, including regional income and political affiliations of elected government officials. In columns 1 and 2, the coefficients of FSMP are estimated to be -0.895 and -0.826 , which are significant at the 5% level. This means the number of students who earned the top two grades in PAPS fitness evaluations decreased by about 0.8 to 0.9 when a school started to provide free lunches to relatively wealthy students as well as poor ones. When location characteristics are controlled in column 3, the association between FSMP and the share of high-fitness students becomes insignificant. However, this does not necessarily imply the absence of FSMP effects. The following paragraph will give a closer examination of FSMP effects in a more sophisticated model presented below.

One of the most important requirements for the validity of DID is that the difference in outcome between treatment and control groups must be stable over time in the absence of treatment [60–62]. Based on the event-study framework in Jacobson et al. [63] and Bailey and Goodman-Bacon [64], we tested this parallel trend assumption in the equation

$$Fitness_{sct} = \sum_{y=-4}^{-2} \pi_y D_j 1(t - T_j^* = y) + \sum_{y=0}^4 \theta_y D_j 1(t - T_j^* = y) + \gamma X_{sct} + \delta R_{ct} + \mu_s + \tau_t + \varepsilon_{sct} \quad (2)$$

where the single treatment dummy FSMP in Equation (1) is replaced with interactions between the choice and timing of FSMP adoption, while the dependent and control variables remain identical. D_j is a binary treatment indicator, which equals 1 if school j ever adopted FSMP; $1(t - T_j^* = y)$ is another indicator for FSMP timing, which equals 1 if school j is observed y years from T_j^* , the year of the school's FSMP adoption. Since our sample period is from 2009 to 2013, y can range from -4 to $+4$. Since there are relatively few observations with non-zero values for $y = \{-4, +4\}$, we use $1(t - T_j^* \leq -3)$ and $1(t - T_j^* \geq +3)$ for three or more years before and after FSMP implementation. One year prior to T_j^* ($y = -1$) is excluded as the reference year. The parameter coefficient π_y represents how student fitness evolved before T_j^* in schools that eventually took up the FSMP compared to their

counterparts in the control group. The coefficient θ_y presents dynamic variations in student fitness outcomes of FSMP adopters after T_j^* compared to schools without the FSMP.

Table 2. Impact of FSMP on student physical fitness.

Dependent Variable	Share of Students with High Fitness Grades			
	(1)	(2)	(3)	(4)
FSMP	−0.895 (0.365) **	−0.826 (0.365) **	−0.453 (0.371)	
Year 0 from FSMP				−0.252 (0.367)
One Year after FSMP				−0.862 (0.464) *
Two Years after FSMP				−1.531 (0.597) **
Three or More Years after FSMP				−0.746 (0.808)
Two Years Prior to FSMP				0.513 (0.384)
Three or More Years Prior to FSMP				0.883 (0.584)
Class Size		−0.090 (0.050) *	−0.091 (0.050) *	−0.095 (0.050) *
Males		−5.489 (5.216)	−5.104 (5.207)	−5.271 (5.197)
Age		−2.639 (1.244) **	−2.472 (1.242) **	−2.470 (1.240) **
Club Activity		1.136 (0.368) ***	1.038 (0.367) ***	0.994 (0.365) ***
Teachers		−0.017 (0.031)	−0.010 (0.031)	−0.015 (0.031)
Dorms		1.401 (1.133)	1.534 (1.134)	1.478 (1.134)
English Rooms		29.653 (41.539)	23.480 (41.593)	21.715 (41.682)
Administration Rooms		2.071 (4.684)	1.967 (4.670)	2.322 (4.667)
Wellness Rooms		−11.764 (11.199)	−13.007 (11.210)	−13.141 (11.141)
Books		0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Income per Capita			0.002 (0.001) ***	0.002 (0.001) ***
Pro-FSMP Mayors			−0.209 (0.710)	−0.099 (0.716)
Pro-FSMP Superintendents			−2.082 (0.449) ***	−2.019 (0.461) ***
Pro-FSMP Council Seats			−1.122 (0.970)	−0.803 (0.984)
Academic Year FE	Yes	Yes	Yes	Yes
School FE	Yes	Yes	Yes	Yes
N	27,407	27,407	27,407	27,407

Notes: This table reports results from regressions of student fitness outcomes on FSMP adoption and other controls. Unit of observation is an academic year. The sample is trimmed and differently weighted with propensity scores for treated and untreated schools. The dependent variable is the number of students with top two grades from annual fitness evaluation (PAPS) per 100 students. In columns 1 to 3, FSMP = 1 if the share of free meal beneficiaries is higher than 90%. All regressions control for school and year fixed effects. Standard errors are clustered at the school level. *, **, and *** indicate p-value less than 0.1, 0.05, and 0.01, respectively.

Regression results for Equation (2) are presented in Table 2, column 4. It is important to note that none of the estimates for π_y are statistically significant. This implies that the choice and timing of FSMP are not correlated with variations in student fitness during the pre-FSMP period. In other words, our finding of a negative FSMP impact on student fitness is not driven by the tendency of FSMP-adopting schools to have fewer high-fitness students. Since our specification in Equation (2) satisfies the parallel trend assumption, where non-FSMP adopters are the valid counterfactual to FSMP-adopting schools, it is possible to interpret the values of θ_y as causal effects. The estimate of θ_1 is statistically indistinguishable from zero. θ_2 and θ_3 are estimated to be -0.862 and -1.531 , which are significant respectively at the 10% and 5% level, respectively. These results mean that the number of high-fitness students decreases by one or two per 100 within two years from the start of FSMP. We explore potential reasons for the association between FSMP and student fitness in the next section.

5.2. FSMP Effects on Investment in Physical Education

There are three possible channels through which the FSMP influences student health outcomes, including fitness levels, at a school. First, the FSMP potentially reduces food insecurity because the quantity and dietary quality of lunch can be improved for low-income students. Despite their eligibility, poor students often refuse to take up free school meals due to a concern about stigmatization [12,65]. The FSMP also benefits students near the poverty line who are ineligible for free school meals and cannot afford meal costs. Hence, the overall association between the FSMP and health outcomes can be positive due to this improvement in nutritional intake for a certain portion of the student population. However, this hypothesis is not supported by our result of a negative impact on student fitness. The inability of this hunger channel to explain our results is actually consistent with the absence of an association between the FSMP and illness-related health outcomes documented in ABLM [14]. They show that the FSMP does not significantly change the share of students who permanently or temporarily leave school for medical reasons and the share of students with serious illnesses.

Second, the FSMP increases disposable income for non-poor households by the amount of school meal fees they had to pay before the program. With extra money in their pockets, these households may increase their investment in the quality of foods they consume. Students can better build their fitness through this food investment. However, this also does not fit with a downward trend in fitness after FSMP implementation.

The third potential mechanism is related to the allocation of educational budgets. As explained in Section 3, universal free school meals make schools bear more financial burden to replenish the budgetary void that was filled by payments from parents before the FSMP. Hence, the portion of school meal expenses within the school budget dramatically increases under the FSMP, which may lead to more frequent withdrawals from SDFs to continue to provide universal free meals. This possibly crowds out SDF investments in other programs including PE. Sallis et al. [35] show that the quality of PE classes is positively associated with abdominal strength, physical endurance, and cardiorespiratory endurance. We postulate that the FSMP reduces investments in PE, which negatively impacts student fitness.

Using models where the dependent variable in Equations (1) and (2) is replaced with the number of SDF withdrawals, we examined whether the FSMP cannibalizes PE investments. Results are presented in Table 3. More schools reported SDF data fields to EDSS than those that reported student fitness. Hence, there are more school-year observations analyzed in our SDF models. With no controls for school and regional characteristics, the number of observations is 34,007. When those are controlled, 31,648 school-years are included in the estimation. Columns 1 to 3 show that the impact of the FSMP on the frequency of SDF withdrawals for PE is negative and statistically significant at the 1% level. Because the linear models in Equations (1) and (2) do not precisely fit the nature of the dependent variable, which is a count of SDF withdrawals, we do not interpret the size of coefficient estimates. Ideally, a variant of the Poisson model can be used; however, nonlinear models are documented to work worse with a large number of fixed effects along multiple dimensions (see Abrevaya [66] and

Garmaise [67]). In order to evaluate the internal validity of our DID specification and to examine annual evolution of the association between FSMP and PE investments from SDF, we do an event study based on equation (2). Column 4 in Table 3 describes that schools immediately decreases the use of SDF after the FSMP is adopted, and this negative association is persistent during the post-FSMP period except for year three and beyond. Our results are robust to a different measure of SDF expenses for PE. Table 4 shows that FSMP adopters decrease the amount of SDF expenditure per student for PE significantly more than non-FSMP schools. This causal interpretation is supported by the absence of statistical significance for the difference in SDF use between treated and untreated schools prior to the FSMP, as presented in Table 4, column 4. The negative impacts are persistently significant for three years following the FSMP.

Table 3. Impact of FSMP on frequency of SDF use for physical education.

Dependent Variable	Number of SDF Withdrawals for Physical Education			
	(1)	(2)	(3)	(4)
FSMP	−1.293 (0.294) ***	−1.172 (0.290) ***	−0.992 (0.288) ***	
Year 0 from FSMP				−0.665 (0.283) **
One Year after FSMP				−1.073 (0.338) ***
Two Years after FSMP				−1.244 (0.536) **
Three or More Years after FSMP				−1.067 (0.719)
Two Years Prior to FSMP				0.018 (0.387)
Three or More Years Prior to FSMP				−0.210 (0.504)
Class Size		−0.033 (0.036)	−0.028 (0.036)	−0.030 (0.037)
Males		2.924 (2.533)	3.324 (2.490)	3.298 (2.491)
Age		−0.354 (0.556)	−0.350 (0.557)	−0.345 (0.550)
Club Activity		0.119 (0.179)	0.222 (0.178)	0.191 (0.173)
Teachers		0.096 (0.155)	0.101 (0.156)	0.100 (0.154)
Dorms		1.818 (1.627)	1.959 (1.617)	1.911 (1.623)
English Rooms		−26.949 (6.808) ***	−12.067 (5.788) **	−10.912 (5.610) *
Administration Rooms		3.476 (4.491)	2.865 (4.436)	2.947 (4.460)
Wellness Rooms		2.683 (7.774)	2.660 (7.713)	2.576 (7.707)
Books		−0.000 (0.000)	−0.000 (0.000)	−0.000 (0.000)
Income per Capita			0.003 (0.001) ***	0.003 (0.001) ***
Pro-FSMP Mayors			−0.455 (0.327)	−0.463 (0.323)
Pro-FSMP Superintendents			1.569 (0.306) ***	1.506 (0.311) ***
Pro-FSMP Council Seats			1.167	1.120

Table 3. Cont.

Dependent Variable	Number of SDF Withdrawals for Physical Education			
			(0.667) *	(0.628) *
Academic Year FE	Yes	Yes	Yes	Yes
School FE	Yes	Yes	Yes	Yes
N	34,007	31,648	31,648	31,648

Notes: This table reports results from regressions of the frequency of SDF withdrawals for physical education on FSMP adoption and other controls. Unit of observation is an academic year. The sample is trimmed and differently weighted with propensity scores for treated and untreated schools. The dependent variable is the number of SDF withdrawals per school spent on student physical activities. In columns 1 to 3, FSMP = 1 if the share of free meal beneficiaries is higher than 90%. All regressions control for school and year fixed effects. Standard errors are clustered at the school level. *, **, and *** indicate p-value less than 0.1, 0.05, and 0.01, respectively.

Table 4. Impact of FSMP on average amount of SDF spent on physical education.

Dependent Variable	Amount of SDF Spent on Physical Education per Student (in KRW)			
	(1)	(2)	(3)	(4)
FSMP	−4592.763 (953.294) ***	−4220.419 (920.900) ***	−3713.813 (931.707) ***	
Year 0 from FSMP				−487.722 (1110.710) ***
One Year after FSMP				−5867.375 (1537.983) ***
Two Years after FSMP				−6065.397 (1754.703) ***
Three or More Years after FSMP				−1661.431 (2475.788)
Two Years Prior to FSMP				−597.920 (913.780)
Three or More Years Prior to FSMP				779.153 (1569.741)
Class Size		−179.366 (118.860)	−165.236 (117.184)	−162.050 (115.893)
Males		10,792.840 (16,352.288)	12,057.963 (16,301.129)	11,035.037 (16,240.012)
Age		−1719.989 (2289.039)	−1654.531 (2309.269)	−1179.701 (2334.449)
Club Activity		2155.215 (1202.690) *	2247.057 (1189.586) *	1868.633 (1154.083)
Teachers		−75.281 (90.144)	−61.995 (90.353)	−83.465 (85.985)
Dorms		6829.827 (4316.314)	7063.810 (4273.027) *	7101.263 (4293.770) *
English Rooms		−90,701.841 (70,837.082)	−57,909.586 (70,173.415)	−79,879.030 (71,403.378)
Administration Rooms		−7559.628 (13,832.824)	−9,153.639 (13,768.190)	−7,085.481 (13,672.719)
Wellness Rooms		4633.368 (30,432.854)	2,934.792 (30,146.536)	3,048.841 (30,075.434)
Books		−0.017 (0.036)	−0.051 (0.035)	−0.040 (0.036)
Income per Capita			9.073 (1.870) ***	9.255 (1.912) ***
Pro-FSMP Mayors			4,133.313 (906.717) ***	4,326.767 (946.775) ***
Pro-FSMP Superintendents			3,727.914	3,994.891

Table 4. Cont.

Dependent Variable	Amount of SDF Spent on Physical Education per Student (in KRW)			
Pro-FSMP Council Seats			(822.989) ***	(877.137) ***
			3,224.255	3,708.332
			(1322.753) **	(1454.863) **
Academic Year FE	Yes	Yes	Yes	Yes
School FE	Yes	Yes	Yes	Yes
N	34,007	31,648	31,648	31,648

Notes: This table reports results from regressions of SDF withdrawals for physical education on FSMP adoption and other controls. Unit of observation is an academic year. The sample is trimmed and differently weighted with propensity scores for treated and untreated schools. The dependent variable is the amount of SDF withdrawals per school spent on student physical activities. In columns 1 to 3, FSMP = 1 if the share of free meal beneficiaries is higher than 90%. All regressions control for school and year fixed effects. Standard errors are clustered at the school level. *, **, and *** indicate p-value less than 0.1, 0.05, and 0.01, respectively.

6. Conclusions

Education programs are vital for the sustainable growth and development of a country. Especially, school meal programs can play an important role in the path of human capital accumulation critical for the sustainability of a country. One important policy question regarding school meal arrangements is whether free meals are provided for every student in a school. ABLM [14] shows that a decline in school violence could be one important advantage of universal school meal programs. However, the full-scale universal provision of free meals should be executed with caution. In a difference-in-difference setting augmented with event studies, our paper shows that the expansion of free meal eligibility through the FSMP in Korean schools negatively impacted student fitness. Given that SDF investments in PE also decreased in response to FSMP adoption, we postulate that the FSMP was followed by a rapid increase in spending for a universal arrangement of free school meals. This appears to decrease funds in a school budget for other educational programs, including PE activities which, in turn, could be detrimental for the sustainability of quality PE.

This paper points to important policy implications for countries such as the United States that try to expand universal free school meals in a budgetary environment where a variety of programs are closely interconnected. The choice between means-tested and universal welfare programs is a multidimensional economic problem. ABLM [14] and our paper provide behavioral and health outcomes of universal welfare benefits in the school environment. Our findings particularly highlight the importance of increasing school budgets enough not to hurt other important educational programs. However, it is not clear how the macro economy is affected by a rise in tax transfer from governments or the issuance of educational bonds. We leave these issues for future research.

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Appendix A

Table A1. Variable definitions.

Variable	Description
FSMP	=1 if the school adopted the Eco-Friendly Free School Meal Program.
High Fitness	Number of students who obtained fitness grades 1 and 2 per 100 students.
Medium Fitness	Number of students who obtained fitness grades 3 and 4 per 100 students.
Low Fitness	Number of students who obtained fitness grade 5 per 100 students.
Number of SDF Uses for PE	Annual number of SDF withdrawals spent for physical education (PE) in a school
Amount of SDF Uses for PE	Annual KRW amount of SDF withdrawals spent for PE in a school
Amount of SDF Uses for PE per Student	Annual KRW amount of SDF withdrawals for PE divided by total number of students
Class Size	Number of students per classroom
Males	Share of male students
Age	Average age of students
Club Activity	Share of students in an extracurricular club.
Teachers	Number of teachers
Dorms	=1 if school has a dorm
English Rooms	Share of rooms for English education
Administration Rooms	Share of rooms for administration
Wellness Rooms	Share of rooms allocated to student wellness
Books	Number of books in school library
Income per capita	Per capita income in the city where the school is located
Pro-FSMP Mayors	=1 if the city mayor is affiliated with a pro-FSMP party
Pro-FSMP Superintendents	=1 if the superintendent is affiliated with a pro-FSMP party
Pro-FSMP Council Seats	Share of the city council members affiliated with pro-FSMP parties

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