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Impact Evaluation on Student BMI and Mental Health

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Abstract

In spring 2015, the South Korean province of South Gyeongsang stopped providing free school lunches to primary and secondary school students while large portions of schools in other provinces continued to provide free lunches at school. After the provincial government faced strong opposition, South Gyeongsang reintroduced the free school lunch program the very next year. Using a difference-in-differences design, we use these policy changes to evaluate their impact on students' body mass index (BMI) and mental health status. Our results show that abolishing the free-lunch policy had negative effects on students' BMI as well as mental health status; furthermore the effects reversed once the policy was reintroduced. The results have strong policy implications: introducing free school lunches increases both the physical and mental health of students and as a result, student welfare. Free-lunch policies, therefore, provide simple and inexpensive instruments to improve learning environments.

JEL: I14, I28, I31, C23

Keywords: free lunch policies; difference in differences design; student health

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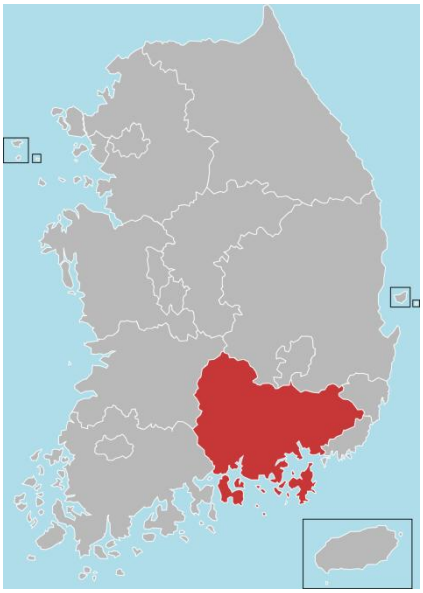
I. Introduction

In spring 2015, the South Korean province of South Gyeongsang stopped providing free school lunches to primary and secondary school students while large portions of schools in other provinces maintained free lunches for all students at school. The governor's stated reasons for this change were to strengthen the financial soundness of the province and to increase the welfare of students from lower-income families by saving resources used to provide free school meals to upper-income families. However, the provincial government faced strong opposition and reintroduced free school lunches in spring 2016.

<Fig.1: Location of South Gyeongsang within South Korea (credit: Wikipedia)>



The existing literature on free-school-lunch policies generally finds positive effects of universal free school meals on students' academic as well as health outcomes. Several studies show that universal free school meal programs significantly improve students' academic outcomes (Gordanier, Ozturk, Williams, and Zhan, 2020; Schwartz and Rothbart, 2020; Ruffini, 2021). Although the effect of such programs varies by socioeconomic status, even students from affluent family backgrounds experience an increase in academic performance. Improving the school meal quality also has significant effects on academic

achievements of students. The British government's "Feed Me Better" campaign to enhance school meal quality, for instance, led to a significant increase in student educational outcomes, especially in English and Science subjects (Belot and James, 2011). Likewise, free school breakfast programs increase students' cognitive achievements (Frisvold, 2015). Other studies focus on the effect of free school meals on student body mass index (BMI), obesity, and health. Davis, Kreisman, and Musaddiq (2020) estimate that exposure to the Community Eligibility Provision (CEP)[1] increases the student BMI by about two percent. Focusing on K-12 schools in Georgia, Davis and Musaddiq (2019) show that the CEP increases the probability of having a healthy weight and decreases the average student BMI. Similarly, Gundersen and Kreider (2009) show that food security is crucial for students attaining favorable health conditions and healthier weights.

There are also studies with a wider focus such as student misconduct and meal satisfaction after students are offered free school meals. Lee and Baek (2016) and Altindag, Baek, Lee, and Merkle (2020) measure the impact of free school lunches on student misbehavior. They find that incidents of student misconduct decreased significantly after free school lunches were introduced. In light of growing concerns among parents about an alleged decrease in meal quality after introducing a free school lunch program, a few studies also evaluate the satisfaction with free school meals in primary and secondary schools. Jang, Choi, and Lyu (2016) evaluate the meal satisfaction of elementary school students in Busan. Similarly, Yang, Park, and Joo (2021) measure the satisfaction of free school meals of secondary school students in Busan. Both studies find no significant decrease in student satisfaction with school meals even after the free school lunch is implemented.

In general, empirical research shows that free school meals lead students into a

[1] CEP is a free breakfast and lunch program for schools and school districts located in low-income areas in the United States.

healthier direction and turn schools into better environments for children and adolescents. The introduction of free school meals obviously levels out social differences and thereby might lead to a reduction of stress among students. And with less stressed students, school violence is likely to decrease. Furthermore, a number of studies shows that perceived stress levels affect eating behavior and result in BMI changes (Nishitani and Sakakibara, 2007; Barry and Petry, 2008; Ohara et.al, 2019). Also, it is well established that this kind of effect is generally larger for females than for males (see, for example, Barry and Petry, 2008; Ohara et.al, 2019; Udo, Grilo, and McKee, 2014; Liu and Umberson, 2015).

The primary goal of this paper is to conduct an impact evaluation on student BMI and mental health after the policy changes in South Gyeongsang. Using a difference-in-differences (DID) design, we find that the abolishment of the free-lunch policy in 2015 decreased the BMI of the average student and that the reintroduction of that policy one year later had the opposite effect. In addition we show that the free-lunch policy led to healthier weights: on average the abolishment of the free-lunch policy caused underweight female students to lose even more weight while its reintroduction helped overweight female and male students to lose weight. Furthermore, these policy changes also affected the mental health of students: negatively when the program was abolished and positively once the program was reintroduced. These results provide a strong argument for policy makers willing to promote a free-school-lunch policy.

II. Data and Methodology

The dataset used in our study is the 2010 wave of the Korean Children and Youth Panel Survey (KCYPS). To focus on secondary students, we use the 4th grade cohort who are 8th graders in 2014 – the year before the free-lunch abolishment – and are 10th graders in 2016 – the year of its reintroduction. The dataset is an unbalanced panel, maintaining a total of 2,070 observations in 2014, 2,061 observations in 2015, and 1,979 observations in 2016. Table 1 describes our research design.

<Table 1: Summary of Research Design>

2014 – 2015 Regression			
Control / Treatment	2014	2015	2016
South Gyeongsang	Controlled	Treated	
Other Regions	Controlled	Controlled	
2015 – 2016 Regression			
Control / Treatment	2014	2015	2016
South Gyeongsang		Controlled	Treated
Other Regions		Controlled	Controlled

In our main regressions, we use the pooled ordinary least squares method (clustered at individual level) which is summarized in equation (1):

$$Y_{it} = \beta_0 + \beta_1(\text{Year}_t) + \beta_2(\text{Location}_i) + \theta(\text{DID}_{it}) + \beta_4(\text{Covariates}_{it}) + \varepsilon_{it} \quad (1)$$

In the following analysis, we focus on the two outcome variables BMI and mental health (MH). The individual covariates controlled in the BMI regressions are mother's education, the health of parents, allowance, the time students go to bed, having a girlfriend or boyfriend, and time spent on television, game, and friends. Mother's education, the health of parents, and allowance are common socio-economic determinants of students' BMI (Müller, Mast, Asbeck, Langnäse, and Grund, 2001; Klein-Platat, Wagner, Haan, Arveiler, Schlienger, and Simon, 2003; Fertig, Glomm, and Tchernis, 2009; Keino, Plasqui, Ettyang, and Borne, 2014;

Li, Xue, Jia, Zhao, Wang, Xu, and Wang, 2017). Variables related to student sociability such as spending time with friends and having a girlfriend or boyfriend can affect the BMI of adolescents (Paxton, Schutz, Wertheim, and Muir, 1997; Webb and Zimmer-Gembeck, 2013). Other common determinants for BMI are related to time use such as playing games, sleeping, and watching television (Sijtsma, Koller, Sauer, and Corpelejin, 2015; Kenney and Gortmaker, 2017).

The individual covariates controlled for in the MH regressions additionally comprise relationships with teachers and peers as they are commonly known to influence student mental health. Tables 2 and 3 show the descriptive statistics of the variables used in our regressions.

<Table 2: Descriptive Statistic for Outcome Variables>

	2014-2015		**2015-2016**		**description**
variable	Obs	mean(sd)	Obs	mean(sd)	
BMI	4,071	20.47467 (3.174513)	3,978	21.08972 (3.269561)	student BMI
MH	4,126	3.295686 (0.7498304)	4,022	3.3272 (0.7382343)	often cry without any reason

Note: The natural logarithm of BMI is used in the following regressions. MH is a categorical variable where 1 denotes “strong yes”; 2,“yes”; 3,“no”; 4,“strong no”.

<Table 3: Descriptive Statistics for Control Variables>

	2014-2015		**2015-2016**		**description**
variable	obs	mean(sd)	obs	mean(sd)	
year	4,126	0.498788 (0.500059)	4,022	0.488314 (0.499926)	treated year = 1, controlled year = 0
location[2]	4,126	0.062046 (0.2412675)	4,022	0.061412 (0.2401148)	treated province = 1, controlled province = 0
moeduc	3,757	14.17301 (2.187652)	3,603	14.18401 (2.171761)	mother's education in years
healthpar	4,004	1.947303 (0.5022758)	3,827	1.950091 (0.5054505)	health of parents 1 = very healthy 2= healthy 3 = unhealthy 4 = very unhealthy
allowance	3,512	4.247181 (3.225568)	3,629	5.503968 (3.950518)	monthly allowance in 10,000KRW
withteach	4,126	1.825012 (0.6445405)	4,022	1.775982 (0.6214999)	confident saying hello to teachers 1 = very confident 2= confident 3 = insecure 4 = very insecure
withpeer	4,126	1.671837 (0.5660426)	4,022	1.677772 (0.5664922)	confident with friends (same categorical values with withteach)
bedhour	4,124	23.53419 (1.026945)	4,022	24.02685 (1.081496)	time student go to bed
tvtime	4,119	70.15489 (65.93838)	4,022	56.96594 (64.25353)	minutes spent in watching tv
gametime	4,114	70.6896 (72.7025)	4,022	60.24888 (71.73506)	minutes spent in playing games
friendtime	4,110	52.49927 (65.53149)	4,022	48.89632 (70.23463)	minutes spent with friends
girlfriend	4,126	1.839796 (0.366839)	4,022	1.828692 (0.376825)	having girlfriend or boyfriend 1 = have, 2 = don't have

For both the BMI and the MH analyses, we also ran separate regressions by gender to measure the potentially heterogeneous effects the free-school-lunch policy had on male and female students. In our BMI regressions, we went one step further and also analyzed the

[2] We dropped the students who did not report their province information as the location is necessary to divide students into control and treatment groups.

effect of the policy on underweight and overweight students. This way we hope to see whether or not the free school lunch is leading students into healthier directions. For the identification of underweight, normal weight, overweight, and obese students, we used the age and gender specific BMI percentiles suggested by the World Health Organization (WHO, 2007). The categorization then follows the guideline of the United States Center for Disease Control which happens to coincide with the corresponding Korean guideline published by the Seoul National University Hospital.[3] This procedure allows to measure the difference (between the control and treatment groups) of average BMI changes (after one year) separately for underweight and overweight as well as female and male students. Consequently, we obtained four additional DID coefficients (by gender and weight status).

To cope with the relatively small numbers of observations in the gender-specific underweight and overweight regressions, we applied the bootstrap method to measure the accuracy of our estimation. Following the standard procedure (Efron and Tibshirani, 1993), we drew a bootstrap sample and calculated the theta coefficient $\hat{\theta}_i$. Repeating this procedure one thousand times allowed us to estimate the standard error of θ as follows:

$$\widehat{se} = \left[\frac{1}{k-1}\sum_{i=1}^{k}(\widehat{\theta_i} - \bar{\theta})^2\right]^{½}, \text{where } \bar{\theta} = \frac{1}{k}\sum_{i=1}^{k}(\widehat{\theta_i}) \qquad (2)$$

In our MH regressions, we also ran separate regressions for girls and boys. However, we did not run separate regressions for underweight and overweight students. Unlike the BMI variable, which is continuous, mental health is a categorical variable. Therefore, only a small portion of observations changes over time. If we focus on the smaller groups like underweight and overweight students, only a few observations will decide the magnitude and sign of coefficients, which leads to consistency issues.

[3] Underweight children are students less than the 5th percentile in BMI, overweight children are students from 85th to less than the 95th percentile in BMI, and obese children are students from the 95th percentile and higher (CDC, 2021; Seoul National University Hospital, 2021).

III. Results

Table 4 displays the BMI regression DID coefficients[4] by years, gender, and weight status.

<Table 4: BMI Regression DID Coefficients >

ln(BMI)	average	female (underweight)	female (overweight)	male (underweight)	male (overweight)
2014-2015	-0.012911	-0.045022***	0.014840	0.018715	0.008174
	(0.011765)	(0.016774)	(0.018788)	(0.03236)	(0.017584)
P>|t|	0.273	0.010	0.432	0.565	0.643
obs	3,263	79	89	96	218
$\widehat{\boldsymbol{\theta}}$(boot. se)		-0.045022*	0.014840	0.018715	0.008174
		(0.026131)	(0.022631)	(0.035562)	(0.020333)
P>|t|		0.085	0.512	0.599	0.688
replications		649	837	623	995
2015-2016	0.016597*	0.060515	-0.021406*	-0.006812	-0.021569*
	(0.010019)	(0.058901)	(0.011492)	(0.035931)	(0.012211)
P>|t|	0.098	0.309	0.067	0.85	0.079
obs	3,392	71	88	85	239
$\widehat{\boldsymbol{\theta}}$(boot. se)		0.060515	-0.021406*	-0.006812	-0.021569*
		(0.068333)	(0.012091)	(0.038647)	(0.012921)
P>|t|		0.376	0.077	0.86	0.095
replications		543	860	881	656

Note: standard errors are clustered at student level and reported in parentheses. (boot. se) denotes bootstrap standard errors. Because of occasionally occurring collinearities, numbers of replications are below one thousand in our bootstrap analysis.

On average, student BMI decreased approximately by 1.3 percent when the free school lunch program was abolished but increased approximately by 1.7 percent when it was reintroduced. Unsurprisingly, student BMI changes are smaller in magnitude and statistically insignificant as losing weight generally takes more time than gaining weight (Hanson *et. al*, 1995). Nevertheless, our results show that an average student consumed more food when the free-school-lunch program was reintroduced.

[4] We statistically checked the pre-trends for the validity of DID design using 2013 – 2014 regression. The DID coefficient estimate was 0.0047796; standard error, 0.0140114; p-value, 0.733. Thus, we could retain the null-hypothesis where there was no treatment effect before the policy change.

Most importantly, we find that the program benefits students' health. Once the program was abolished in 2015, the average BMI of underweight female students decreased even further by approximately 4.5 percent. On the contrary, the average BMI of overweight male and female students decreased approximately by 2.1 percent after the program was reintroduced in 2016. These results underscore that introducing free school meals helps students to reach and maintain a healthier weight which is consistent with Davis and Musaddiq (2019). We also checked the robustness of these findings. In a first step, we address the relatively small number of observations by applying the bootstrapping method described in equation (2). As can be seen in Table 4, the estimated coefficients are still statistically significant even with bootstrapped standard errors. In a second step, we take a closer look at those students leaning toward low weights (see Table A1 in the appendix for the regression results). Again, we reconfirm that lower-weight females generally lost weight once the program was abolished. Moreover, the DID coefficients close to zero for the 2015–2016 regressions restricted to students whose BMI percentile is greater than 25 percent also reconfirm our point that average students gained weight while overweight students lost weight (as shown in Table 4).

Table 5 displays the MH regression DID coefficients by years and genders.

<Table 5: Mental Health Regression DID Coefficients>

MH	**average**	**female**	**Male**
2014-2015	-0.3212785***	-0.4793953***	-0.1762045*
	(0.081016)	(0.124339)	(0.103899)
P>|t|	0.000	0.000	0.09
Obs	3,300	1,578	1,722
2015-2016	0.1318867*	0.289502***	-0.0463791
	(0.073136)	(0.10649)	(0.098481)
P>|t|	0.072	0.007	0.638
Obs	3,430	1,629	1,801

Note: standard errors are clustered at student level and reported in parentheses.

As has been discussed in the introduction, plenty of evidence suggests that there is a link between mental stress and BMI measures. At the same time, many studies find that free-school-lunch policies (or the absence thereof) can be linked to student misconduct (low SWB, more stress, etc.). As a consequence, besides the obvious (and direct) link between free-school-lunch policies and students' diets there is another (and indirect) pathway via mental stress. While an exact identification of the pathway is beyond the scope of this paper, the MH variable in our dataset allows us to check whether this indirect link is of any potential importance.

During the time when the free-school-lunch program was abolished, students had to prove their eligibility (i.e. low economic status) for free school lunches. Thus, teachers and classmates implicitly knew about precarious economic backgrounds. Consequently, students with these backgrounds were mentally discouraged by the policy change in 2015. The above effect is captured by the MH regression results. As the MH regressions show, students felt more depressed when the free lunch was abolished while less depressed when the free lunch was reintroduced with high statistical significance. Note that the coefficients' magnitude and statistical significance are higher when the program was abolished as opposed to its

reintroduction. Moreover, the effects on mental health are stronger for female students as the regression results display both bigger magnitudes as well as higher statistical significance than the regression results for male students. Our findings are consistent with the existing literature which shows that the mental health of female students is more vulnerable to violence and outside shocks (Romito and Grassi, 2007; Misca and Thornton, 2021). We also rerun the MH regressions for the split estimation samples (along the 25th BMI percentile, see Table A2 in the appendix). The results obtained are not only consistent with Table 5 but also allow an insight into which group of students is affected more. We find that lower-weight female students are more affected mentally by the abolishment of the free-school-lunch policy than the other females. Similar effects of the policy abolishment can be seen for male students although they are generally affected less and insignificant at conventional levels. With respect to the reintroduction of the free-lunch policy in the following year, the results show that female students cry less without any reason and this finding is less pronounced for the lower-weight females. The corresponding regressions for male students do not lead to any conclusive results. Overall our MH regressions lend some credibility to the assertion that an indirect pathway between free-school-lunch policies and BMI measures (via mental stress) exists and that this indirect pathway is particularly important for underweight female students.

IV. Conclusion

Both our BMI regressions as well as our MH regressions suggest that free-school-lunch policies generally benefit students' health and welfare. In particular female students do profit from free-school lunch programs. The case for free-school-lunch policies is further strengthened by our analysis of different body types. Our weight specific regressions show that free lunch policies are linked to healthier outcomes. The existence of such a program leads to weight losses among overweight students (both female and male) whereas the

absence of free-school-lunches harms (female) underweight students by causing additional weight losses. It is very plausible that our weight and gender specific results are not just driven by a direct change of students' diets attributable to free school lunches. In fact, our results suggest that other pathways are simultaneously at work. The MH regressions confirm our view that stress could indirectly link free-lunch policies and students' BMI.

By and large, our analysis makes a strong point in favor of free-school-lunch policies. They provide simple and inexpensive instruments to improve student health and welfare, to benefit female students, and to create better learning environments more generally.

V. Appendix

<Table A1: Robustness Check Using Students with Lower and Upper Weight on ln(BMI)>

ln(BMI)	female (BMI percentile ≤ 25%)	female (BMI percentile > 25%)	male (BMI percentile ≤ 25%)	male (BMI percentile > 25%)
2014-2015	-0.021677	-0.013249	0.015392	-0.020719
	(0.016305)	(0.015935)	(0.016766)	(0.021758)
P>|t|	0.185	0.406	0.359	0.341
Obs	434	1,114	399	1,316
2015-2016	0.021220	0.012292	0.018690	0.000007
	(0.016774)	(0.012747)	(0.014640)	(0.019506)
P>|t|	0.207	0.335	0.203	1.00
Obs	451	1,143	402	1,396

Note: standard errors are clustered at student level and reported in parentheses. Lower weight female students generally lost weight. The male DID coefficient with students BMI greater than 25 percent close to zero insinuates that average weight students gained weight while overweight students lost weight. The same logic applies to the female DID coefficient with students BMI greater than 25 percent. However, we did not get the DID coefficient close to zero as the portion of overweight female students is smaller than the portion of overweight male students.

<Table A2: Robustness Check Using Students with Lower and Upper Weight on MH>

MH	female (BMI percentile ≤ 25%)	female (BMI percentile > 25%)	male (BMI percentile ≤ 25%)	male (BMI percentile > 25%)
2014-2015	-0.580159***	-0.401678**	-0.174461	0.146469
	(0.213240)	(0.161942)	(0.153403)	(0.140716)
P>|t|	0.007	0.013	0.256	0.298
Obs	434	1,114	399	1,316
2015-2016	0.130650	0.259139*	-0.060789	-0.029795
	(0.241997)	(0.135447)	(0.180577)	(0.119459)
P>|t|	0.59	0.056	0.737	0.803
Obs	451	1,143	402	1,396

Note: standard errors are clustered at student level and reported in parentheses.

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