Relationship between School Attendance Support and Academic Performance: An Analysis of Panel Data from Adachi Ward[*1]

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Abstract

The aim of this paper is to perform quantitative analysis about the relationships between receipt status of school financial support and student's characteristics such as academic performance, obesity, home-learning conditions, everyday attitudes towards learning, and academic performance and physical capabilities. Focusing on all pupils and students attending Adachi ward (Tokyo) public elementary schools and junior high schools, we construct panel data by linking two surveys ("The Survey on the Physical Capabilities of Pupils and Students," and the "Adachi Comprehensive Survey of Acquisition of Basic Academic Skills" (conducted from second year of elementary school until third year of middle school), which was independently conducted by Adachi ward in 2009–2017) to pupil/student name registers (list of school-age children) with information about application for and receipt of school attendance support. Even having controlled for pupils' and students' fixed-effects, the results of this analysis reveal the possibility that pupils and students who are continuous beneficiaries of public assistance may be put in circumstances with difficulties to learning. We find that, pupils and students who are not eligible for national public assistance but receive municipal school attendance support are in better conditions in terms of overall academic performance and home-learning compared to pupils and students that are continuous beneficiaries of public assistance. Regarding the relationship between academic performance and physical capabilities, it was revealed that, having controlled for pupils' and students'

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fixed-effects, there is a high probability that there is a positive correlation between physical capabilities and academic performance, and a negative correlation with obesity.

Keywords: school financial support; academic performance; obesity; home-learning conditions; everyday attitudes towards learning; physical capabilities.
JEL Classification: I21, J24

I. Introduction

Adachi ward designated 2015 the "Inaugural Year of Child Poverty Countermeasures." Recognizing it to be important that all children acquire "survival strength" to carve out their own futures, without being unduly influenced or controlled by the environments in which they have been born and raised, the ward promotes concrete projects and developments built on the three foundations of "education and learning," "health and lifestyle," and "building schemes to encourage change." Comprehensive measures to counter child poverty are being implemented as part of this endeavor, with schools as a "platform": (1) support for securing academic performance and experience; (2) providing learning environments that incorporate links with consultation systems and relevant institutions; (3) guaranteeing place to be; and (4) implementing measures focused on career support for the future.[1]

The aim of this paper is to focus on "education and learning" from amongst these three pillars and gain a statistical understanding of the actual conditions of children's upbringings (academic performance and attitudes). Accordingly, we perform quantitative analysis about the relationships between school financial support receipt status and student's characteristics such as academic performance, obesity, home-learning conditions and everyday attitudes towards learning. Focusing on all pupils and students attending Adachi ward public elementary schools and junior high schools, we construct panel data by linking pupil/student name registers (list of school-age children), information about application for and receipt of school attendance support, and two surveys, that is, "The Survey on the Physical Capabilities of Pupils and Students," and the "Adachi Comprehensive Survey of Acquisition of Basic Academic Skills" (conducted from second year of elementary school until third year of middle school), which was independently conducted by Adachi ward in 2009–2017. This study also inspects the relation between physical capabilities and academic performance, and thereby aims to gain a comprehensive understanding of processes in the upbringing of pupils and students in the stages of compulsory education, in the context of school attendance support receipt status. One characteristic feature and contribution of this paper is its use of panel data on individual pupils and students, which has not previously seen much use in Japan, to quantitatively clarify the relationships between school attendance support receipt status and

[1] Adachi ward website (https://www.city.adachi.tokyo.jp/sesaku/miraihetunaguadachipurojekuto.html) (Accessed: April 16, 2018).

a variety of indicators of upbringing, whilst controlling for pupils' and students' fixed-effects.

The results of this analysis revealed the following points. First, regarding the relationships between school attendance support receipt status and academic performance and obesity, and home-learning conditions and everyday attitudes towards learning, even having controlled for pupils' and students' fixed-effects, the results suggest that pupils and students continuously belonging to the category of beneficiaries of (national) public assistance may be placed in circumstances with difficulties to learning. Pupils and students receiving school attendance support subsidies independently implemented by the local government (who are not eligible for national public assistance but still need support) were, with statistical significance, in better condition in terms of overall academic performance and home-learning circumstances compared to pupils and students who are continuous public assistance beneficiaries. Accordingly, these measures may be offering some help for pupils and students facing economic hardship. Lastly, regarding the relationship between academic performance and physical capabilities, having controlled for pupils' and students' fixed-effects, we see a positive correlation between physical capabilities and academic performance, and observe a negative correlation between physical capabilities and obesity, but no statistically-significant correlation is observed for school attendance support status, which is a proxy variable for economic circumstance.

The research literature that is relevant to the study in this paper differs depending on whether the "school attendance support receipt status" is seen as a proxy variable for household income, or as a change in income to a low-income household. If this school attendance support receipt status is seen as a proxy variable for household income, there are countless studies that have investigated how household income is associated with indicators of upbringing such as academic performance. Particularly in Japan, there is a plethora of results of such research by educational sociologists such as Kariya (2001) and Mimizuka (2014). Our study differs greatly from this previous research in that we use panel data to comprehensively analyze relations to obesity and physical capabilities too, for instance, whilst controlling for children' fixed effects.

One example of analysis that considers relations between receipt of free or reduced-price lunches as a proxy variable for household income, academic performance, obesity home-learning conditions and everyday attitudes towards learning, is presented by Morrissey, Hutchison, and Winsler (2014). Their paper uses data concerning children from their time in kindergarten to fourth year of elementary school in Florida, in the United States, to examine the relations between information about measures for providing children from low-income households with free or reduced-price lunches, school attendance rates, and academic performance. The results reveal that the attendance rates and academic performance are relatively low for children receiving free or reduced-price lunches compared with children who do not receive free or reduced-price lunches. Whilst this study does analyze the relation between various indicators of upbringing and household income, our research differs in that we also conduct more comprehensive analysis of home-learning conditions and

everyday attitudes towards learning and, furthermore, analyze relationships to physical capabilities.

Studies from outside of Japan that examine the effects exerted on household consumption and assets by changes in income and provision of subsidies for low-income households include Fishback and Kantor (1995), Hubbard, Skinner, and Zeldes (1995), Gruber (1997), (2000), Engen and Gruber (2001), and Gruber and Yelowitz (1999). Research that focuses specifically on relations with development in terms of childrens' academic performance, physical capabilities, and so forth, includes Currie and Moretti (2008), and Hoynes and Schanzenbach (2009), for instance, which analyze results of Food Stamp Programs. Even in global terms, however, there are few studies that conduct comprehensive analysis of a variety of indicators, having considered receipt of school attendance support, such as that examined in the present paper, as signifying transfers to low-income households.

The structure of the present paper is as follows. Section II provides a simple description of the school attendance support system. Section III describes the data used in analysis. Section IV introduces the regression models used in analysis, and subsequently Section V explains the analysis results. Section VI considers the implications and limitations of the paper, and provides a conclusion.

II. School attendance support

Article 19 of the School Education Law stipulates that "municipalities shall grant necessary support to guardians of school-age pupils and students recognized as facing difficulty attending school due to economic reasons," and thus school attendance support is implemented by municipalities. The recipients of this support are: "public assistance beneficiaries" as prescribed in the Public Assistance Act; and "school attendance support beneficiaries," who are recognized by the municipal board of education to be facing a degree of hardship equivalent to public assistance beneficiaries. With Public Assistance, half of the amount needed for providing support to public assistance beneficiaries is covered by the Japanese national government using the Central Government Subsidy for Public Assistance for pupils and students requiring public assistance. Meanwhile, state subsidies for aiding school attendance support beneficiaries were abolished from 2005 following the Trinity Reform Package; local fiscal measures have been put in place, and thus this support is independently implemented by each municipality. Matters subject to this aid include lunch expenses, commuting expenses, off-campus activity expenses, medical expenses, and expenses for any items necessary for school attendance.

Table 1-1 indicates the 2016 school attendance support certification criteria in Adachi ward in and neighboring wards. The public assistance and school attendance support receipt rate for 2015 in Adachi ward is 35–40%, which is highest not only amongst neighboring wards, but across all of the 23 wards in Tokyo. The condition for certification for receipt of school attendance support is any of the following: "suspension or cessation of support based on the Public Assistance Act," "provision of childcare allowance," and "a fixed coefficient

Table 1-1. School attendance support certification criteria for Adachi Ward and neighboring wards (2016)

Municipality name	Public assistance or school attendance support receipt rate in 2015	School attendance support certification criteria														Methods for notifying about school attendance support system (multiple answers allowed)								
		(1) Suspension or cessation of support based on the Public Assistance Act	(2) Local inhabitant tax exemption	(3) Local inhabitant tax reduction	(4) National pension insurance payment exemption	(5) National Health Insurance Act payment reduction, exemption, or postponed settlement	(6) Provision of childcare allowance	(7) A fixed coefficient multiplied by the standard public assistance amount used to measure the required amount for special-assistance education attendance funds, or, the standard amount for public assistance	(8) Other	For (7): Coefficient (multiplication rate), grounds for basis, and target figure amount				Child poverty indicators		(3) Featured on Board of Education website	(4) Featured in local government publicity materials	(5) Written notice to schools	(6) Featured in school attendance guidance materials	(7) Lectures conducted for teaching staff	(8) Lectures conducted for guardians	(9) Other
										Coefficient (multiplication rate)	Grounds for basis		Target figure amount (annual)	(1) Documents distributed at schools each year at time of advancement to next grade	(2) School attendance support system documents distributed at schools at time of enrolment							
											Type, e.g. tax basis	Period for base amount											
Adachi Ward	Under 40%	○					○	○		1.1	Tax basis	Fiscal year 3 years prior	399	○	○	○	○	○	○			
Katsushika Ward	Under 30%	○					○	○	○	1.2	Other	Previous fiscal year	347	○	○	○	○	○				
Sumida Ward	Under 35%	○	○	○	○		○	○		1.2	Other	Other	400	○	○	○	○						
Arakawa Ward	Under 30%	○							○					○	○	○	○						
Kita Ward	Under 30%	○					○	○	○	1.2	Tax basis	Previous fiscal year	419	○	○		○			○			

multiplied by the standard public assistance amount used to measure the required amount for special-assistance education attendance funds, or, the standard amount for public assistance." This "standard public assistance amount times a certain coefficient" is "1.1 times the standard public assistance amount"; an applicant is certified for school attendance support if their tax basis is smaller than this threshold, and that standard is 3,990,000 yen annually. The school attendance support certification criteria include no conditions such as the "local inhabitant tax reduction or exemption" used by Sumida ward, and the standards are also lower than areas such as Sumida ward and Kita ward. Adachi ward's certification examination application procedures happen following the start of the new fiscal year in April, and certification itself happens in June–July. Note that the public assistance and school attendance support receipt rate for 2016 is 32.3% for the whole of Adachi ward (29.4% for elementary schools, 38.7% for middle schools), and although this rate has tended to decrease in recent years, it still greatly surpasses Japan's national average of 15.4% and Greater Tokyo's average of 20.5%.

As Table 1-2 indicates, in Adachi ward, guardians of elementary and middle school pupils and students receive assistance for elementary school pupils for: expenses for school supplies (fixed amount), expenses for school supplies for pupils and students entering new schools (fixed amount), commuting expenses (actual expenses), off-campus activities (varies depending on whether or not overnight accommodation is involved; fixed amount), and school club expenses. Assistance is also provided for middle school students for sports equipment expenses (up to a certain limit) and school trip expenses (fixed amount), in addition to the matters above. Note that since lunch and school trip expenses are paid for via deposit into the school principal's account, these matters are provided in kind. Insofar as Table 1-2 indicates, the amounts of assistance provided are roughly the same levels as neighboring wards, and other 23 wards across Tokyo.

In this paper, "public assistance" refers to persons requiring public assistance as stipulated in Article (6), Paragraph (2) of the Public Assistance Act, and "school attendance support" refers to persons recognized by the municipal board of education to be facing degrees

Table 1-2. Elementary and middle school attendance support certification standards for Adachi Ward and neighboring wards (2016)

Municipality name	Elementary school attendance support amount items (amounts provided annually per person)																	
	School supplies			Expenses for school supplies for pupils and students entering new schools			Commuting expenses			School trip expenses			Off-campus activities (without overnight stay)			Off-campus activities (with overnight stay)			School club expenses		
	Form of provision	Amount (Note: If ‘actual expenses,’ actual expenses amount; if ‘up to a limit,’ upper-limit amount)	Average amount provided (Note: If ‘actual expenses,’ actual expenses amount; if ‘up to a limit,’ upper-limit amount)	Form of provision	Amount (Note: If ‘actual expenses,’ actual expenses amount; if ‘up to a limit,’ upper-limit amount)	Average amount provided (Note: If ‘actual expenses,’ actual expenses amount; if ‘up to a limit,’ upper-limit amount)	Form of payment	Amount (Note: If ‘actual expenses,’ actual expenses amount; if ‘up to a limit,’ upper-limit amount)	Average amount provided (Note: If ‘actual expenses,’ actual expenses amount; if ‘up to a limit,’ upper-limit amount)	Form of payment	Amount (Note: If ‘actual expenses,’ actual expenses amount; if ‘up to a limit,’ upper-limit amount)	Average amount provided (Note: If ‘actual expenses,’ actual expenses amount; if ‘up to a limit,’ upper-limit amount)	Form of payment	Amount (Note: If ‘actual expenses,’ actual expenses amount; if ‘up to a limit,’ upper-limit amount)	Average amount provided (Note: If ‘actual expenses,’ actual expenses amount; if ‘up to a limit,’ upper-limit amount)	Form of payment	Amount (Note: If ‘actual expenses,’ actual expenses amount; if ‘up to a limit,’ upper-limit amount)	Average amount provided (Note: If ‘actual expenses,’ actual expenses amount; if ‘up to a limit,’ upper-limit amount)	Form of payment	Amount (Note: If ‘actual expenses,’ actual expenses amount; if ‘up to a limit,’ upper-limit amount)	Average amount provided (Note: If ‘actual expenses,’ actual expenses amount; if ‘up to a limit,’ upper-limit amount)
Adachi Ward	Fixed amount	19,120 (including expenses for commuting supplies, extracurricular/club activity supplies)	19,120 (including expenses for commuting supplies, extracurricular/club activity supplies)	Fixed amount	23,890	23,890	Actual expenses	12,800	12,800				Fixed amount	1,920	1,920	Fixed amount	3,810	3,810	Other		
Katsushika Ward	Fixed amount	15,400 (first year); 18,450 (second/third years); 18,660 (fourth to sixth years)	15,400 (first year); 18,450 (second/third years) 18,660 (fourth to sixth years)	Fixed amount	22,800	22,800	Actual expenses	8,489	8,489	Fixed amount	5,660 (sixth year); 4650 (special education class)	5,660 (sixth year); 4,650 (special education class)	Fixed amount	1,400 (first/second years) 2,100 (third/fourth years) 3,000 (fifth/ sixth years)	1,400 (first/second years) 2,100 (third/fourth years) 3,000 (fifth/ sixth years)						
Sumida Ward	Fixed amount	15,690 (first year); 18,880 (second to sixth years);	15,690 (first year); 18,880 (second to sixth years);	Fixed amount	23,890	23,890							Actual expenses	1,510	1,510	Other	7,400 (forest camp school) 8,370 (seaside school)	7,400 (forest camp school) 8,370 (seaside school)	Fixed amount	240	240
Arakawa Ward	Fixed amount	18,888	18,888	Fixed amount	23,890	23,890	Actual expenses	10,285	10,285				Upper-limit amount	2,120	1,388	Upper-limit amount	8,370	7,810	Upper-limit amount	240	238
Kita Ward	Fixed amount	18,880 (second to sixth years) (including expenses for commuting supplies)	18,880 (second to sixth years) (including expenses for commuting supplies)	Fixed amount	23,890	23,890	Actual expenses	5,418	5,418				Fixed amount	3,400 (fifth/ sixth years)	3,400 (fifth/ sixth years)	Fixed amount	5,365 (fourth/ fifth years)	5,365 (fourth/ fifth years)	Fixed amount	240	240

Note: School attendance support in these areas does not cover single-item commuting supplies expenses, student council fees, PTA fees, home-learning expenses (e.g., cost of purchasing textbooks)

Municipality name	Middle school attendance support amount items (amounts provided annually per person)																	
	School supplies			Expenses for school supplies for pupils and students entering new schools			Commuting expenses			School trip expenses			Off-campus activities (without overnight stay)			Off-campus activities (with overnight stay)			School club expenses			School supplies		
	Form of provision	Amount (Note: If ‘actual expenses,’ actual expenses amount; if ‘up to a limit,’ upper-limit amount)	Average amount provided (Note: If ‘actual expenses,’ actual expenses amount; if ‘up to a limit,’ upper-limit amount)	Form of provision	Amount (Note: If ‘actual expenses,’ actual expenses amount; if ‘up to a limit,’ upper-limit amount)	Average amount provided (Note: If ‘actual expenses,’ actual expenses amount; if ‘up to a limit,’ upper-limit amount)	Form of provision	Amount (Note: If ‘actual expenses,’ actual expenses amount; if ‘up to a limit,’ upper-limit amount)	Average amount provided (Note: If ‘actual expenses,’ actual expenses amount; if ‘up to a limit,’ upper-limit amount)	Form of provision	Amount (Note: If ‘actual expenses,’ actual expenses amount; if ‘up to a limit,’ upper-limit amount)	Average amount provided (Note: If ‘actual expenses,’ actual expenses amount; if ‘up to a limit,’ upper-limit amount)	Form of provision	Amount (Note: If ‘actual expenses,’ actual expenses amount; if ‘up to a limit,’ upper-limit amount)	Average amount provided (Note: If ‘actual expenses,’ actual expenses amount; if ‘up to a limit,’ upper-limit amount)	Form of provision	Amount (Note: If ‘actual expenses,’ actual expenses amount; if ‘up to a limit,’ upper-limit amount)	Average amount provided (Note: If ‘actual expenses,’ actual expenses amount; if ‘up to a limit,’ upper-limit amount)	Form of provision	Amount (Note: If ‘actual expenses,’ actual expenses amount; if ‘up to a limit,’ upper-limit amount)	Average amount provided (Note: If ‘actual expenses,’ actual expenses amount; if ‘up to a limit,’ upper-limit amount)	Form of provision	Amount (Note: If ‘actual expenses,’ actual expenses amount; if ‘up to a limit,’ upper-limit amount)	Average amount provided (Note: If ‘actual expenses,’ actual expenses amount; if ‘up to a limit,’ upper-limit amount)
Adachi Ward	Fixed amount	35,640 (including expenses for commuting supplies, extracurricular/club activity supplies)	35,640 (including expenses for commuting supplies, extracurricular/club activity supplies)	Upper-limit amount	7,510 (upper limit for judo) 51,940 (upper limit for kendo)	3,820	Fixed amount	26,860	26,860	Actual expenses	47,800	47,800	Fixed amount	57,290	57,290	Fixed amount	3,090	3,090	Fixed amount	4,270	4,270	Other		
Katsushika Ward	Fixed amount	30,400 (first year); 34,300 (second/third years)	30,400 (first year); 34,300 (second/third years)	Upper-limit amount	7,440 (upper limit for judo) 50,400 (upper limit for kendo)	4,094	Fixed amount	26,300	26,300	Actual expenses	35,637	35,637	Fixed amount	60,000	60,000	Fixed amount	600 (first year); 1,600 (second year); 3,400 (third year); 1,000(night)	600 (first year); 1,600 (second year); 3,400 (third year); 1,000(night)	Fixed amount	3,200	3,200			
Sumida Ward	Fixed amount	30,450 (first year); 34,410 (second/third years)	30,450 (first year); 34,410 (second/third years)	Upper-limit amount	7,860	4,511	Fixed amount	26,860	26,860				Upper-limit amount	69,750	57,444	Actual expenses	2,380	2,380	Other	10,290 (forest camp school) 11,840 (seaside school)	10,290 (forest camp school) 11,840 (seaside school)	Fixed amount	1,230	1,230
Arakawa Ward	Fixed amount	34,416	34,416				Fixed amount	26,860	26,860	Actual expenses	39,930	39,930	Upper-limit amount	69,750	67,327	Upper-limit amount	3,090	2,991	Upper-limit amount	7,250	6,322	Upper-limit amount	1,230	1,105
Kita Ward	Fixed amount	34,410 (second/third years) (including expenses for commuting supplies)	34,410 (second/third years) (including expenses for commuting supplies)	Upper-limit amount	7,860	3,951	Fixed amount	26,860	26,860	Actual expenses	28,879	28,879	Upper-limit amount	61,000	61,000	Fixed amount	5,200 (third year);	5,200 (third year);						

Note: School attendance support in these areas does not cover single-item commuting supplies expenses, student council fees, PTA fees, home-learning expenses (e.g., cost of purchasing textbooks)

of hardship equivalent to public assistance beneficiaries as stipulated in Article (6), Paragraph (2) of the Public Assistance Act. In some cases, a person does apply for school attendance support but is not certified; persons who applied but were not eligible to receive school attendance support expenses are referred to as "rejected applicants."

III. Data

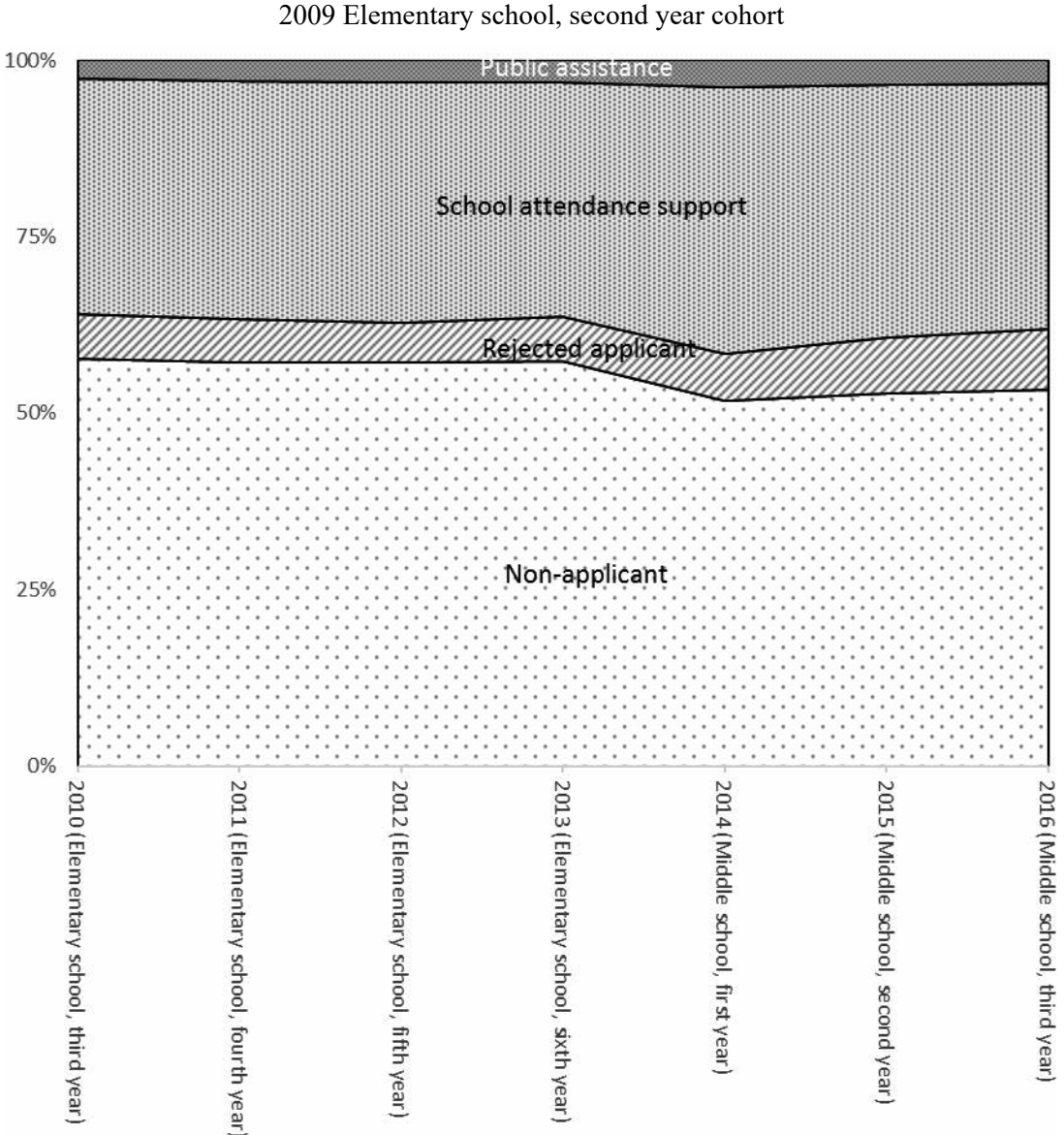
This paper focuses on all pupils and students attending Adachi ward public elementary schools and junior high schools, and uses panel data built by linking: (1) data from the "Adachi Comprehensive Survey of Acquisition of Basic Academic Skills" (hereinafter: "Adachi Basic Academic Skills Survey"; subjects from second year of elementary school to third year of middle school), which was independently conducted by Adachi ward in 2009–2017; (2) pupil/student name registers (hereinafter: "list of school-age children"); (3) data regarding application for and receipt of school attendance support; and (4) "The Survey on the Physical Capabilities of Pupils and Students" (hereinafter: "Physical Capabilities Survey"). Note, however, that the "Physical Capabilities Survey" is not yet completely linked; this paper, therefore, uses only survey results from 2015–2016. The number of observed values for each year is approximately 37,000–39,000. Please refer to Bessho et al. (2020) included in this special issue for further details of the procedures involved in creating the data.

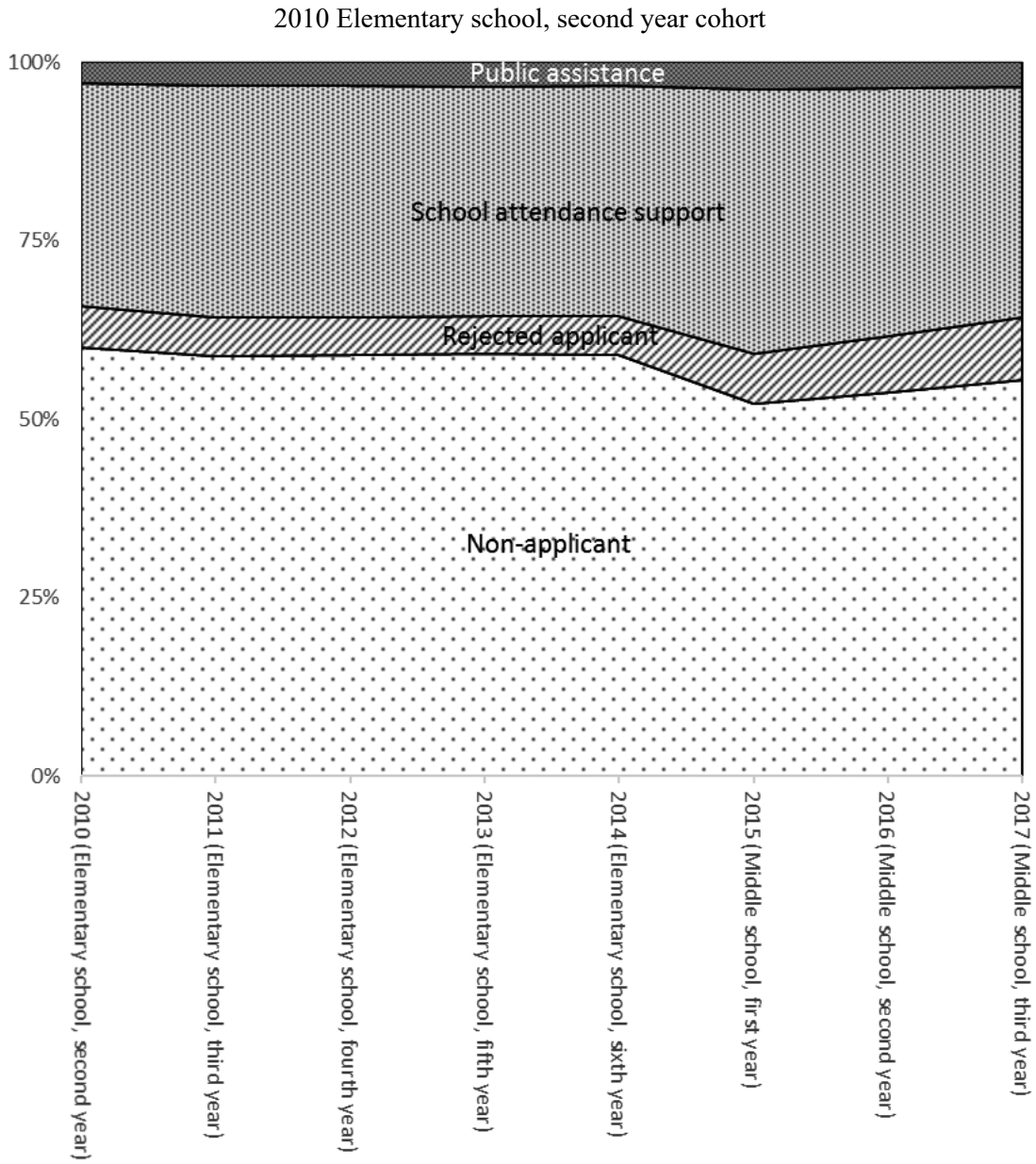
The data in this paper includes the following information. First, the Adachi Basic Academic Skills Survey includes the results of academic performance tests and attitude surveys (questionnaires) that were conducted on pupils and students. The academic performance test includes results in Japanese language arts and mathematics for elementary school pupils in their second year and above, and results in Japanese language arts, mathematics and English for middle school students (English results are included only for second- and third-year middle school students). The attitude survey acquires responses from pupils and students regarding home-learning conditions, everyday attitudes towards learning, and so forth. For instance, the Adachi ward Board of Education places emphasis on "*haya-ne, haya-oki, asa-gohan*" (literally, "early to bed, early to rise, breakfast," a motto indicating three important aspects of a child's daily life), and in order to acquire information about the circumstances of pupils and students regarding these elements, the survey poses questions on a range of dozens of items, such as "Do you eat breakfast every day?" and "Do you normally live in a regular/disciplined fashion?" Second, school attendance support status is differentiated as mentioned in the previous section, i.e. between: "public assistance" beneficiaries, referring to persons as stipulated in Article (6), Paragraph (2) of the Public Assistance Act; "school attendance support" beneficiaries, referring to persons recognized by the municipal board of education to be facing degrees of hardship equivalent to public assistance beneficiaries as stipulated in Article (6), Paragraph (2) of the Public Assistance Act; and "rejected applicants," referring to persons who applied for school attendance support but were not eligible to receive expenses. Third, the "Physical Capabilities Survey" includes: height and body weight, measurement values for grip strength, sit-ups, toe-touches, side-steps, 20m shuttle

run (beep test), 50m sprint, standing long-jump, long-distance run, and a total physical capability score calculated from these individual items.

The children who could be tracked over the longest time period from the data in this paper are those who were in the second year of elementary school in 2009 and 2010; Figure 1 shows the results of tracking the school attendance support receipt status receipt status of these children until their third year of middle school. This reveals that the school attendance support receipt rate is around 33–35% and the public assistance receipt rate around 3–4%

Figure 1. Trends in school attendance support status for 2009 and 2010 Elementary school, second year cohort





for any of the cohorts; compared with the national average school attendance support receipt rate (around 13–14%) and public assistance receipt rate (around 1.5%) for the same periods, the aid receipt rate in Adachi ward is substantially higher. Figure 1 also shows that the school attendance support receipt rate tends to discontinuously increase due to omission from the cohort of pupils that move into private education when the cohort advances to middle school.

IV. Estimation method

IV-1. School attendance support status and academic performance and obesity, and home-learning conditions and everyday attitudes towards learning

This paper uses fixed-effects models and random-effects models to quantitatively investigate the relationships between school attendance support status and academic performance, obesity, home-learning conditions, and everyday attitudes towards learning. The estimation model is as follows.

$$y_t^i = \alpha + \beta_{jk}\, s_{jkt}^i + \eta grade_t^i + \theta year + \mu_i + v_{it} \quad (1)$$

In equation (1), the dependent variable y_t^i indicates the acadeic performance, obesity, home-learning conditions, everyday attitudes towards learning of pupil or student *i* at time *t*. Point scores for Japanese, arithmetic/mathematics and English have been standardized on the basis of the average values and standard deviations for each year and grade to have an average of 50 and a standard deviation of 10, and are used as dependent variables for academic performance. For obesity, since the survey measures body weight and height, we create a "Rohrer's Index (body weight (kg) ÷ height (cm)^3×10^7)" to indicate the obesity levels of pupils and students of middle-school age and below. A Rohrer's Index of under 100 is defined as "underweight," from 100 to under 115 is defined as "slightly underweight," from 115 to under 145 as "normal," from 145 to under 160 as "slightly obese," and 160 and above as "obese." Here we make a Rohrer's Index of 160 and above into an obesity dummy vari-

Table 1. Trends in school attendance support status

s_{jk}		School attendance support status at current time (**k**)			
		Non-applicant	Rejected applicant	School attendance support	Public assistance
School attendance support status at previous time (*j*)	Non-applicant	s_{00} 136,551 (92.64)	s_{01} 4,771 (3.24)	s_{02} 5,706 (3.87)	s_{03} 371 (0.25)
	Rejected applicant	s_{10} 5,106 (36.63)	s_{11} 6,722 (48.22)	s_{12} 2,095 (15.03)	s_{13} 18 (0.13)
	School attendance support	s_{20} 2,841 (3.30)	s_{21} 5,403 (6.28)	s_{22} 77,226 (89.78)	s_{23} 550 (0.64)
	Public assistance	s_{30} 328 (4.29)	s_{31} 0 (0.0)	s_{32} 499 (6.53)	s_{33} 6,814 (89.18)

Note: The numerical values is the number of observed values; in parenthesis is the ratio (%) this is of child numbers at the previous time. Pearson chi2(9) = 4.4e+05 (Pr = 0.000)

able, and of under 100 into an underweight dummy variable, which are used as dependent variables. For home-learning conditions and everyday attitudes towards learning, we use, from the results of the attitude survey accompanying the Adachi Basic Academic Skills Survey: a response of "attends private tuition" as 1 (otherwise, 0); a response of "there is no one at home to help with study" as 1 (otherwise, 0); a response of "checks unfamiliar words in a Japanese dictionary (including eletronic dictionaries)" or "sometimes checks [...]" as 1 (otherwise, 0); and a response of "thinks of alternative solving methods in arithmetic/mathematics problems" or "usually thinks of [...]" as 1 (otherwise, 0). Regression analysis is performed individually on the above 9 dependent variables in equation (1).

Next, for the explanatory variables: s^{i}_{jkt} indicates change in school attendance support status ("non-applicant," "rejected applicant," "school attendance support", "public assistance") from the previous time (j) through to the current time (k) for pupil or student i. As shown in the Table below, "non-applicant" is expressed as 0, "rejected applicant" as 1, "school attendance support" as 2, and "public assistance" as 3. For instance: s_{00} indicates the status was previously and is still now "non-applicant," s_{01} indicates the status was previously "non-applicant" but is now "applied but rejected," s_{02} indicates the status was previously "non-applicant" but is now "school attendance support," and s_{03} indicates the status was previously "non-applicant" but is now "public assistance." In equation (1), s_{33} is treated as an omitted variable, and s_{01}–s_{32} are all added as binary variables. Note that, owing to the system requirements for school attendance support, as detailed previously, no child changes from previously (j) being "public assistance" to currently (k) being "rejected applicant," and thus s_{31} should be zero for all pupils and students. In fact, the number of observed values for s_{31} =1 was 0, and thus s_{31} is not included as an explanatory variable. Grade and year dummies have also been added.

Here, we take a 1-year lag, and look at the influence of changes in school attendance support status from the previous time (j) until the recent time (k). The Adachi Basic Academic Skills Survey is conducted each year in April, at the start of the fiscal year. School attendance support applications are submitted from each household in April, at the start of the fiscal year and, following examination, it is decided in July whether or not assistance will be provided. The status indicated in the school attendance support data refers to the time at the end of the fiscal year. If the explained variables are the results of the Adachi Basic Academic Skills Survey conducted in April 2016, for instance, then school attendance support changes from July 2015 to July 2016—i.e., when decisions are made regarding the provision/non-provision of school attendance support—will be used as the explanatory variables. Since school attendance support status decided in July 2016 reflects household circumstances in April 2016, the analysis in this paper will estimate the effects exerted on children's academic performance, obesity, and home-learning conditions by changes in school attendance support status at the time tests were conducted.

In equation (1), α, β_{jk}, γ, η, θ indicate estimated coefficients, and the term μ_i represents the children's unobservable (unobserved) attributes that do not change over time, i.e., their fixed effects. Additionally, v_{it} is a usual error term, for which $v_{it} \sim i.i.d.\ N(0, \sigma_v^2)$ is assumed.

This paper conducts estimations using fixed-effects models and random-effects models, and performs an F-test and a Durbin-Wu-Hausman test in order to select between the models. First, the F-test verifies the statistical significance of any fixed effects. Next, if the null hypothesis, in which there is no correlation between random-effects and explanatory variable x_{kit-1} is dismissed in the Durbin-Wu-Hausman test, then a fixed-effects model is preferable to a random-effects model. Since fixed-effects models were chosen in all instances in this paper, only the fixed-effects model results will be discussed hereinafter.

IV-2. Physical capabilities and academic performance

This paper also uses a fixed-effects model and a random-effects model to conduct quantitative investigation into the relation between physical capabilities and academic performance. The estimation model is as follows.

$$z_t^i=\delta+\zeta_j testscore_{jt}^i+\lambda overweight_t^i+\rho athleticclub_t^i+\sigma_k s_{kt}^i+\pi grade_t^i+\tau year+\psi_i+\varepsilon_{it} \quad (2)$$

In equation (2), z_t^i indicates the total physical capability score at time t for child i. Notably, these measurement values have all been nationally standardized according to Tokyo metropolitan government, and therefore can also be compared in time series.

For the explanatory variables: in analysis of the whole sample, $testscore_{jt}^i$ uses the standardized scores for Japanese and arithmetic/mathematics (j=1, 2). The standardized scores for English have not been included because we only have data for the second and third years of middle school, resulting in significantly lower numbers of observed values. $overweight_t^i$ is a variable that indicates tendency towards obesity using a Rohrer's Index, which calculated on the basis of height and body weight: the variable takes a value of 1 if the Index is at least 160, and 0 otherwise. $athleticclub_t^i$ is a dummy variable taking a value of 1 if a child belongs to a sports club, and a value of 0 if otherwise. The previous year's school attendance support status is included as s_{kt}^i, with "non-applicant" as an omitted variable (k =1, 2, 3). Grade and year dummies have also been added. δ, ζ_j, λ, ρ, β_k, σ, π, τ indicate estimated coefficients, and the term ψ_i represents the children's unobservable (unobserved) attributes that do not change over time, i.e., their fixed effects. Additionally, ε_{it} is a general error term, for which $\varepsilon_{it} \sim i.i.d.\ N(0, \sigma_\varepsilon^2)$ is assumed. In the same manner as with academic performance, an F-test and a Durbin-Wu-Hausman test were performed, resulting in fixed-effects being selected; the discussion in this paper therefore focuses on fixed-effects.

V. Estimation results

V-1. Summary statistics

The average values and standard deviations of the results of the Adachi Basic Academic Skills Survey and the Physical Capabilities Survey are shown by school attendance support receipt status in Table 2-1 and Table 3-1 for, respectively, elementary schoolers and middle schoolers. These Tables reveal that in all subjects—Japanese, arithmetic/mathematics, and

English—the children who have not applied for school attendance support have the highest standardized scores, followed by rejected applicants, school attendance support, and then public assistance, who each have successively lower standardized scores. For reference, the box-and-whisker plots in Figures 2-1 to 2-3 show the variation in standardized scores for each subject by school attendance support status and by school year. In the box-and-whisker plots, the top line of each box indicates the upper quartile (75%), the middle line indicates the median value, the bottom line of each box indicates the lower quartile (25%), and the tips of the whiskers indicate the maximum and minimum values. These figures show that in all academic subjects and all school years, the median standardized scores for pupils and students who have not applied for school attendance support is over 50; by contrast, the median standardized scores for public assistance beneficiary pupils and students is under 50. Moreover, the larger difference between the standardized scores of the upper 25% and the lower 25% indicates that there is great variation amongst such pupils and students.

Table 2-1. Summary statistics for academic performance, physical attributes and physical capabilities according to school attendance support receipt status (Elementary school)

Variable	School attendance support receipt status											
	Non-applicant			Rejected applicant			School attendance support			Public assistance		
	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.
1. Academic performance												
Japanese standardized score	95,997	51.56	(9.25)	7,817	49.71	(9.72)	47,928	47.90	(10.36)	4,004	43.66	(11.52)
Arithmetic standardized score	95,997	51.57	(9.16)	7,817	50.03	(9.69)	47,928	47.91	(10.44)	4,004	42.82	(11.94)
2. Physical traits and capabilities												
Body weight (kg)	23,662	32.63	(7.89)	2,131	32.87	(8.15)	10,716	33.21	(8.51)	888	34.47	(9.51)
Body weight: standardized score	23,662	49.78	(9.60)	2,131	49.53	(9.92)	10,716	50.31	(10.55)	888	52.27	(11.81)
Height (cm)	23,720	136.99	(9.24)	2,137	137.29	(9.37)	10,754	137.06	(9.32)	896	137.01	(9.84)
Height: standardized score	23,720	50.15	(9.91)	2,137	49.62	(10.04)	10,754	49.71	(10.03)	896	49.83	(10.75)
Rohrer's Index: Body weight (kg) ÷ Height (cm)^3×10^7	23,639	125.50	(17.05)	2,128	125.54	(17.39)	10,695	127.38	(18.72)	887	131.86	(20.13)
→ Underweight: Rohrer's Index of under 100	23,639	0.02	(0.13)	2,128	0.01	(0.12)	10,695	0.02	(0.13)	887	0.01	(0.11)
→ Slightly underweight: Rohrer's Index of 100–115	23,639	0.26	(0.44)	2,128	0.26	(0.44)	10,695	0.24	(0.42)	887	0.17	(0.37)
→ Normal: Rohrer's Index of 115–145	23,639	0.60	(0.49)	2,128	0.61	(0.49)	10,695	0.60	(0.49)	887	0.59	(0.49)
→ Slightly obese: Rohrer's Index of 145–160	23,639	0.07	(0.26)	2,128	0.07	(0.25)	10,695	0.08	(0.27)	887	0.14	(0.34)
→ Obese: Rohrer's Index of 160 or higher	23,639	0.04	(0.20)	2,128	0.05	(0.21)	10,695	0.06	(0.24)	887	0.09	(0.29)
Grip strength (national standardized score)	23,732	48.53	(10.80)	2,140	49.39	(11.32)	10,786	49.08	(11.04)	898	49.29	(11.41)
Sit-ups (national standardized score)	23,659	50.22	(9.98)	2,135	50.87	(10.24)	10,748	49.93	(9.89)	889	48.03	(10.34)
Toe-touches (national standardized score)	23,729	50.28	(10.93)	2,140	50.85	(10.92)	10,788	50.30	(11.01)	893	49.04	(11.42)
Side-steps (national standardized score)	23,690	48.90	(10.38)	2,135	48.93	(10.55)	10,762	47.73	(10.50)	890	45.70	(10.36)
20m shuttle run (national standardized score)	23,596	48.48	(9.67)	2,124	49.19	(9.96)	10,702	47.43	(9.64)	881	45.32	(9.14)
50m sprint (national standardized score)	23,677	49.14	(17.83)	2,132	48.90	(36.38)	10,753	48.06	(26.30)	882	45.99	(13.72)
Standing long-jump (national standardized score)	23,688	48.04	(10.73)	2,136	48.44	(10.50)	10,764	47.43	(10.80)	889	45.38	(11.27)
Total physical abilities score (national standardized score)	23,343	48.07	(10.81)	2,103	49.05	(10.76)	10,575	47.43	(10.49)	863	44.95	(10.77)

Table 3-1. Summary statistics for academic performance, physical attributes and physical capabilities according to school attendance support receipt status (Middle school)

Variable	School attendance support receipt status											
	Non-applicant			Rejected applicant			School attendance support			Public assistance		
	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.
1. Academic performance												
Japanese standardized score	51,402	51.70	(9.40)	6,124	49.80	(9.68)	38,092	48.62	(10.04)	3,637	44.98	(10.77)
Arithmetic standardized score	51,402	52.02	(9.41)	6,124	49.99	(9.58)	38,092	48.31	(9.90)	3,637	43.54	(10.18)
English standardized score	35,398	52.07	(9.63)	4,313	49.61	(9.63)	26,618	48.08	(9.81)	2,537	44.24	(9.64)
2. Physical traits and capabilities												
Body weight (kg)	12,878	47.54	(8.61)	1,705	47.90	(8.40)	8,701	47.69	(8.44)	797	49.02	(9.00)
Body weight: standardized score	12,878	49.86	(10.22)	1,705	50.08	(10.15)	8,701	49.95	(10.27)	797	51.92	(11.28)
Height (cm)	12,840	156.81	(7.58)	1,711	157.10	(7.65)	8,826	156.70	(7.48)	815	156.27	(7.53)
Height: standardized score	12,840	50.15	(9.89)	1,711	50.18	(9.94)	8,826	49.79	(10.08)	815	49.48	(10.30)
Rohrer's Index: Body weight (kg) ÷ Height (cm)^3×10^7	12,492	122.19	(16.90)	1,664	122.88	(17.10)	8,520	123.45	(17.62)	778	128.62	(22.96)
→ Underweight: Rohrer's Index of under 100	12,492	0.05	(0.22)	1,664	0.04	(0.20)	8,520	0.04	(0.21)	778	0.03	(0.17)
→ Slightly underweight: Rohrer's Index of 100–115	12,492	0.33	(0.47)	1,664	0.33	(0.47)	8,520	0.31	(0.46)	778	0.24	(0.43)
→ Normal: Rohrer's Index of 115–145	12,492	0.52	(0.50)	1,664	0.53	(0.50)	8,520	0.53	(0.50)	778	0.53	(0.50)
→ Slightly obese: Rohrer's Index of 145–160	12,492	0.07	(0.25)	1,664	0.07	(0.25)	8,520	0.07	(0.26)	778	0.13	(0.33)
→ Obese: Rohrer's Index of 160 or higher	12,492	0.03	(0.17)	1,664	0.04	(0.19)	8,520	0.04	(0.19)	778	0.07	(0.26)
Grip strength (national standardized score)	13,356	47.75	(10.29)	1,771	47.96	(10.17)	9,087	47.45	(10.37)	826	48.70	(11.11)
Sit-ups (national standardized score)	13,311	48.14	(10.37)	1,772	47.98	(10.77)	9,060	47.30	(10.61)	831	46.24	(11.26)
Toe-touches (national standardized score)	13,418	47.17	(10.27)	1,782	46.87	(10.10)	9,141	46.56	(10.11)	835	46.12	(10.42)
Side-steps (national standardized score)	13,317	46.84	(11.10)	1,768	46.63	(11.50)	9,066	45.65	(11.41)	823	43.59	(12.15)
20m shuttle run (national standardized score)	5,160	47.06	(10.24)	735	46.91	(9.83)	3,521	45.95	(10.26)	316	43.16	(10.20)
50m sprint (national standardized score)	13,056	46.27	(23.45)	1,713	45.78	(30.95)	8,893	44.95	(33.39)	812	43.54	(13.14)
Standing long-jump (national standardized score)	13,350	46.21	(11.14)	1,776	45.91	(10.83)	9,075	44.90	(11.55)	825	43.71	(11.51)
Total physical abilities score (national standardized score)	12,211	44.89	(10.30)	1,621	44.91	(10.33)	8,228	43.80	(10.34)	724	42.66	(10.71)
Long-distance run (national standardized score)	10,650	44.22	(13.52)	1,425	44.10	(13.88)	7,142	42.68	(14.76)	639	39.21	(15.93)

With regard to variables other than academic performance: the proportion of children deemed obese on the basis of the Rohrer's Index in elementary schools is 4% in the group that has not applied for school attendance support, yet tends to be higher at 9% amongst public assistance beneficiary pupils; in middle schools, too, the proportion is 3% in the group that has not applied for school attendance support, yet tends to be higher at 7% amongst public assistance beneficiary students. Furthermore, the results display low indicators for public assistance beneficiary pupils and students in all measures of physical capabilities except grip strength.

Attitude survey results are shown by school attendance support receipt status for elementary- and middle-schoolers in Table 2-2 and Table 3-2, respectively. Across all school years, private tuition attendance rates are the highest for the group that has not applied for school attendance support, followed by successively lower rates for pupils and students that were rejected applicants for school attendance support, then school attendance support pupils and students, and then public assistance pupils and students, thus showing the same trends as academic performance. Furthermore, it is clear that, in general, higher ratios of pupils and students from school attendance support and public assistance beneficiary households face concerns about home-learning. The groups that have not applied for school attendance support and households that were rejected applicants for school attendance support have better attitudes towards learning—considering, for instance, whether a child: does homework properly; continually repeats failed problems over and over again until they understand them; consolidates material learnt in class in a clear manner appropriate for themselves; is able to proactively tackle even difficult matters; checks unfamiliar words in a Japanese dictionary or *kanji* character dictionary; and thinks of alternative solving methods in mathematics problems.

Lastly, we look at lifestyle habits—e.g., whether a child: eats breakfast every day; has a regular daily routine such as sleeping early and rising early (*haya-ne haya-oki*); studies for at least two hours on weekdays; usually plays videogames for at least one hour per day;

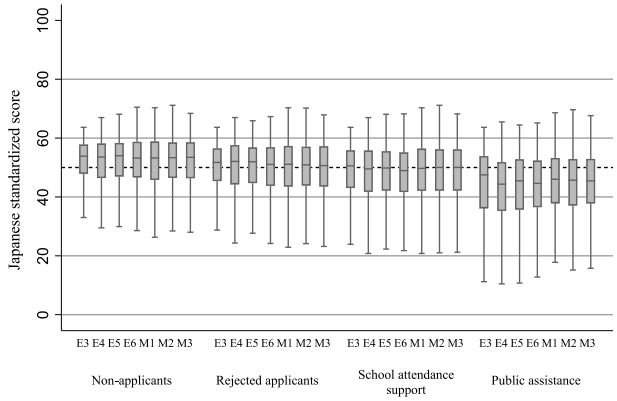
Table 2-2. Basic statistics for attributes and attitude survey results according to school attendance support receipt status (Elementary school)

Variable	School attendance support receipt status											
	Non-applicant			Rejected applicant			School attendance support			Public assistance		
	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.
3. Attributes and attitudes survey results												
Consolidates material learnt in class in clear, personal manner: "very true" or "somewhat true"	53,307	0.69	(0.46)	4,278	0.66	(0.47)	28,882	0.64	(0.48)	2,471	0.57	(0.50)
Can proactively tackle even difficult matters: "very true" or "somewhat true"	63,143	0.80	(0.40)	5,154	0.80	(0.40)	31,163	0.75	(0.43)	2,555	0.69	(0.46)
"Checks" or "sometimes checks" unfamiliar words in a Japanese dictionary (including electronic dictionaries)	65,535	0.77	(0.42)	5,958	0.74	(0.44)	31,407	0.72	(0.45)	2,645	0.68	(0.47)
"Thinks" or "usually thinks" of alternative solving methods for solved arithmetic/mathematics problems	38,319	0.69	(0.46)	3,729	0.66	(0.47)	19,276	0.63	(0.48)	1,664	0.58	(0.49)
Female	91,353	0.49	(0.50)	7,686	0.49	(0.50)	46,964	0.49	(0.50)	3,920	0.53	(0.50)
Going to school is "enjoyable" or "quite enjoyable"	95,530	0.89	(0.32)	7,791	0.88	(0.33)	47,623	0.86	(0.35)	3,968	0.83	(0.38)
School study/classes are "enjoyable" or "quite enjoyable"	95,655	0.87	(0.33)	7,797	0.86	(0.35)	47,731	0.84	(0.37)	3,974	0.81	(0.39)
Attends private tuition	89,364	0.46	(0.50)	7,322	0.35	(0.48)	44,817	0.29	(0.45)	3,739	0.24	(0.43)
Home-learning: doesn't know what or how to study	83,198	0.11	(0.31)	6,798	0.13	(0.33)	42,159	0.15	(0.36)	3,522	0.20	(0.40)
Home-learning: has no place to study	83,198	0.01	(0.11)	6,798	0.01	(0.11)	42,159	0.02	(0.14)	3,522	0.03	(0.17)
Home-learning: no one to help with study	83,198	0.03	(0.17)	6,798	0.03	(0.18)	42,159	0.05	(0.21)	3,522	0.08	(0.27)
Does homework properly: "very true" or "somewhat true"	65,138	0.95	(0.21)	4,980	0.95	(0.22)	34,208	0.93	(0.26)	2,891	0.87	(0.34)
"Definitely eats" or "mostly eats" breakfast every day	95,697	0.98	(0.15)	7,795	0.97	(0.18)	47,782	0.95	(0.22)	3,985	0.89	(0.31)
Brushes teeth morning and night: "very true" or "somewhat true"	95,523	0.97	(0.17)	7,775	0.97	(0.17)	47,636	0.97	(0.17)	3,973	0.95	(0.21)
Regular daily life, e.g. early to bed & early to rise: "very true" or "somewhat true"	71,006	0.78	(0.41)	5,526	0.78	(0.42)	37,234	0.75	(0.43)	3,121	0.69	(0.46)
Sleeps for at least eight hours during normal school time	82,564	0.85	(0.36)	6,750	0.85	(0.35)	41,733	0.85	(0.36)	3,475	0.79	(0.41)
Studies for at least one hour on weekdays	71,262	0.52	(0.50)	6,517	0.45	(0.50)	34,463	0.41	(0.49)	2,915	0.41	(0.49)
Usually plays videogames for at least 1.5 hours per day	95,720	0.30	(0.46)	7,787	0.35	(0.48)	47,737	0.37	(0.48)	3,988	0.41	(0.49)
Does not read a single book in a month	95,759	0.19	(0.39)	7,797	0.22	(0.42)	47,780	0.23	(0.42)	3,985	0.26	(0.44)
Has dreams and goals for adulthood: "very true" or "somewhat true"	80,759	0.89	(0.31)	6,780	0.90	(0.31)	40,537	0.88	(0.32)	3,410	0.86	(0.35)
Sees positive parts to self: "very true" or "somewhat true"	36,252	0.74	(0.44)	3,282	0.71	(0.45)	15,899	0.68	(0.47)	1,287	0.58	(0.49)
Proactively participates in local projects: "very true" or "somewhat true"	71,888	0.60	(0.49)	5,716	0.60	(0.49)	35,482	0.58	(0.49)	2,892	0.51	(0.50)
Member of a sports team	23,664	0.63	(0.48)	2,135	0.65	(0.48)	10,738	0.52	(0.50)	890	0.36	(0.48)

Table 3-2. Basic statistics for attributes and attitude survey results according to school attendance support receipt status (Middle school)

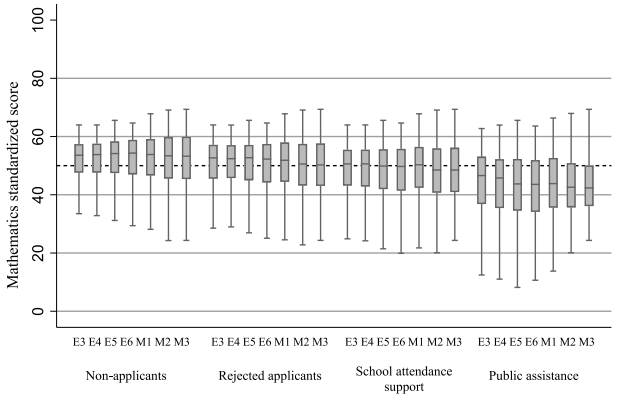
Variable	School attendance support receipt status											
	Non-applicant			Rejected applicant			School attendance support			Public assistance		
	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.
3. Attributes and attitudes survey results												
Consolidates material learnt in class in clear, personal manner: "very true" or "somewhat true"	40,075	0.61	(0.49)	4,517	0.59	(0.49)	30,908	0.56	(0.50)	2,958	0.51	(0.50)
Can proactively tackle even difficult matters: "very true" or "somewhat true"	37,926	0.67	(0.47)	4,403	0.68	(0.47)	27,740	0.64	(0.48)	2,680	0.58	(0.49)
"Checks" or "sometimes checks" unfamiliar words in a Japanese dictionary (including electronic dictionaries)	37,906	0.56	(0.50)	5,106	0.53	(0.50)	27,648	0.52	(0.50)	2,620	0.50	(0.50)
"Thinks" or "usually thinks" of alternative solving methods for solved arithmetic/mathematics problems	37,902	0.53	(0.50)	5,110	0.49	(0.50)	27,642	0.47	(0.50)	2,616	0.42	(0.49)
Female	37,955	0.48	(0.50)	5,131	0.48	(0.50)	27,659	0.49	(0.50)	2,577	0.51	(0.50)
Going to school is "enjoyable" or "quite enjoyable"	37,679	0.82	(0.38)	4,300	0.82	(0.39)	28,679	0.80	(0.40)	2,739	0.76	(0.43)
School study/classes are "enjoyable" or "quite enjoyable"	51,348	0.61	(0.49)	6,118	0.60	(0.49)	38,041	0.57	(0.49)	3,628	0.55	(0.50)
Attends private tuition	51,297	0.53	(0.50)	6,116	0.45	(0.50)	37,990	0.36	(0.48)	3,628	0.27	(0.44)
Home-learning: doesn't know what or how to study	46,037	0.43	(0.50)	5,345	0.48	(0.50)	33,788	0.50	(0.50)	3,221	0.56	(0.50)
Home-learning: has no place to study	44,696	0.02	(0.15)	5,147	0.03	(0.18)	32,594	0.03	(0.18)	3,098	0.06	(0.24)
Home-learning: no one to help with study	44,881	0.08	(0.27)	5,190	0.09	(0.29)	32,888	0.12	(0.32)	3,136	0.18	(0.38)
Does homework properly: "very true" or "somewhat true"	33,133	0.91	(0.28)	3,650	0.91	(0.28)	25,918	0.88	(0.33)	2,482	0.79	(0.41)
"Definitely eats" or "mostly eats" breakfast every day	51,359	0.95	(0.21)	6,118	0.94	(0.24)	38,049	0.92	(0.27)	3,634	0.85	(0.36)
Brushes teeth morning and night: "very true" or "somewhat true"	51,351	0.99	(0.10)	6,120	0.99	(0.10)	38,050	0.99	(0.11)	3,625	0.98	(0.13)
Regular daily life, e.g. early to bed & early to rise: "very true" or "somewhat true"	40,032	0.61	(0.49)	4,507	0.60	(0.49)	30,850	0.58	(0.49)	2,944	0.54	(0.50)
Sleeps for at least eight hours during normal school time	50,591	0.45	(0.50)	6,047	0.44	(0.50)	37,370	0.46	(0.50)	3,531	0.43	(0.50)
Studies for at least one hour on weekdays	37,916	0.61	(0.49)	5,105	0.55	(0.50)	27,644	0.50	(0.50)	2,617	0.46	(0.50)
Usually plays videogames for at least 1.5 hours per day	51,349	0.43	(0.49)	6,118	0.46	(0.50)	38,041	0.48	(0.50)	3,625	0.53	(0.50)
Does not read a single book in a month	51,369	0.28	(0.45)	6,123	0.31	(0.46)	38,062	0.30	(0.46)	3,631	0.31	(0.46)
Has dreams and goals for adulthood: "very true" or "somewhat true"	51,335	0.77	(0.42)	6,117	0.78	(0.42)	38,037	0.78	(0.42)	3,624	0.77	(0.42)
Sees positive parts to self: "very true" or "somewhat true"	18,109	0.63	(0.48)	2,457	0.62	(0.48)	12,005	0.59	(0.49)	1,134	0.52	(0.50)
Proactively participates in local projects: "very true" or "somewhat true"	37,925	0.37	(0.48)	4,403	0.38	(0.48)	27,740	0.36	(0.48)	2,679	0.33	(0.47)
Member of a sports team	13,391	0.62	(0.49)	1,776	0.65	(0.48)	9,120	0.58	(0.49)	831	0.47	(0.50)

Figure 2-1. Japanese standardized score: Grade and school attendance support receipt status



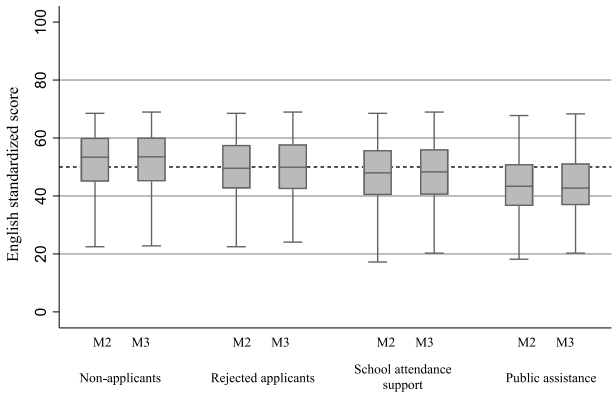
(Source) Adachi Comprehensive Survey of Acquisition of Basic Academic Skills, 2010-2017

Figure 2-2. Mathematics standardized score: Grade and school attendance support receipt status



(Source) Adachi Comprehensive Survey of Acquisition of Basic Academic Skills, 2010-2017

Figure 2-3. English standardized score: Grade and school attendance support receipt status



(Source) Adachi Comprehensive Survey of Acquisition of Basic Academic Skills, 2010-2017

sleeps for at least eight hours during normal school time. Here, largely the same results were obtained as with attitudes towards learning: groups that have not applied for school attendance support and pupils and students from households that were rejected applicants for school attendance support tended to have more favorable lifestyle habits.

V-2. Estimation results

V-2-1. School attendance support status and academic performance, obesity, home-learning conditions and everyday attitudes towards learning

Table 4 shows estimation results for equation (1). As defined in the previous section, school attendance support status is a proxy variable for household economic circumstance. Accordingly, s_{00} (non-applicant → non-applicant), s_{11} (rejected applicant → rejected applicant), s_{22} (school attendance support → school attendance support), and s_{33} (public assistance → public assistance) imply no change in economic circumstances. Meanwhile, s_{01} (non-applicant → rejected applicant), s_{02} (non-applicant → school attendance support), s_{03} (non-applicant → public assistance), s_{12} (rejected applicant → school attendance support), s_{13} (rejected applicant → public assistance), and s_{23} (school attendance support → public assistance) signify a relative worsening in economic circumstances. Further, s_{10} (rejected applicant → non-applicant), s_{20} (school attendance support → non-applicant), s_{21} (school attendance support→ rejected applicant), s_{30} (public assistance → non-applicant), and s_{32} (public assistance → school attendance support) are considered to imply improvement in economic circumstances.

Now, taking s_{33} (public assistance → public assistance) as a reference, let us look at the relationship between the dependent variables and these changes in economic circumstance. First, looking at cases of no change in economic circumstances (s_{00}, s_{11}, s_{22}): for case s_{00}, considered to have the most favorable economic circumstances, the standardized score for Japanese is around 0.5 higher at a 5% significance level, the probability of private tuition at-

Table 4. Estimation results: school attendance support status, academic performance and obesity, home-learning conditions and everyday attitude towards learning (Fixed-effects model)

Definition of variable		(1) Japanese standardized score	(2) Arithmetic/ mathematics standardized score	(3) English standardized score	(4) Rohrer's Index of 160 or higher (obese)	(5) Rohrer's Index of under 100 (underweight)	(6) Private tuition attendance	(7) Home learning (no one at home to help with study)	(8) Checks unfamiliar words in Japanese/ *kanji* dictionaries	(9) Thinks of alternative solving methods in mathematics problems
Non-applicant→Non-applicant	(S_{00})	0.478**	0.274	0.363	-0.014	0.021	0.046***	-0.032***	0.002	0.058**
		(0.233)	(0.229)	(0.745)	(0.023)	(0.023)	(0.017)	(0.009)	(0.024)	(0.029)
Non-applicant→Rejected applicant	(S_{01})	0.384	0.343	0.495	-0.012	0.015	0.026	-0.028***	-0.007	0.047
		(0.251)	(0.246)	(0.771)	(0.023)	(0.023)	(0.018)	(0.010)	(0.025)	(0.031)
Non-applicant→School attendance support	(S_{02})	0.415*	0.259	0.593	-0.023	0.014	0.021	-0.021**	-0.013	0.054*
		(0.239)	(0.235)	(0.738)	(0.022)	(0.022)	(0.017)	(0.010)	(0.024)	(0.030)
Non-applicant→Public assistance	(S_{03})	0.256	-0.614	0.545	0.031	0.096***	-0.010	0.014	-0.039	0.064
		(0.365)	(0.358)	(0.851)	(0.027)	(0.027)	(0.026)	(0.015)	(0.035)	(0.043)
Rejected applicant→Non-applicant	(S_{10})	0.423*	0.239	0.655	-0.014	0.015	0.027	-0.025**	0.011	0.048
		(0.245)	(0.241)	(0.748)	(0.023)	(0.023)	(0.018)	(0.010)	(0.024)	(0.030)
Rejected applicant→Rejected applicant	(S_{11})	0.460*	0.190	0.619	-0.021	0.011	0.023	-0.012	-0.003	0.042
		(0.247)	(0.243)	(0.756)	(0.023)	(0.023)	(0.018)	(0.010)	(0.025)	(0.030)
Rejected applicant→School attendance support	(S_{12})	0.626**	0.499*	0.788	-0.012	0.012	0.019	-0.023**	0.024	0.066**
		(0.264)	(0.259)	(0.764)	(0.023)	(0.023)	(0.019)	(0.011)	(0.026)	(0.031)
Rejected applicant→Public assistance	(S_{13})	-1.365	-1.302	0.567	-0.002	0.001	-0.078	0.215***	-0.109	-0.009
		(1.478)	(1.452)	(2.661)	(0.093)	(0.093)	(0.111)	(0.066)	(0.127)	(0.151)
School attendance support→Non-applicant	(S_{20})	0.031	-0.072	1.077	-0.006	0.017	-0.016	-0.021**	-0.034	0.023
		(0.257)	(0.252)	(0.757)	(0.023)	(0.023)	(0.018)	(0.011)	(0.025)	(0.031)
School attendance support→Rejected applicant	(S_{21})	0.113	0.230	0.760	-0.015	0.006	0.036**	-0.011	0.008	0.052*
		(0.241)	(0.237)	(0.731)	(0.022)	(0.023)	(0.017)	(0.010)	(0.024)	(0.029)
School attendance support→School attendance support	(S_{22})	0.409*	0.128	0.878	-0.009	0.002	0.010	-0.017*	0.009	0.051*
		(0.224)	(0.220)	(0.710)	(0.022)	(0.022)	(0.016)	(0.009)	(0.023)	(0.028)
School attendance support→Public assistance	(S_{23})	-0.107	-0.009	-0.248	0.009	0.003	0.021	-0.025*	0.045	0.049
		(0.304)	(0.299)	(0.675)	(0.020)	(0.020)	(0.022)	(0.013)	(0.029)	(0.035)
Public assistance→Non-applicant	(S_{30})	-0.163	-0.379	0.107	0.031	-0.007	0.053*	0.011	-0.059	-0.027
		(0.438)	(0.430)	(1.020)	(0.028)	(0.028)	(0.032)	(0.018)	(0.040)	(0.051)
Public assistance→School attendance support	(S_{32})	0.500	-0.114	0.695	0.020	0.014	0.002	0.002	0.001	0.044
		(0.313)	(0.308)	(0.611)	(0.021)	(0.021)	(0.022)	(0.013)	(0.028)	(0.033)
Constant		49.216***	49.473***	49.530***	0.061***	0.019	0.362***	0.077***	0.692***	0.579***
		(0.247)	(0.242)	(0.713)	(0.022)	(0.022)	(0.018)	(0.010)	(0.023)	(0.030)
Observations		223,245	223,245	47,327	60,803	60,803	212,575	194,013	173,502	130,933
F test that all u_i=0		10.9	11.3	11.13	5.1	3.08	3.92	1.7	2.27	2.28
Prob>F		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Durbin-Wu-Hausman test (Chai)		1820.040	2045.930	390.790	52.420	29.910	1206.260	324.370	2091.290	141.070
Prob>chi2		0.000	0.000	0.000	0.000	0.071	0.000	0.000	0.000	0.000
Number of ID_all		55,527	55,527	26,323	36,642	36,642	55,264	54,843	55,153	49,092

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Gender dummy, school year dummy, and year dummy have been controlled for in all regression analysis

tendance increases by around 5 percentage points at a 1% significance level, and the proportion of affirmative responses to "thinks of alternative solving methods in mathematics problems" increases by 6 percentage points at a 5% significance level. Furthermore, ratio that responded "there is no one at home to help with study" is 3 percentage points lower at a 1% significance level. Meanwhile, for pupils and students that continue to be ineligible for provision of school attendance support expenses by local government despite having applied (s_{11}), the standardized score for Japanese increased by around 0.5 at a 10% significance level, but no improvements were found in any other circumstances. In fact, whilst the statistical significance level is not particularly robust at 10%, for pupils and students continuously receiving support from local government (s_{22}) the standardized score for Japanese and the ratio of affirmative responses to "thinks of alternative solving methods in mathematics problems" tended to be higher, at around 0.4 points and 5 percentage points respectively, and the ratio that responded "there is no one at home to help with study" is 2 percentage points lower.

Next, let us consider cases in which economic circumstances appear to have worsened. First are cases of worsening from the state of not having applied school attendance support (s_{01}, s_{02}, s_{03}). With s_{03}, the greatest change in circumstances, the ratio of "underweight"

Rohrer's Index of under 100 increases by 9.6 percentage points at a 1% significance level. Meanwhile, with s_{01} and s_{02}, the probability that "there is no one at home to help with study" decreases by 2.8 and 2.1 percentage points, respectively. With s_{02}, standardized scores for Japanese increase by 0.4 at a 10% significance level, and the ratio that responded "thinks of alternative solving methods in mathematics problems" increases by 5.4 percentage points at a 10% significance level. Looking now at changes from the state of rejected applicant (s_{12}, s_{13}): for pupils and students that changed from rejected applicant to school attendance support (s_{12}), standardized scores for Japanese increased by around 0.6 at a 5% significance level, and standardized scores for arithmetic/mathematics increased by around 0.5 at a 10% significance level. Additionally, with these pupils and students, the probability that "there is no one at home to help with study" decreases by 2 percentage points, and the ratio that responded "thinks of alternative solving methods in mathematics problems" also increased by around 7 percentage points, at a 5% significance level. Meanwhile, for s_{13}, in which economic circumstances have worsened considerably, whilst no statisticallysignificant differences in standardized scores were observed, standardized scores for Japanese and arithmetic/mathematics tended to be lower, and the probability that "there is no one at home to help with study" decreased considerably by around 22 percentage points at a 1% significance level, implying greater difficulties in home-learning. Lastly, for cases of changes from school attendance support (s_{23}), in the same manner as with s_{13}, no statistically significant results were observed for standardized scores, but standardized scores for Japanese, arithmetic/mathematics and English all tended to be lower, and the probability that "there is no one at home to help with study" decreases by around 3 percentage points at a 10% significance level.

Lastly, let us look at cases of improvement in economic circumstances. For improvement from rejected applicant (s_{10}), standardized scores for Japanese increased by around 0.4 at a 10% significance level, and the probability that "there is no one at home to help with study" decreased by 3 percentage points at a 5% significance level. Next, looking at changes from school attendance support (s_{20}, s_{21}): with s_{20}, the probability that "there is no one at home to help with study" decreases by 2 percentage points at a 5% significance level. For s_{21}, though not measured with statistical significance, standardized scores tended to be higher in all academic subjects, the private tuition attendance rate increased by 4 percentage points at a 5% significance level, and the proportion that responded with "thinks of alternative solving methods in mathematics problems" increased by around 5 percentage points at a 10% significance level. For change from public assistance (s_{30}, s_{32}), although a great improvement in economic circumstances would be surmised with s_{30}, the private tuition attendance rate may have increased by around 5 percentage points at a 10% significance rate, but no other statistically significant relationship was observed.

V-2-2. Physical capabilities and academic performance

Table 5 shows the results of equation (2) estimated for the whole sample, for girls, and for boys respectively. Let us first look at academic performance. Statistically significant positive

values were obtained for all standardized scores, except female scores in Japanese; accordingly, there is considered to be a positive correlation between physical capabilities and academic performance. Meanwhile, the dummy variable indicating obesity—i.e., a Rohrer's Index of 160 or higher—had statistically significant negative values in all estimation formulas; it is therefore highly likely that there is a negative correlation between physical capabilities and obesity. Additionally, a positive correlation was observed between sports team membership and physical capabilities. However, no statistically significant correlation was observed with the proxy variable for economic circumstances, i.e. school attendance support status. Further, since the coefficients for academic performance, obesity and sports team membership—i.e., those which yielded statistically significant results—are more prominent for males than for females, there may be a gender difference in the correlations between this group of variables and physical capabilities.

Table 5. Estimation results: physical capabilities and academic performance (fixed-effects model)

Definition of variable	(1) All	(2) Female	(3) Male
Japanese standardized score	0.021***	0.013	0.029***
	(0.006)	(0.009)	(0.008)
Arithmetic/mathematics standardized score	0.059***	0.051***	0.065***
	(0.006)	(0.009)	(0.009)
Rohrer's Index 160 or higher (obese)	-1.902***	-1.832***	-2.280***
	(0.264)	(0.358)	(0.386)
Member of sports team	0.750***	0.621***	0.789***
	(0.089)	(0.118)	(0.133)
Rejected applicant	-0.016	-0.040	0.050
	(0.184)	(0.247)	(0.271)
School attendance support	0.164	0.064	0.317
	(0.189)	(0.256)	(0.277)
Public assistance	-0.235	0.044	-0.895
	(0.563)	(0.684)	(0.952)
Constant	41.046***	42.591***	39.756***
	(0.424)	(0.614)	(0.584)
Observations	57,382	28,873	28,509
R-squared	0.054	0.045	0.079
Number of ID_all	35,565	17,746	17,819

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Gender dummy, school year dummy, and year dummy have been controlled for in all regression analysis

VI. Conclusion

In this paper, we performed quantitative analysis about the relationships between school attendance support receipt status and academic performance and obesity, home-learning conditions and everyday attitudes towards learning, and between physical capabilities and academic performance. This analysis was conducted through simple fixed-effects models, focusing on all pupils and students attending Adachi ward public elementary schools and junior high schools, and using panel data built by linking pupil/student name registers (list of school-age children), information about application for and receipt of school attendance support, and "The Survey on the Physical Capabilities of Pupils and Students," and the "Adachi Comprehensive Survey of Acquisition of Basic Academic Skills" (conducted from second year of elementary school until third year of middle school), which was independently conducted by Adachi ward in 2009–2017. Taking continuous beneficiaries of public assistance as a control group, and even having controlled for pupils' and students' fixed-effects, the results of this analysis reveal that: with the shift considered to be the most extreme worsening of economic circumstances, namely from non-applicant to public assistance, the ratio of "underweight" children increases, and the academic performance and home-learning conditions of other groups tends to be better, suggesting the possibility that public assistance beneficiary pupils and students are left in circumstances that are difficult in terms of learning. Pupils and students who receive school attendance support independently implemented by municipalities are identified, with statistical significance, to be in better conditions in terms of overall academic performance and home-learning compared to pupils and students that are continuous beneficiaries of public assistance. Thus, the measures in question may be serving a certain function for pupils and students facing economic hardship. Regarding the relationship between academic performance and physical capabilities, it was revealed that, having controlled for pupils' and students' fixed-effects, there is a high probability that there is a positive correlation between physical capabilities and academic performance, and a negative correlation with obesity.

There are many limitations to this paper, and many issues for the future. Firstly: the results in this paper are, ultimately, observations of "correlations"; any causal relations, including any mechanisms thereof, have yet to be distinguished and analyzed. Since the data used in this paper is administrative data, it is difficult to control influence from unobserved factors in household attributes such as family structure, and income, assets, education levels and so forth. For example: with a shift from public assistance to school attendance support non-applicant, where it would be expected that household economic circumstances have probably improved to a considerable degree, when little improvement is seen in academic performance, home-learning conditions, everyday attitudes towards learning, and so forth, there is thought to be influence from some unobservable factors. One possibility here is that, following great changes in family structure and attributes due to, e.g., the parents' divorce, the observed trends may be the result of a child's circumstances being more affected by

these other such factors, rather than by economic improvements. Otherwise, it may be difficult for the attitudes and behaviors of the family or the child themselves to change, regardless of economic improvement, once they require public assistance. Additionally, further analysis is needed regarding academic performance and physical capabilities, namely into: why standardized scores, particularly standardized scores in arithmetic/mathematics show a statistically significant positive correlation with physical capabilities; whether there is any causal relation between the two; and what sort of mechanisms are behind this phenomenon.

Second, and relatedly: since the results obtained in this paper cannot specify any causal relations, it is difficult to clearly define policy implications regarding school attendance support, in particular. For example, the results show: a positive association between considerable worsening of a household's economic circumstances (non-applicant → public assistance) and a child being "underweight"; and difficulties arising in home-learning conditions for cases of rejected applicant → public assistance, but can specify no causality for either phenomenon. The results are not robust in many areas: the statistical significance of correlations with school attendance support status, for instance, changes depending on academic subject. Nonetheless, the results obtained by this study suggest the possibility that: school attendance support measures by local government are serving a certain function for pupils and students facing economic hardship; and it may be important that education conducted in public elementary and middle schools be well-balanced between both academic performance and physical capabilities.

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