

Educational Disparity in Drinking and Smoking in Japan for 2013–2019: a Cross-sectional Study

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Abstract

Background

In Japan, studies of the relationship between drinking and educational background have not been as advanced as smoking studies, while Japan has extremely easy access to alcohol on a global level. We divided Japanese adults by drinking status, educational background, age, and gender, and analyzed the relationship, comparing to smokers' data for reference.

Methods

Data were drawn from the Comprehensive Survey of Living Conditions (2013: 191,973 men, 214,815 women; 2016: 176,969 men, 196,181 women; 2019: 167,276 men, 183,963 women). We classified them as current drinkers, binge drinkers, current smokers, and heavy smokers. Drinking and smoking prevalence were analyzed by disparity indices, including rate difference, rate ratio, between-group variance, and slope index of inequality.

Results

We found that higher positive estimates of educational disparity indices were among younger drinkers and got lower by aging. Surprisingly, among current drinkers, we also revealed women aged 45-94 had a negative estimate of an educational disparity index, while men aged 45-94 had negative one moving in a positive direction.

Conclusions

Education has a certain effect in preventing drinking, but the effect is so small among middle-aged and elderly people that other factors easily contribute to the phenomenon that those with a high education drink more than those with a low education. We estimated one of the factors is that many elderly women, who were high-educated and often forced to drink in accordance with women's empowerment, are still alive and keep drinking. Further observation is needed to confirm it or reveal other factors.

Introduction

Alcohol use is a risk factor for larynx, pharynx, oral, liver, colon, and breast cancer. The World Health Organization reported that alcohol-attributable deaths accounted for 5.3% of all deaths. [1] Although drinking a small amount may help prevent ischemic heart disease and diabetes, a recent study concluded that the most desirable alcohol consumption to minimize health risk is zero. [2] We are interested in Japanese drinkers' characteristics and the changes over time, because Japan is most tolerant of drinking on a global level. [3]

Harper S et al. analyzed the relationship between educational disparity and harmful behaviors. [4] It revealed that educational background was differently associated with harmful behaviors, some of which people with a high education tended to do. However, the study lacked gender and age analysis. Tabuchi T et al. reported the trend was apparently stronger in young smokers than in old smokers, in cross-sectional study. [5] On the other hand, there are no study about drinkers and their educational background by sufficient analysis in Japan.

Therefore, our purpose was to reveal how differently their educational background were related to drinking by gender and age, in comparison with smoking analysis. We conducted the study in two phases. First, drinking prevalence in 2019 was analyzed by some disparity indices and we tried to find the trend. Second, drinking prevalence for 2013-2019 was analyzed by slope index of inequality (SII), and we tried to find the change over time and some interpretations of it.

Methods

Study population

We used the data from the Comprehensive Survey of Living Conditions (CSLS) that was conducted by the Japan Ministry of Health, Labor and Welfare in 2013, 2016 and 2019. In total, 234,383 households responded in 2013, [6] 224,208 in 2016, [7] and 227,279 in 2019. [8] Figure 1 shows the flowchart of the sample data selection. Detailed number of participants is shown in S1 Table.

Educational level

The survey offered six response options for participants' education level: (1) junior high school, (2) high school, (3) technical college, (4) 2-year college, (5) 4-year university, and (6) graduate school. Many previous studies deal with educational background capable of being ranked like high-educated or low-educated. [9–12] However, we did not use those categories because the education background was completely different from the past. [13] It is difficult to apply the same educational categories to all generations, especially when very old participants are involved in the study. Therefore, we analyzed educational background as an ordinal variable, rather than as ranked group or years of schooling.

Drinking definition

The definition of binge drinking differs among counties and across time. Therefore, we adopted the definition used by Health Japan 21, which classifies binge drinking as drinking more than about 60 g/day of pure alcohol. [14] The survey offered eight response options for drinking frequency: (1) "every day," (2) "5–6 days/week," (3) "3–4 days/week," (4) "1–2 days/week," (5) "1–3 days/month," (6) "hardly ever," (7) "stopped drinking," and (8) "can't drink." In addition, there were six options for daily alcohol consumption: (a) "179 ml or less (converted to 15% alcohol content beverage)," (b) "180–359 ml," (c) "360–539 ml," (d) "540–719 ml," (e) "720–899 ml," and (f) "900 ml or more." Therefore, we classified binge drinkers as those who chose options (1) and (d)–(f), and (2) and (f). In this way, we extracted binge drinkers from the group who drank 5–7 days/week. We defined the group who drank 5–7 days/week as current drinkers, even if their alcohol consumption were unclear.

Smoking definition

We defined those who smoked more than 20 cigarettes each day as heavy smokers. The definition of current smokers was daily and occasional smokers, even if their cigarettes consumption were unclear. The survey offered four response options for smoking: (1) "I smoke every day," (2) "I sometimes smoke," (3) "I haven't been smoking for more than a month," and (4) "I've never smoked." Those who chose options (1) or (2) were considered current smokers.

Statistical analysis

We calculated the current drinking prevalence (percentage of current drinkers), binge drinking prevalence (percentage of binge drinkers among current drinkers), current smoking prevalence (percentage of current smokers), and heavy smoking prevalence (percentage of heavy smokers among daily smokers) by educational background, gender, and age.

The indices used in this study were rate difference (RD), rate ratio (RR), between-group variance (BGV), and SII. RD is the difference between the maximum and minimum values, and RR is the ratio between these values. BGV is the variance based on each groups' point estimate and population.

In this study, we used SII to see the change of educational disparity in drinking. SII is a slope of the regression line drawn from low ranked groups to high ranked groups, which is based on each group's point estimate and population. If a SII, including the confidence interval (CI), is positive, it indicates the trend that people with a low education drink or smoke more than those with a high education. A negative SII (including the CI) means the opposite. SII is recommended to quantify health inequalities. [15] Detailed explanation of SII is in S1 Fig.

We did not calculate the point estimates of disparity indices in the groups with fewer than 100 persons, because RD and RR are sensitive to such small population. When the confidence level is 95% and point estimate is 50%, a sample size of 100 can be used to determine a confidence interval of $\pm 10\%$. [16]

It is already reported that aging weakens the relationship between smoking and educational background. [5] The purposes of these indices were to examine what trend was in drinking and how it changed for 6 years. These indices were calculated by HD*Calc Version 2.0.0. [17]

In this study, the young group represented people aged 25–44 years, and the middle-aged and elderly group represented those aged 45–94 years, because we emphasized the quality of education at that time. The reason we set 45 years old as the cutoff point is that the major changes in Japanese traditional severe education occurred in the early 1980s.

Results

First, we calculated educational disparity indices for current drinkers, binge drinkers, current smokers, and heavy smokers, and the result in 2019 is presented in Table 1. The materials for the calculation are in S2-5 Tables and the results in other years are in S6-9 Tables.

Table 1
Educational disparity indices of drinking and smoking by gender and age in 2019.

Disparity Indices of current drinkers, 2019								
		25-34	35-44	45-54	55-64	65-74	75-84	85-94
Men	RD	13.0(16.5,9.5)	10.1(13.3,6.9)	11.9(15.4,8.4)	10.0(13.5,6.5)	11.5(15.6,7.4)	4.8(10.0,-0.4)	9.3(19.7,-1.1)
	BGV	6.1(8.9,3.3)	6.3(8.9,3.6)	6.9(9.7,4.1)	7.7(10.8,4.6)	4.0(6.1,1.9)	1.9(3.9,0.0)	2.0(5.5,-1.6)
	RR	2.2(2.7,1.8)	1.4(1.6,1.3)	1.4(1.6,1.3)	1.3(1.4,1.2)	1.3(1.5,1.2)	1.1(1.3,1.0)	1.4(2.2,0.9)
	SII	7.5(5.6,9.4)	8.9(7.0,10.9)	9.0(7.1,11.0)	8.3(6.2,10.4)	-0.9(-2.9,1.1)	-4.6(-7.0,-2.1)	-3.0(-7.0,0.9)
Women	RD	10.3(12.9,7.7)	6.3(9.7,2.9)	6.4(11.1,1.7)	3.5(5.6,1.4)	5.1(6.7,3.5)	2.0(3.8,0.2)	2.7(5.9,-0.5)
	BGV	4.3(6.1,2.5)	2.8(4.0,1.5)	2.1(3.2,0.9)	0.6(1.2,-0.1)	1.5(2.3,0.7)	0.4(0.8,0.1)	0.4(0.9,-0.1)
	RR	3.9(5.2,3.0)	1.7(2.4,1.3)	1.5(1.9,1.2)	1.3(1.5,1.1)	1.6(1.9,1.4)	1.5(2.0,1.1)	2.1(3.9,1.1)
	SII	5.7(4.4,6.9)	5.9(4.5,7.3)	3.9(2.4,5.3)	-1.2(-2.7,0.3)	-4.5(-5.7,-3.3)	-2.5(-3.5,-1.4)	-2.3(-3.5,-1.0)
Disparity Indices of binge drinkers, 2019								
Men	RD	20.1(28.6,11.6)	20.8(26.2,15.4)	18.1(22.7,13.5)	9.1(12.9,5.3)	3.7(6.9,0.5)	1.3(2.5,0.1)	2.0(3.1,0.9)
	BGV	28.3(44.0,12.7)	24.3(33.5,15.1)	14.2(19.7,8.7)	3.5(5.6,1.4)	0.5(1.1,-0.1)	0.3(0.8,-0.2)	0.4(1.1,-0.2)
	RR	3.0(5.5,1.7)	2.6(3.5,1.9)	2.8(3.8,2.0)	2.2(3.5,1.5)	1.9(4.0,0.9)	1.5(2.3,1.0)	0.0(0.0,0.0)
	SII	18.1(12.9,23.2)	17.1(13.9,20.3)	12.9(10.3,15.5)	6.5(4.4,8.5)	2.3(0.8,3.8)	1.7(0.1,3.3)	2.3(0.2,4.5)
Women	RD	8.5(13.7,3.3)	27.1(35.3,18.9)	16.8(23.1,10.5)	6.0(10.5,1.5)	1.5(3.8,-0.8)	N/A	N/A
	BGV	12.9(29.5,-3.6)	30.1(45.2,15.1)	14.9(22.1,7.6)	1.6(3.5,-0.2)	0.2(0.9,-0.4)	N/A	N/A
	RR	2.0(3.3,1.2)	4.4(6.3,3.1)	4.0(6.0,2.6)	2.8(5.1,1.5)	1.7(4.2,0.7)	N/A	N/A
	SII	13.1(4.6,21.6)	17.4(13.2,21.5)	13.6(10.5,16.6)	4.6(2.2,6.9)	1.8(-0.3,3.9)	N/A	N/A
Disparity Indices of current smokers, 2019								
Men	RD	47.1(43.2,51.0)	39.5(42.6,36.4)	40.3(43.4,37.2)	31.6(34.7,28.5)	17.9(20.6,15.2)	4.9(8.8,1.0)	2.8(6.1,-0.5)
	BGV	104.7(117.9,91.5)	103.1(113.8,92.4)	85(94.1,75.9)	54.8(62.2,47.5)	14.4(17.5,11.3)	1.4(2.4,0.4)	0.2(0.9,-0.4)
	RR	4.5(5.3,3.8)	3.7(4.2,3.2)	4.0(4.7,3.5)	3.6(4.3,2.9)	3.0(4.2,3)	1.7(3.1,1)	1.8(4.9,0.7)
	SII	36.1(33.7,38.4)	36.3(34.3,38.3)	33.3(31.4,35.2)	27.0(25.1,28.9)	13.1(11.5,14.7)	3.8(2.2,5.3)	0.7(-1.5,2.9)
Women	RD	34.7(38.5,30.9)	39.4(42.9,35.9)	34.6(37.8,31.4)	17.1(19.7,14.5)	3.8(4.6,3.0)	1.8(2.4,1.2)	1.8(3.6,0.0)
	BGV	55.0(63.3,46.8)	66.2(73.7,58.8)	48.7(54.3,43.1)	11.0(13.2,8.8)	1.3(1.8,0.8)	0.3(0.5,0.1)	0.1(0.1,0.0)
	RR	21.4(47.7,9.6)	16.8(28.9,9.7)	10.4(12.2,8.8)	15.3(61.2,3.8)	2.2(2.7,1.8)	3.3(6.6,1.6)	0.0(0.0,0.0)
	SII	23.7(22.1,25.2)	26.4(25.1,27.7)	23.1(21.9,24.4)	11.7(10.5,12.8)	3.5(2.6,4.4)	1.8(1.1,2.5)	-0.2(-0.8,0.5)
Disparity Indices of heavy smokers, 2019								
Men	RD	8.9(13.7,4.1)	13(17.1,8.9)	18.5(24.4,12.6)	2.7(5.5,-0.1)	4.9(11.1,-1.3)	0.9(5.5,-3.7)	N/A
	BGV	5.2(8.6,1.8)	11.4(16.2,6.5)	12.4(18.0,6.9)	1.4(3.5,-0.6)	1.0(3.0,-1.1)	0.1(2.3,-2.1)	N/A
	RR	2.3(4.3,1.3)	2.2(3.0,1.6)	2.8(4.5,1.7)	1.1(1.3,1.0)	1.3(2.0,0.9)	1.1(1.7,0.7)	N/A
	SII	8.0(5.4,10.5)	11.0(8.6,13.3)	11.2(8.5,14)	4.3(1.4,7.2)	1.9(1.4,5.3)	-1.4(-6.5,3.7)	N/A
Women	RD	10.2(14,6.4)	6.9(10.4,3.4)	10.0(14.5,5.5)	7.3(10.8,3.8)	1.7(4.5,-1.1)	N/A	N/A
	BGV	9.8(16.6,3.1)	3.4(7.0,-0.1)	5.9(10.8,1.0)	4.5(8.8,0.1)	0.6(3.3,-2.1)	N/A	N/A
	RR	12.3(66.0,2.3)	2.5(3.8,1.6)	3.5(6.3,1.9)	2.4(3.4,1.7)	1.3(1.8,0.9)	N/A	N/A
	SII	11.4(7.7,15.1)	5.4(1.9,8.8)	9.2(5.5,13.0)	2.2(-1.6,6.0)	1.8(-3.4,7)	N/A	N/A
RD; Rate difference, BGV: Between-group variance, RR; Rate ratio, SII; Slope index of inequality								
N/A; not applicable, because disparity indices using at least three educational categories were not available.								

Second, we calculated the SII for the young group (aged 25–44 years), and the middle-aged and elderly group (aged 45–94 years). The result is in Table 2.

Table 2
Slope index of inequality for educational disparity with 95% CI in drinking and smoking.

			SII of educational	SII of educational	p value	SII of educational	p value
Age			disparity in 2013	disparity in 2016	2013 vs 2016	disparity in 2019	2016 vs 2019
Current	Men	25-44	11.6(10.4,12.9)	9.8(8.5,11.1)	0.05	9.4(8.0,10.8)	0.68
Drinker		45-94	-4.0(-5.0,-3.0)	-2.6(-3.6,-1.6)	0.06	-0.9(-1.9,0.1)	0.02
	Women	25-44	8.0(7.1,8.9)	7.1(6.1,8.0)	0.14	6.4(5.4,7.5)	0.33
		45-94	-9.8(-10.3,-9.2)	-9.3(-9.9,-8.8)	0.24	-9.1(-9.7,-8.5)	0.56
Binge	Men	25-44	17.7(15.6,19.8)	13.8(11.4,16.3)	0.02	17.3(14.6,20.0)	0.06
Drinker		45-94	0.0(-0.9,0.8)	0.0(-0.9,0.9)	0.93	0.4(-0.6,1.4)	0.57
	Women	25-44	14.8(12.0,17.7)	16.9(13.7,20.1)	0.34	17.0(13.3,20.6)	0.98
		45-94	1.3(0.03,2.7)	0.6(-0.7,2.0)	0.45	3.0(1.7,4.4)	0.01
Current	Men	25-44	37.2(35.9,38.6)	37.6(36.2,39.1)	0.71	36.5(34.9,38.0)	0.27
Smoker		45-94	1.4(0.5,2.2)	2.7(1.8,3.5)	0.04	6.2(5.3,7.1)	<0.0001
	Women	25-44	30.2(29.3,31.1)	28.3(27.3,29.3)	0.01	25.4(24.4,26.4)	<0.0001
		45-94	-0.7(-1.1,-0.3)	0.1(-0.3,0.6)	0.01	1.5(1.1,1.9)	<0.0001
Heavy	Men	25-44	14.9(13.1,16.7)	10.4(8.5,12.3)	0.001	9.9(7.9,11.9)	0.71
Smoker		45-94	-1.1(-2.8,0.6)	-0.5(-2.2,1.3)	0.61	3.3(1.6,5.0)	0.002
	Women	25-44	8.0(5.6,10.4)	9.1(6.3,11.8)	0.58	7.2(4.3,10.0)	0.35
		45-94	0.3(-2.0,2.7)	-0.5(-2.9,1.9)	0.61	4.0(1.7,6.2)	0.01
SII; Slope index of inequality							

Table 1 showed that younger drinkers had higher positive estimates of educational disparity indices, and older drinkers had lower ones, as well as smoking. However, the decline of educational disparity indices in drinking was relatively flat comparing to smoking.

Table 2 showed that young drinkers had a positive educational disparity at all time points, as well as young smokers. On the other hand, middle-aged and elderly drinkers showed marked difference. In 2013, middle-aged and elderly current drinkers (men, women) had negative educational disparity. In 2019, such negative educational disparity was not observed in men, but still observed in women.

Discussion

As stated in Method section, a positive SII (including the CI) means the trend that people with a low education drink or smoke more than those with a high education. A negative SII (including the CI) means the opposite. As Harper S et al. reported, low education is not always associated with harmful behaviors. [4] By subdividing the characteristics of drinkers, we discovered which groups have positive or negative educational disparity indices.

First, we assumed that the desirable situation for developed countries is that positive estimates of educational disparities are observed in harmful behaviors. From this point of view, there is no problem in smoking in the latest year, because positive estimates of SII are always observed among any genders. The same thing can be said for drinking behaviors among young. However, middle-aged and elderly groups do not have positive estimate of SII in current drinking. Especially, women have negative one, which means the trend that people with a high education do current drinking more than those with a high education. We do not think education in the past had any effect of driving them to drinking. As Table 1 shows, the estimates of educational disparity indices become smaller among the older groups. We assumed the role of education at that time was so small among them that other factors easily drove them to drinking.

Second, we focused on the difference of educational disparity by gender. Among middle-aged and elderly men, there was no statistical educational disparity in current drinking in the latest year. On the other hand, among middle-aged and elderly women, a negative estimate of SII was observed in current drinking. It is difficult to do correct estimation for the difference by gender, but it may reflect gender disparity in the past. For example, in Japan around 1970, many women became family workers, so the number of female employees was small. [18] At that time, young female employees were often forced to entertain middle-aged men of important position in restaurant, bar and so on. This may be one of the interpretations of our study.

Young female employees and middle-aged men, who were relatively high-educated, had many chances of drinking, and those women may keep current drinking. This hypothesis can explain the reason why the estimate of SII is moving in the positive direction among the middle-aged and elderly men, while the estimate of SII is negative and stable among the middle-aged and elderly women. Middle-aged men at that time are on their way to decreasing acutely, and the number of women, who were high-educated and often forced to drink, is decreasing slowly, but many still alive. It also matches the difficulty of stopping drinking from early initiation. [19]

Asians should not underestimate the risks associated with alcohol, because it is known that around half of Asians are likely to accumulate acetaldehyde through a genetic problem and to have complications. [20] Japan is the most tolerant of drinking on a global level. [3] Therefore, specific plans to change people's awareness of risks associated with alcohol are required, especially for elderly.

Finally, there are some limitations in this study. First, as noted by the Centers for Disease Control and Prevention in the US, recent common definitions of binge drinking differ for men and women from the perspective of health risks. [21] For example, this is generally five standard drinks for men and four standard drinks for women in 2 hours. However, the definition of binge drinking used by Health Japan 21 is the same for both men and women, and the questions in the national survey reflected this definition. Therefore, we could not extract binge drinkers using the more common definition. Second, this is a cross-sectional study, and we cannot infer the direction of causality. Third, CSLC is a self-reported data, so it lacks precision about consumption of drinking.

Conclusions

We concluded that education has some effects to prevent people from drinking, and the effects are highest in young and decline gradually with age. Surprisingly, there is a negative estimate of SII among middle-aged and elderly women in current drinking. We do not think education in the past drove them to drinking, because this result doesn't directly reflect the educational effect on drinking. The educational effect was so small at that time that other factors easily contribute to the phenomenon that those with a high education drink more than those with a low education. We focused on the fact that socioeconomic status, including educational background, has different weight in different gender, age, period and so on. This result may reflect the gender disparity in the past when they started drinking, and the undesirable effect remaining until now. One of the estimates is that many women, who were high-educated and often forced to drink by wining and dining culture, are still alive and keep drinking. This hypothesis can also explain the result that the situation about middle-aged and elderly male drinkers and their educational background is getting better, because men of important positions at that time are decreasing rapidly now. If this hypothesis is correct, it reflects the fact that little progress has been made in getting drinkers to stop drinking. Therefore, further observation is needed to confirm whether time resolves the problem truly or other countermeasures should be necessary.

Abbreviations

SII: slope index of inequality

CSLS: the Comprehensive Survey of Living Conditions

RD: rate difference

RR: rate ratio

BGV: between-group variance

CI: the confidence interval

Declarations

Ethics approval and consent to participate

This study was reviewed and approved by Kindai University Ethics Committee (Approval No. R03-139). In addition, all methods were performed in accordance with the guidelines and regulations stipulated by the Committee. Furthermore, informed consent was obtained from all subjects or their legal guardians in the form of opt-out on the web-site.

Consent for publication

Not applicable.

Availability of data and materials

The data that support the findings of this study are available from the Ministry of Health, Labor and Welfare in Japan, but restrictions apply to the availability of these data, which were used under permission for the current study, and so are not publicly available. Data are however available from

the authors upon reasonable request and with permission of the Ministry of Health, Labor and Welfare in Japan. Yasuhiro Kakiuchi should be contacted if the readers want to request the data from this study.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Haruaki Naito wrote the draft of main manuscript. Yasuhiro Kakiuchi and Takahiro Tabuchi acquired the data and revised the main manuscript. Masataka Taguri contributed to the creation of Tables and figures. Motoki Osawa contributed to the conception and design of the study, performance of the analysis, and interpretation of the data. All authors read and approved the final manuscript.

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Figures

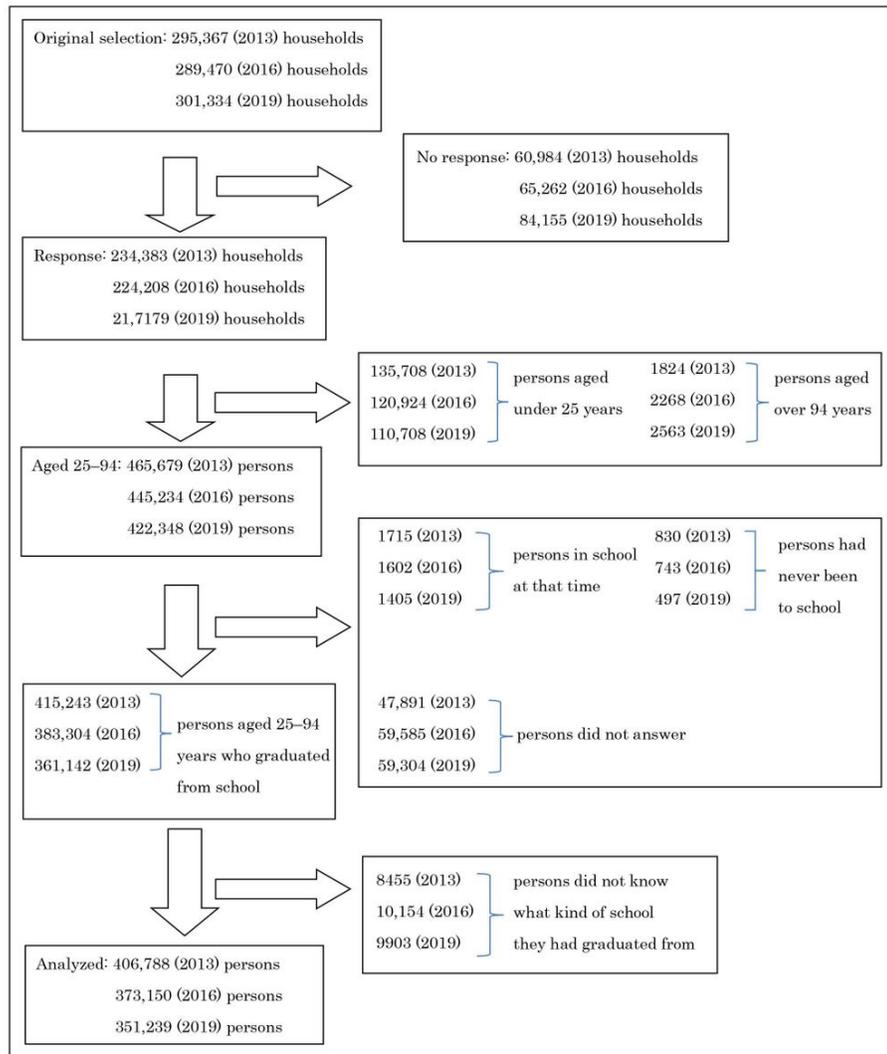


Figure 1

Flow chart of the analyzed sample data from the Comprehensive Survey of Living Conditions.

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