Original Article

Association between Awareness of Taking Education on Medicines, and Knowledge, Attitudes and Behavior about Medicines among Japanese High School Students

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Background: Education on medicines was implemented as part of health and physical education at all junior high schools since 2012 in Japan, after the revision of Course of Study. However, no studies have been done on a nationwide scale to evaluate this curriculum's effectiveness.

Objective: The aim of this study is to assess the association between awareness of taking education on medicines, and knowledge, attitudes and behavior about medicines.

Methods: We conducted a national cross-sectional survey using an anonymous self-administered questionnaire in 2017. We randomly selected 83 public high schools from each prefecture in Japan and distributed our questionnaires to 15-16 years old first year high school students. The questionnaire included questions concerning gender, health care, medicine use, consulting partner, experience of purchasing, getting and giving medicines, and knowledge, attitudes and behavior about medicines.

Results: The number of valid responses was 17,437 (effective response rate was 98.5%). Of these, 29.5% responded that they remembered taking the education on medicines class, 24.9% responded they had never participated, and 45.2% did not remember. For both male and female students, those who remembered taking the class scored significantly higher on the questions regarding knowledge of terminology, knowledge of proper use, and attitudes and behavior than those who had not taken the class or did not remember.

Conclusions: Our findings suggest that a memorable education on medicines class may be effective in promoting students' proper use of medicines. However, we found that many of the students did not remember taking the class. It is therefore necessary to develop and establish education on medicines programs with validated effectiveness. Furthermore, the results of this study imply that there is a need for further investigation on the implementation status of the class at junior high school.

Keywords: high school students, education on medicines, medicine use, course of study

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I. Background

As Japan's society ages, the amount spent on medical care continues to increase. In 2014, medical expenses reached 40.8 trillion yen, more than 40% of Japan's national budget[1]. Therefore new initiatives are needed to decrease the amount of money the government spends on medical care. In recent years, several organizations have proposed self-medication as one solution to this problem. In 2000, the World Health Organization defined self-medication as programs that help people become "responsible for their own health and mild disability"[2]. In 2002, the Ministry of Health, Labor and Welfare made recommendations concerning a policy regarding over-the-counter (OTC) medicines that allowed people to practice self-medication.

These recommendations were put into law in 2006, when the Ministry of Health, Labor and Welfare announced the Revised Pharmaceutical Affairs Law[3], which greatly changed the sale of over-the-counter

medicines. A supplementary resolution to the law required education on medicines in schools that taught medical knowledge while creating an environment for safe OTC medicine use to promote healthy and safe self-medication.

In 2008, the Ministry of Education, Culture, Sports, Science and Technology followed these guidelines, adding curriculum on proper medicine use to the health and physical education requirements in their "New Course of Study for Junior High School Students"[4]. Finally, in 2012, this curriculum was implemented as education on medicines, which is taught in health and physical education classes at junior high schools throughout the country. In 2013, a higher level of education on medicines were implemented in high schools.

Education on medicines is vital part of the curriculum to teach Japanese citizens the proper use of medicines. Previous studies have found that Japanese high school students often misuse medicines. For example, 20.9 - 31.6% of students do not keep track of dosage times correctly and 3.4- 21.2% do not use the correct dosage[5-7]. Despite this frequent misuse, these previous studies also found that Japanese students use medicines often. For example, 57.5- 65.8% of Japanese junior high school and high school students reported that they had used medicines at least once in the past month, and 11.7- 42.2% said that they determine when and how to use medicine[5)7)]. As Japanese students become more responsible for using medicines themselves as they age, it is important to start education about the proper use of medicine in junior high school.

Two years after education on medicines started in junior high schools, Teramachi et al. conducted a nationwide survey to determine how the curriculum was being taught[8]. They found that education on medicines was implemented in most junior high schools. However, when they surveyed students in their first year of high school in Gifu prefecture, only 31% remembered going through the curriculum. About 70% responded that they never took education on medicines class, or that they did not remember[6].

In past years, we conducted several surveys in order to better understand the following: 1) medicine use among elementary, junior high, and high school students[5]: 2) to what extent education on medicines has been implemented in junior high schools across Japan[8]: and 3) the association between high school students' awareness of taking the education on medicines class and medication use in Gifu prefecture[6]. Despite the fact that education on medicines started at the junior high school level in 2012, there are no existing studies that has evaluated its effectiveness on a national scale. This study attempts to clarify the association between students' awareness of taking this curriculum and knowledge of, attitudes toward, and behavior regarding medicines.

II. Methods

1. Participants and procedures

We randomly selected two or three public high schools from each prefecture to take part in survey using a 2016 list of all high schools in Japan. We explained the purpose of the survey to the principal of each school and received written consent. The education on medicines curriculum is usually carried out in the third year of junior high. Therefore, we distributed our questionnaires to 15-16 years old first year high school students from May to July shortly after they started high school in 2017. In principle, all the students belonging to the grade participated in this study. The Gifu Pharmaceutical University ethics committee approved our study.

2. Study population

We obtained initial consent from 83 school principals. Our final data sample includes surveys from 81 schools; two were excluded from our analysis because they conducted the questionnaire in August. We distributed 17,895 questionnaires to the 81 schools and collected 17,812; there were 17,709 responses. The number of valid responses was 17,437 (8,205 male and 9,232 female students), and the effective response rate was 98.46%. We invalidated 272 answers because students did not answer latter half of the questionnaire and/or did not record their gender.

3. Measures

We collected data using an anonymous self-administered questionnaire with 13 questions. The contents of the questionnaire were examined along with a school teacher to determine whether students could understand them or not. Additionally, this questionnaire had been used in our previous studies[5)6)].

The following explanation was stated at the beginning of the questionnaire; 'Please tell me how you think about medicine. "Medicine" used in this questionnaire refers to the medicine you get at hospital or buy at a community

pharmacy. It includes not only medicines for internal use but also compresses, external medicines and disinfectant used for injuries and other occasions. It also includes household medicines, eye drops, troches and inhalants. However, it does not include nutritional supplements or energy drinks. Please do not write anything if you do not want to answer the questionnaire. Not completing the questionnaire will not affect your grades.' Students answered the questionnaires in their classroom after standardized instruction; they were typically distributed by homeroom teachers.

Students were asked their gender to understand students' personal characteristics (Q1). Health care and medicine use were assessed through the following questions. (Q2) How are you dealt with when you are in poor physical condition? (i.e., sleep early, take medicine at home, consult with their families, consult with the school teacher, see a doctor, consult at a pharmacy, other) (Q3) For what purpose do you use medicine? (i.e., stomachache, headache, cold, fever, toothache, allergies, car sickness, other) (Q4) Who do you consult when you use medicine? (i.e., parents/grandparents, brothers/sisters, friend, doctor/dentist, pharmacist, school teacher, other, there are medicines that are to be used regularly, there is no medicine that is to be used regularly) (Q5-7) Have you ever done the following: purchased medicine using your own judgment, received medicine from a friend, gave medicine to a friend.

Knowledge, attitudes and behavior about medicines were assessed through the following questions. (Q8) When you use medicine, what kinds of things are you careful about? (i.e., read the description, check the dosage, check the dosage time, check that I had a meal, take medicine with water, check the medicine agree with my constitution, I do not care, other) (Q9) When you use medicine, what do you think is important to be careful of? (i.e., read the description, check the dosage, check the dosage time, check that I had a meal, take medicine with water, check the medicine agree with my constitution, other) (Q10) What terminology do you know? (i.e., OTC medicine, medical medicine, generic medicine, family pharmacy, medication notebooks, doping, school pharmacist) (Q11) Which items related to medicines' proper use do you know? (i.e., do not take medicine with milk or juice, do not bite tablets or disassemble capsules, between meals is not during meals, take medication for the indicated number of days, most medicines have some side effects, do not take overdose even if medicine does not work soon, do not take it twice the next time, even if you forget to take it once, OTC medicine for cold is symptomatic treatment medicine). We asked respondents to select "yes" for their choices on the lists.

To determine students' experience with education on medicines, we asked respondents whether they had ever taken classes on medicine in school (Q12). Additionally, we asked respondents who did remember taking the education on medicines class in which subject they took the classes (i.e., health and physical education class in junior high school, health and physical education class in high school, period for integrated studies, a lecture, others, I do not remember) (Q13).

4. Statistical analysis

We first evaluated gender difference using the χ^2 test for all question items. Next, we determined the mean scores for medicinal knowledge, attitudes and behavior. We awarded each "yes" answer a value of 1. To confirm the normality of distribution, we conducted Kolmogorov-Smirnov test.

Finally, we compared the mean scores to students' awareness of taking the education on medicines class by using Kruskal-Wallis test. All analyses were conducted using IBM SPSS Statistics 23 (IBM Japan Ltd., Tokyo, Japan). Before comparing these mean scores to students' awareness, Kolmogorov-Smirnov test was conducted.

III. Results

1. Health care and medicine use

Table 1 shows the results of the question items concerning health care and medicine use. The highest prevalence of answers regarding how students deal with a poor physical condition was "sleep early" (male = 73.9%, female = 72.3%), followed by "take medicine at home" (male = 53.6%, female = 61.6%). Significantly higher percentages of female students responded that they "take medicine at home" and "consult with their families" (male = 39.3%, female = 56.3%) than male students.

Students were most likely to use medicine for a "cold" (male = 63.0%, female = 65.7%), a "fever" (male = 59.3%, female = 63.3%) and "headache" (male = 42.2%, female = 49.7%); female students were significantly more likely to use medicines for all complaints except for "diarrhea."

The most common consulting partners when using medicines were "parents/grandparents" (male = 52.6%, female = 90.2%), followed by "doctor/dentist" (male = 21.6%, female = 19.3%). Female students were more

Table 1 Gender difference in question items on health care and medicine use

Variable	Male, % (n=8,205)	Female, % (n=9,232)	Total, % (N=17,437)	df	χ^2 Value	*P* Value
How to deal with poor physical condition						
Sleep early	73.9	72.3	73.1	1	6.004	.015
Take medicine at home	53.6	61.6	57.8	1	115.342	<.001
Consult with their families	39.3	56.3	48.3	1	508.152	<.001
Consult with the school teacher	3.6	4.1	3.9	1	3.558	.060
See a doctor	36.9	37.8	37.4	1	1.359	.246
Consult at a pharmacy	1.3	0.7	1.0	1	130.650	<.001
Other	4.4	3.0	3.7	1	24.080	<.001
Purpose of using medicine						
Stomachache	30.3	47.5	39.4	1	541.275	<.001
Headache	42.2	49.7	46.2	1	97.436	<.001
Diarrhea	16.5	12.5	14.4	1	57.861	<.001
Cold	63.0	65.7	64.4	1	14.087	<.001
Fever	59.3	63.3	61.4	1	28.783	<.001
Toothache	3.3	5.4	4.4	1	46.139	<.001
Allergies	30.5	34.8	32.8	1	36.975	<.001
Car sickness	21.8	37.2	30.0	1	491.467	<.001
Other	4.8	5.6	5.2	1	5.589	.019
Consultation partner when using medicines						
Parents/Grandparents	52.6	90.2	86.6	1	214.411	<.001
Brothers/Sisters	1.9	3.1	2.5	1	23.596	<.001
Friend	1.6	2.8	2.3	1	27.771	<.001
Doctor/Dentist	21.6	19.3	20.4	1	14.068	<.001
Pharmacist	6.5	5.9	6.2	1	2.155	.148
School teacher	1.2	1.2	1.2	1	.002	1.000
Other	0.6	0.5	0.5	1	.609	.469
Use by myself (1)[a]	12.0	13.2	12.6	1	5.152	.024
Use by myself (2)[b]	15.4	15.8	15.7	1	.573	.452
Experience of purchasing, getting, giving medicine						
Purchased due to self-judgment	11.9	13.0	12.4	1	6.960	.031
Get from a friend	6.5	21.6	14.5	1	807.309	<.001
Give to a friend	6.8	22.0	14.9	1	789.165	<.001

[a](1)There are medicines that are to be used regularly
[b](2)There is no medicine that is to be used regularly

likely to ask "parents/grandparents".

A significantly higher percentage of female students responded that they had experience of "purchase due to self-judgment" (male = 11.9%, female = 13.0%), "get from a friend" (male = 6.5%, female = 21.6%) and "give to a friend" (male = 6.8%, female = 22.0%).

2. Knowledge, attitudes and behavior about medicines

Table 2 shows the result of question items on knowledge, attitudes and behavior. The recognition rate of terms such as "medication notebook" (male = 79.3%, female = 91.6%), "doping" (male = 86.8%, female = 82.2%) and "family pharmacy" (male = 64.4%, female = 75.7%) was relatively high, while less students recognized terms like "school pharmacist" (male = 25.6%, female = 27.8%). Significantly higher percentages of female students responded that they recognized terms like "medication notebook" and "family pharmacy" than male students.

Regarding the knowledge of proper use of medicine, the highest correct response rates were for the following statements: "do not take medicine with milk or juice" (male = 80.7%, female = 85.7%) and "do not overdose even if medicine does not work immediately" (male =

Table 2 Gender difference in question items on knowledge, attitudes and behavior about medicines

Variable	Male, % (n=8,205)	Female, % (n=9,232)	Total, % (N=17,437)	df	χ^2 Value	*P* Value
Knowledge of terminology						
OTC medicine	53.5	50.4	51.9	1	16.016	<.001
Medical medicine	57.6	63.2	60.6	1	58.018	<.001
Generic medicine	61.5	66.0	63.9	1	38.155	<.001
Family pharmacy	64.4	75.7	70.3	1	266.333	<.001
Medication notebooks	79.3	91.6	85.8	1	539.742	<.001
Doping	86.8	82.2	79.1	1	567.043	<.001
School pharmacist	25.6	27.8	26.8	1	10.805	.001
No response	2.0	1.1	1.5	—	—	—
Knowledge on proper use						
(1)[a]	80.7	85.7	83.4	1	76.993	<.001
(2)[b]	73.9	73.1	73.5	1	1.646	.203
(3)[c]	46.4	46.1	46.2	1	.102	.761
(4)[d]	51.1	55.7	53.5	1	36.620	<.001
(5)[e]	64.4	62.8	63.6	1	4.693	.031
(6)[f]	77.2	84.6	81.1	1	154.840	<.001
(7)[g]	72.5	78.5	75.7	1	85.465	<.001
(8)[h]	34.0	28.2	31.0	1	67.303	<.001
No response	2.4	1.0	1.6	—	—	—
Attitude regarding proper use						
Read the description	78.1	81.8	80.1	1	37.328	<.001
Check the dosage	76.8	80.6	78.8	1	37.899	<.001
Check the dosage time	69.3	71.3	70.4	1	8.082	.004
Check that I had a meal	35.8	37.1	36.5	1	3.233	.072
Take medicine with water	49.9	50.6	50.2	1	.830	.363
Check the medicine agree with my constitution	37.7	44.1	41.1	1	73.440	<.001
No response	1.0	0.7	0.8	—	—	—
Behavior on proper use						
Read the description	52.7	52.7	52.7	1	.008	.939
Check the dosage	78.1	86.0	82.3	1	186.792	<.001
Check the dosage time	69.9	74.3	72.2	1	42.113	<.001
Check that I had a meal	30.7	35.1	33.0	1	36.926	<.001
Take medicine with water	57.8	58.1	58.0	1	.181	.678
Check the medicine agree with my constitution	9.4	10.1	9.8	1	2.618	.108
I do not care	5.4	3.2	4.2	1	47.729	<.001
Other	1.0	0.8	0.9	1	1.304	.259
No response	0.5	0.2	0.4	—	—	—

[a] do not take medicine with milk or juice
[b] do not bite tablets or disassemble capsules
[c] between meals is not during meals
[d] take medication for the indicated number of days
[e] most medicines have some side effects
[f] do not take overdose even if medicine does not work soon
[g] do not take it twice the next time, even if you forget to take it once
[h] OTC medicine for cold is symptomatic treatment medicine

77.2%, female = 84.6%). On the other hand, the lowest correct response rates were for the following statements: "OTC medicine for cold is symptomatic treatment medicine" (male = 34.0%, female = 28.2%).

Regarding attitude-related questions, the majority of students thought that "reading the description" (male =

78.1%, female = 81.8%), "check the dosage" (male = 76.8%, female = 80.6%) and "check the dosage time" (male = 69.3%, female = 71.3%) were important when using medicines.

For the behavior-related questions, more students reported that they check "the dosage" (male = 78.1%, female = 86.0%) and "the dosage time" (male = 69.9%, female = 74.3%) when using medicines, while fewer answered that they check the medicine agrees with their constitution (male = 9.4%, female = 10.1%).

3. Awareness of education on medicines and the association with knowledge, attitudes and behavior about medicines

Table 3 shows the results concerning awareness of taking education on medicines class. Twenty-nine percent (male = 30.8%, female = 28.4%) of the students responded that they had taken the education on medicines class, while 24.9% (male = 25.6%, female = 24.4%) responded "no" (i.e., they had not taken the class), and 45.2% (male = 43.2%, female = 47.0%) responded "I do not remember". Of the 5,130 students who remembered taking the class, most had participated in their "junior high school health and physical education class" (male = 83.7%, female = 84.9%).

Table 4 shows the distribution of scores concerning knowledge, attitudes and behavior. Before comparing these mean scores to students' awareness of taking the education on medicines class, normality test was conducted. The result of Kolmogorov-Smirnov test showed that the distribution of the variables were not normal distribution.

Our results of Kruskal-Wallis test showed a significant association between students' awareness of taking education on medicines class and their knowledge of, attitudes toward, and behavior regarding medicines. **Table 5** shows the association between awareness of taking education on medicines and knowledge, attitudes and behavior. For both male and female students, those who remembered taking the class scored significantly higher on questions regarding knowledge of terminology (yes = 4.66, no = 4.25, I do not remember = 4.25 for male, and yes = 4.85, no = 4.32, I do not remember = 4.32 for female), knowledge of proper use (yes = 5.51, no = 4.80, I do not remember = 4.80 for male, and yes = 5.60, no = 5.00, I do not remember = 4.97 for female), attitudes (yes = 3.75, no = 3.30, I do not remember = 3.41 for male, and yes = 3.88, no = 3.52, I do not remember = 3.60 for female) and behavior (yes = 3.29, no = 2.95, I do not remember = 2.96 for male, and yes = 3.39, no = 3.14, I do not remember = 3.13 for female) than those who had not taken the class or did not remember.

IV. Discussion

To our knowledge, this is one of the largest Japanese studies on adolescents' medicine use and the first to clarify the association between students' awareness of taking an education on medicines class and their

Table 3 Gender difference in question items on awareness of taking a education on medicines class and the subject in which the class was held

Variable	Male, % (n=8,205)	Female, % (n=9,232)	Total, % (N=17,437)	df	χ^2 value	*P* Value
Awareness of taking education on medicines–						
Yes	30.8	28.4	29.5			
No	25.6	24.4	24.9	2	28.042	<.001
I do not remember	43.2	47.0	45.2			
No response	0.4	0.2	0.3	—	—	—
Subject in which education on medicines class was held						
	Male (n=2,519)	Female (n=2,611)	Total (n=5,130)			
Health and physical education class in junior high school	83.7	84.9	84.3	1	1.366	.266
Health and physical education class in high school	7.8	5.7	6.7	1	9.147	.003
Period for integrated studies	9.1	8.0	8.5	1	2.081	.147
A lecture	29.5	26.9	28.2	1	4.317	.044
Others	1.5	1.3	1.4	1	0.400	.723
I do not remember	4.9	5.6	5.2	1	1.296	.317
No response	0.9	0.5	0.7	—	—	—

Table 4 Distribution of scores on knowledge, attitudes and behavior

Variable and Score	Male, % (n=8,205)	Female, % (n=9,232)	Total, % (N=17,437)
Knowledge of terminology			
7	13.2	12.3	12.7
6	18.0	19.1	18.5
5	17.3	20.6	19.0
4	18.2	19.9	19.1
3	14.1	14.2	14.2
2	9.9	8.4	9.1
1	7.3	4.5	5.8
0	2.0	1.1	1.5
Knowledge of proper use			
8	13.3	10.1	11.6
7	14.7	15.2	15.0
6	18.4	20.9	19.7
5	16.8	20.4	18.7
4	12.6	14.4	13.5
3	9.1	9.5	9.3
2	6.7	5.3	5.9
1	6.2	3.2	4.6
0	2.4	1.0	1.6
Attitude regarding proper use			
6	19.5	20.4	20.0
5	12.2	12.4	12.3
4	17.3	20.2	18.8
3	18.5	20.3	19.4
2	13.3	13.5	13.4
1	18..2	12.5	15.2
0	1.0	0.7	0.8
Behavior regarding proper use			
8	0.0	0.0	0.0
7	0.2	0.1	1.2
6	4.4	4.3	4.3
5	12.9	113.7	13.3
4	21.6	23.3	22.5
3	24.1	27.3	25.8
2	17.5	19.2	18.4
1	18.8	11.9	15.1
0	0.5	0.2	0.4

knowledge, attitudes and behavior about medicines on a national scale.

We found that Japanese high school students often use medicines to treat colds, fevers and headaches. This finding is consistent with research in other countries. For example, Shehnaz et al. reported that adolescents often used medicines to treat symptoms such as headaches, fever, allergies, colds, menstrual pain, and stomachaches. Likewise, Gualano et al. demonstrated that adolescents often used analgesics and cold medicine[10]. We found the largest gender differences in students' use of medicine to be the treatment of stomachaches. This is consistent with the results of several international studies[11-13], indicating that female students may use these kinds of medicines more frequently than male student due to menstrual pain[14)15)].

Our study shows that students are most likely to consult their parents and grandparents before taking medicine, and that this tendency is stronger in females than in males. This result is consistent with other studies in Japan[5-7], Canada[16] and Kuwait[17] that found adolescents were the most likely to consult a "guardian" and that this tendency was stronger in females. However, other studies have differing findings. For example, one study in Malta found that 73.6% of adolescents ages 14 - 16 reported getting information from "family physicians," while 67.9% received information from "pharmacists." Both of these percentages were higher than the percentage of those who reported getting information from their parents (66.2%)[18]. Since each country has a different medical system and students' ability to consult with doctors and pharmacists may vary, there is a possibility that such cultural differences may affect adolescents' information sources.

We also found that female students were significantly more likely than males to purchase medicines using their own judgment, get medicines from friends, or give medicines to friends. This finding is consistent with the findings of previous research in Japan[5-8] and the United States[18]. This result may reflect the fact that medicine usage is higher in females than in males[19)20)] and that many females frequently use analgesics for menstrual pain[14)15)]. Daniel suggested that this behavior may lead to high-risk medicine use, since adolescents may not share information on the effects and negative interactions of medicines when sharing medicines with their friends[19].

We found that students have extensive knowledge about the terminology related to medicine and proper medicine use. The results showed the recognition rates of the following words were as follows; "medication notebooks" was 85.7%, "doping" was 79.1% and "family pharmacy" was 70.3%. In our previous studies in 2010 and 2014, high school students' recognition rates of these words were as follows; "medication notebooks" was 38.8% (2010) and 68.5% (2014), "doping" was 73.5% (2010) and57.3% (2014) and "family pharmacy" was 56.0% (2010) and 51.1% (2014). Comparing these results, the recognition rates of the terms "medicine notebook" and "family pharmacy" were higher in this survey than in our previous studies. The promotion of utilizing of medicinal medicine notebooks and family pharmacies may affected students' recognition of

Table 5 Association between awareness of taking education on medicines and knowledge, attitudes and behavior

	Male					Female				
Variable	**n**	**Mean**	***H* Value**	***P* Value**	**Post-Hoc Test**	**n**	**Mean**	***H* Value**	***P* Value**	**Post-Hoc test**
Knowledge of terminology (Max=7, Min =0)										
(1)Yes	2,519	4.66				2,612	4.85			
(2)No	2,089	4.25	153.173	<.001	(1)>(2)>(3)	2,240	4.32	177.046	<.001	(1)>(2), (3)
(3)I do not remember	3,533	4.07				4,321	4.32			
No response[a]	31	1.55				21	2.90			
Knowledge of proper use (Max=8, Min =0)										
(1)Yes	2,519	5.51				2,612	5.60			
(2)No	2,089	4.80	188.916	<.001	(1)>(2), (3)	2,238	5.00	213.223	<.001	(1)>(2), (3)
(3)I do not remember	3,532	4.80				4,323	4.97			
No response[a]	31	2.03				21	2.86			
Attitude regarding proper use (Max=6, Min =0)										
(1)Yes	2,519	3.75				2,611	3.88			
(2)No	2,089	3.30	86.526	<.001	(1)>(2), (3)	2,240	3.52	68.493	<.001	(1)>(2), (3)
(3)I do not remember	3,532	3.41				4,321	3.60			
No response[a]	31	1.71				21	2.52			
Behavior regarding proper use (Max=8, Min=0)										
(1)Yes	2,519	3.29				2,612	3.39			
(2)No	2,089	2.95	88.446	<.001	(1)>(2), (3)	2,240	3.14	69.119	<.001	(1)>(2), (3)
(3)I do not remember	3,533	2.96				4,323	3.13			
No response[a]	31	1.52				21	2.10			

[a] "No response" was excluded from the analysis

terminology.

A large percentage of students indicated that they knew to check the dosage and dosage time when taking medicine. However, relatively few students knew to take medicines with water or ensure the medicine agrees with their constitution. Furthermore, we found differences between students' beliefs regarding the use of medicine and their actual practices. For example, many responded that while they believed reading the description of medicines and ensuring it agreed with them were important when using medicine, they did not actually practice these behaviors. This suggests that students' favorable attitudes may not be linked to actual behavior. For items with large differences, education may be necessary to encourage attitudes to be put into actual behavior.

It is impossible to directly compare the results of this research with the results of other studies because of the difference in question format. However, there are several previous studies that have reported on adolescents' knowledge of, attitudes toward, and behavior regarding of medicin. For example, Ellul et al. target adolescents between the age of 14 and 16 in Malta[18] and found that over 90% can correctly answer whether "a pregnant woman needs to consult a doctor before using medicine" or "alcohol may affect the efficacy of a medicine." However, only 27.6% could answer whether a "vitamin overdose may adversely affect health." Ellul et al. suggest that a school curriculum on the proper use of medicines may be the best way to combat this lack of knowledge.

This study showed that 82.3% of the students had checked the dosage and 72.2% of them had been careful about the dosage time when they used medicine. All of the rates regarding behavior on proper use were consistent with our previous studies in 2010 and 2014. For instance, 78.8% (2010) and 82.4% (2014) of high school students had checked the dosage, and 68.4% (2010) and 71.1% (2014) of them checked the dosage time.

In this study, 52.7% of the students responded that they had read the description when using medicines. The Japan Self-Medication Industry[22] reported that 40.2% of Japanese adults responded that they "always read" the description, and 37.8% and 22.0% of them "sometimes read" and "do not read" it respectively.

As mentioned earlier, parents and grandparents are most familiar consulting partner for students when they use medicine, but the results of the Japan Self-Medication Industry's survey imply that adults' behavior is not always appropriate. Therefore, education may be necessary not only for students but also for adults.

This study showed that 29.5% of students remembered taking the education on medicines class. These results are similar to the findings of Teramachi et al. in their study of high school students in Gifu prefecture (31.0%) [6]. Additionally, 24.9% and 45.2% of the high school students in this study reported that they either did not take the class or do not remember, which is similar to the 19.5% and 48.0% in Teramachi's study[6]. Since this study is a cross-sectional survey, there is a possibility that recall bias may exist with awareness of taking education on medicines, meaning that the awareness may not agree

with the actual experience. Despite this limitation, it seems to be serious issue that these high percentages of students answered that they either did not take the class or do not remember.

The answer of "I do not remember" may include the answers students who did not remember even though they did, in fact, take the class, and students who really did not take class. In Japan, new Course of Study[4] makes it mandatory for schools to include curriculum on the proper use of medicines in junior high school. Teramachi et al. reported that only 1.0% (5/524 schools) of junior high schools did not teach about medicine[8] during November 2010 to January 2011. However, the data utilized for this study implied that the implementation rate of education on medicine at junior high schools was not high. Therefore, further investigation on the implementation status of the class is required.

A possible explanation for students who did not remember a class despite actually taking it include that students did not have positive attitude toward the class or that the class was not attractive to students.

Teramachi et al.[6] noted that students' poor awareness might be because not all the education on medicines classes had been equally well-taught or productive. Furthermore, since proper medicine use is relatively new learning content, perhaps the lessons were not something that attracts student interest because of poor understanding of teachers' methods and a lack of teaching materials even if teachers want to provide effective classes. Therefore, it is necessary to investigate the type of class that is likely to be attractive to students and remain in their memories. Next, the obstacles to implementing education on medicines classes that attracts students' attention need to be investigated.

Finally, we found that the students who had remembered participating in the education on medicines class were more likely to score higher on knowledge of, attitudes toward, and behavior regarding of medicines than other groups. Conversely, there was little difference between the groups that answered "No" or "I do not know" concerning the experience of taking an education on medicines class. These results suggest that a memorable class will encourage students to use medicines properly. However, students' personal character, attitude toward the class and home education may influence the results of the scores on knowledge, attitudes and behavior. Particularly, as the results of this study and previous studies[5-7)16)17] indicate, parents are the most important consulting partner for students when students use medicines, and students probably learn to think how their parents think about medicine use.

Although adolescents' nonmedical use of medicines is a social problem in other countries[23-27], this is a limited issue in Japan and few studies have been done on the topic. Likewise, the education on medicines curriculum in Japanese junior high and high schools is completely different from drug abuse prevention education focusing on the proper use of medicines for improving health, rather than abuse prevention. In the new Course of Study for Junior High School Students[4], it is clearly stated that students should be taught that "medicines have a principal action and side effects" and that "medicines must be used properly, in adherence to various rules, including number of doses, dosage time, and dosage"[4]. Because our questions were closely related to the curriculum in Course of Study, we were able to measure the effect of the class based on the Course.

Based on the growing social need for the dissemination of self-medication, the content of education on medicines classes was specified in Course of Study. It is meaningful that education on medicines has been implemented in almost all junior high schools, based on the Course. However, the results of this study showed that many students did not remember taking classes implying that there were schools where adequate education had not been done. In each school, classes were conducted based on textbooks prepared in accordance with Course of Study. It appears that, education on medicines may not lead to students' favorable knowledge, attitudes and behavior in some cases, and that its success may dependent on the methods and structure of the class. To promote proper medicine use of adolescents through education at schools, it is necessary to develop and establish education on medicines programs that allow students to acquire preferred knowledge, attitudes and behavior and to evaluate the effectiveness of these programs.

V. Limitations

Our study is the largest unprecedented survey examining Japanese adolescents' knowledge of, attitudes toward, and behavior regarding medicine use. It is also the only nationwide survey to evaluate the effectiveness of education on medicines at junior high schools. Our methodology —the random extraction of surveyed schools from all regions of Japan and a short survey period to minimize bias—is very effective. Furthermore, the effective response rate of this study was quite high at 98.5%.

However, despite these strengths, there are also several limitations to our study. First, there is a possibility of recall bias: there were students who answered negatively to items concerning the awareness of taking classes and actual experiences. In addition, about half of the students did not remember whether they took the class or not. Therefore, it is necessary to be cautious in interpreting the results. While the risk of this bias can be reduced by a longitudinal survey, the current research was also quite rigorous; it was based on a nationwide large-scale survey, and we adopted a retrospective cross-sectional research method. Second, most of the survey questions asked for yes or no answers, so the degree of each variable could not be considered. To measure changes in knowledge, attitudes and behavior more accurately, it is necessary to conduct a longitudinal survey using a scale that can measure the transition level. Furthermore, to measure knowledge more precisely, a question form—such as a true - false question—may be more ideal.

VI. Conclusions

Medicines are familiar to adolescents, and in high school students begin to use medicines based on their own judgement and without consulting adults. However, because there are some students who do not use medicines properly—even for medical purposes—it is very important to provide instruction at school on the proper use of medicines. In this research, we surveyed the effectiveness of education on medicines implemented in junior high school since 2014.

Our study showed that students who remembered taking education on medicines class showed higher scores in knowledge of, attitudes toward, and behavior regarding medicine than other students. This indicates that classes that students remember have the effect of promoting adolescents' proper medicine use. However, we also found that even though the majority of the students may have actually participated in the education on medicines curriculum, many were not aware of taking the class. This result offers a warning concerning the present state of education on medicines in Japan.

To make education on medicines meaningful for students, we suggest the following three actions based on our findings. First, programs should be implemented both to promote adolescents' proper medicine use and to be memorable to students. Second, these effective programs should be implemented nationwide. Third, the effectiveness of the education on medicines program should be continually evaluated.

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