Factors Contributing to Plate Waste Among Elementary School Children in Tokyo, Japan: Application of the Theory of Planned Behavior

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Please note that this study was published before the SY2014-15 implementation of the Smart Snacks Nutrition Standards for Competitive Food in Schools, as required by the Healthy, Hunger-Free Kids Acts of 2010. As such, certain research relating to food in schools may not be relevant today.

ABSTRACT

Purpose/Objectives

The purpose of this study was to identify the aspects of the Theory of Planned Behavior with the greatest relevance to plate waste (PW) among elementary school children in Tokyo, Japan.

Methods

A total of 111 fifth- and sixth-grade students at an elementary school in Tokyo, Japan responded to a self-report questionnaire. The questionnaire focused on the associations among attitudes, subjective norms, perceived behavioral control, and PW behavior. Differences based on gender, grade level, height, and weight were considered. Pearson’s correlation coefficients (r) and multiple regression analyses were used to examine the factors contributing to PW.

Results

Scores for attitudes toward PW were higher among girls (p < 0.05). Perceived behavioral control (r = 0.535, p < 0.001) was associated with PW. Perceived behavioral control had an impact on PW (standardized β = 0.593, p < 0.001, adjusted R² = 0.332).

Application to Child Nutrition Professionals

Although nutrition education directed at reducing PW in Japan has focused on attitudes, this study suggests that perceived behavioral control is also important for helping children reduce PW.

INTRODUCTION

Leaving meals uneaten, which is known as plate waste (PW), has become a serious problem not only in Japan, but also worldwide (Buzby & Guthrie, 2002). In Japan, 45.3% of elementary school children either habitually or occasionally leave portions of their school lunch uneaten (Safety Division of the National Agency for the Advancement of Sports and Health in Japan, 2007). PW may lead to various problems, such as unbalanced or reduced nutrition (Baik & Lee, 2009; Lee, Lee, & Shanklin, 2001; Nozue et al., 2010), environmental degradation (McCaffree, 2009), and the high cost of disposing of PW (The Board of Education of Edogawa City, Tokyo, personal communication, October 19, 2009). Most Japanese feel guilty about PW due to their cultural background. Japanese express this kind of feeling using the word “Mottainai,” which refers to a sense of regret concerning waste when the intrinsic value of an object or resource is not properly utilized (Matsumura, 1995). For these reasons, PW is considered an undesirable behavior in Japan. Some previous studies on school lunch PW proposed scheduling a recess period before lunch to prevent children from leaving their meals early to play (Bergman, Buergel, Englund, & Femrite, 2004; Getlinger, Laughlin, Bell, Akre, & Arjmandi, 1996). Another study indicated that allowing students to make some choices for themselves, such as by providing salad bars or buffet-style service, could reduce PW (McCaffree, 2009). However, these studies focused on schools’ and dietitians’ plans and meal service for entire school populations, rather than children’s cognition. One study reported that habitual PW in children aged 6 and 9 years was associated with several undesirable types of dietary behavior, such as eating only...
what they liked or frequently eating snacks (Baik & Lee, 2009). Other possible factors contributing to PW, such as attitudes and beliefs, were not examined in that study.

In behavioral science, an individual’s behavior may be explained by various factors, such as attitudes. To our knowledge, no previous studies about PW have been based on behavioral science. The Theory of Planned Behavior (TPB) is the most notable example of a behavioral science theory aimed at explaining individuals’ behavior using the concept of attitudes (Ajzen & Fishbein, 1980). TPB has been used to identify important factors influencing various dietary behaviors (Kim, Reicks, & Sjöberg, 2003; Lv & Brown, 2011; Murnaghan et al., 2010). TPB suggests that an individual’s PW behavior is determined by intention, which is influenced by three factors: attitudes toward PW, subjective norms, and perceived behavioral control. Attitudes are determined by beliefs about the likelihood of outcomes and their importance (e.g., “I believe that PW makes those who cooked the meal feel sad, and that is important to me”). Subjective norms are determined by what others think the individual should do and the individual’s motivation to comply (e.g., “My parents think I should not leave my meal uneaten, and I want to live up to their expectations.”). Perceived behavioral control is determined by control beliefs that can facilitate or inhibit the behavior (e.g., “I have confidence that I will not leave my meal uneaten even when I am not hungry.”).

The purpose of this study was to examine which of these TPB variables (attitudes, subjective norms, or perceived behavioral control) exert the greatest impact on PW among elementary school children in Tokyo, Japan.

**METHODOLOGY**

**Participants and Study Design**
The study was conducted among 112 fifth- and sixth-grade children at an elementary school in Tokyo, Japan. A self-report, cross-sectional questionnaire survey was undertaken as part of a study of children’s PW (Abe & Akamatsu, 2011a, 2011b). An unregistered questionnaire was used, and children were asked to fill in their grade level, class, and student identification number. Researchers were not provided with any information that could identify any individual, such as class lists, so anonymity for all participants was maintained.

The principal of the elementary school, who is responsible for decisions about whether to cooperate with such an investigation, provided consent for the survey data collection. This study was approved by the Ethics Committee of Ochanomizu University.

**Sample and Data Collection**
The questionnaires were distributed to children in their classrooms in May 2009. Homeroom teachers instructed the children to fill in the questionnaires according to a protocol developed by the researchers to standardize the procedure. Completion of the questionnaires was voluntary. The children were told by their teachers that there would not be any negative consequences for them (e.g., it would not influence their grades at school), even if they refused to participate in the survey. The teachers also informed the children that by responding to the questionnaire, the children were consenting to participate in the study. To preserve anonymity, the teachers were required to refrain from walking around the classrooms and glancing at the children’s responses while the children were filling in the questionnaire. Children returned the questionnaires to the teacher, who then placed them in an envelope. The researchers collected the questionnaires from the participating school.

**Instruments**
PW: Three measures were used to examine children’s daily PW behavior. These items constitute the “Gratitude for Food” scale (Izuchi & Akamatsu, 2009): “I always finish my meals,” “I eat any food and am not a picky eater,” and “I clean my plate (e.g., I never leave a grain of rice.).” Responses were scored from 1 (strongly disagree) to 4 (strongly agree). Higher scores indicated less PW. Data collected in a previous study (Abe & Akamatsu, 2011a) found these items to be valid by comparing the answers with the weight of the PW from school lunch. Higher scores indicated that the PW weighed less ($r = - .36, p < 0.001$).
The questionnaire also included three variables drawn from the TPB: attitudes, subjective norms, and perceived behavioral control. These variables were developed by the researchers, and the content validity was established before the survey was conducted, with participation by the principal, teachers, and a dietitian in the elementary school.

Attitudes: Ten items concerning attitudes toward PW were developed based on a prior report of children’s thoughts on PW (The Norinchukin Bank, 2011). Each item asked whether the respondent was concerned with various consequences of PW (e.g., “Are you concerned that you will not have a balanced diet if you do not finish eating your meals?”). The items were designed to be answered using a four-point scale ranging from 1 = (not concerned) to 4 = (very concerned).

Subjective norms: Four items about subjective norms were developed (e.g., “My family members think it is wrong to leave meals uneaten.”). Each item was designed to be answered using a four-point scale ranging from 1 = (strongly disagree) to 4 = (strongly agree).

Perceived behavioral control: Ten items about confidence regarding not wasting food in particular situations were developed based on prior reports of children’s thoughts on PW and reasons for not finishing their school lunches (The Norinchukin Bank, 2011; The Safety Division of the National Agency for the Advancement of Sports and Health in Japan, 2007). Each item asked whether students would finish their meals in various situations (e.g., “How likely is it that you will finish a meal when you don’t have much time to eat?”). The items were designed to be answered using a four-point scale ranging from 1 = (have no confidence) to 4 = (have a lot of confidence).

Children were also asked to fill in their numeric height and weight, as measured within 1 month, and their gender.

Statistical Analysis
The demographic characteristics and body mass index (BMI) of the participants were calculated from the data provided by the children about height and weight. The mean values and standard deviations (SDs) for scores on all items were obtained. After the internal consistency of each scale was estimated using Cronbach’s α, the total score, mean value, and SD for each scale were calculated. The two sample t-test was performed to assess gender-based differences in the total scores for each scale. Associations between scores for PW behavior and scores for the three TPB variables were examined using Pearson’s correlation coefficient (r). Finally, to examine the factors contributing to PW, stepwise multiple regression analysis was performed with the PW behavior scale as the dependent variable and the three TPB variables, adjusted for gender, grade level, and BMI, as the independent variables.

Statistical analysis was conducted using IBM SPSS Statistics 19.0 software (IBM Japan, Inc., Tokyo, Japan). A p-value of < 0.05 was used to determine significance.

RESULTS AND DISCUSSION
Demographic Characteristics of the Participants
A total of 111 children (boys = 49%, girls = 51%; fifth grade = 48%, sixth grade = 52%) completed the questionnaires (response rate = 99%). The mean values (SDs) of height and weight for boys were 141.9 (7.8) cm and 34.9 (8.1) kg, respectively; for girls, these values were 145.1 (7.2) cm and 36.4 (5.5) kg, respectively. Mean BMI values (SDs) for fifth- and sixth-graders were 17.1 (2.5) kg/m2 and 17.5 (2.0) kg/m2, respectively.

Mean BMI values by gender were almost the same as the national mean BMIs (participants’ mean values: boys = 17.3 kg/m2, girls = 17.3 kg/m2; national mean values: boys = 18.0 kg/m2, girls = 17.7 kg/m2) (Ministry of Education, Culture, Sports, Science and Technology, 2009a).

Scores for PW Behavior
A higher score for PW behavior indicates less PW. The mean score (SD) for the item “I always finish my meals” was 3.1 (0.9); for “I eat any food and am not a picky eater” the mean score (SD) was 2.7 (1.0), and for “I clean my plate (e.g., I never leave a grain of rice)” the mean score (SD) was 3.1 (0.9). The PW behavior scale had good internal consistency, with a Cronbach’s α of 0.75. The mean value (SD) of the total score for PW behavior was 8.9 (2.2).

No significant differences in total scores for PW behavior related to gender [boys 8.9 (2.6) vs. girls 9.0 (1.9), t(107) = -0.186, p = 0.853], or grade level [5th grade 8.9 (2.1) vs. 6th grade 9.0 (2.4), t(107) =
Scores on TPB Variables

Table 1 shows scores for each TPB item and the mean values (SDs) for each TPB variable. The Cronbach’s α indicated good internal consistency for all scales.

Table 1. Attitudes, subjective norms, and perceived behavioral control of Japanese school children concerning school lunch plate waste

<table>
<thead>
<tr>
<th>Items</th>
<th>Scorea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitudes toward PW, d (Cronbach’s α = 0.87)</td>
<td>3.3 (0.5)</td>
</tr>
<tr>
<td>If I leave meals uneaten, I feel sorry for those who cooked the meals.</td>
<td>3.6 (0.7)</td>
</tr>
<tr>
<td>If I leave meals uneaten, I feel sorry for those living in poor countries.</td>
<td>3.5 (0.8)</td>
</tr>
<tr>
<td>If I leave meals uneaten, food is “Mottainai.”</td>
<td>3.5 (0.7)</td>
</tr>
<tr>
<td>If I leave meals uneaten, I won’t have a balanced diet.</td>
<td>3.4 (0.8)</td>
</tr>
<tr>
<td>If I leave meals uneaten, I am not treating life with respect.</td>
<td>3.4 (0.7)</td>
</tr>
<tr>
<td>If I leave meals uneaten, I can’t grow.</td>
<td>3.3 (0.9)</td>
</tr>
<tr>
<td>If I leave meals uneaten, I won’t be healthy.</td>
<td>3.3 (0.8)</td>
</tr>
<tr>
<td>If I leave meals uneaten, money is “Mottainai.”</td>
<td>3.2 (0.8)</td>
</tr>
<tr>
<td>If I leave meals uneaten, it makes more waste.</td>
<td>3.2 (0.7)</td>
</tr>
<tr>
<td>If I leave meals uneaten, I am criticized.</td>
<td>2.8 (1.0)</td>
</tr>
<tr>
<td>Subjective normsb (Cronbach’s α = 0.81)</td>
<td>3.4 (0.6)</td>
</tr>
<tr>
<td>My teachers think it is wrong to leave meals uneaten.</td>
<td>3.7 (0.7)</td>
</tr>
<tr>
<td>People think it is wrong to leave meals uneaten.</td>
<td>3.7 (0.6)</td>
</tr>
<tr>
<td>My family thinks it is wrong to leave meals uneaten.</td>
<td>3.5 (0.8)</td>
</tr>
<tr>
<td>My friends think it is wrong to leave meals uneaten.</td>
<td>3.0 (0.9)</td>
</tr>
<tr>
<td>Perceived behavioral controlc (Cronbach’s α = 0.87)</td>
<td>2.3 (0.7)</td>
</tr>
<tr>
<td>When those around me leave meals uneaten.</td>
<td>2.9 (1.0)</td>
</tr>
<tr>
<td>When too much food is offered.</td>
<td>2.7 (0.9)</td>
</tr>
<tr>
<td>When I don’t have much time to eat.</td>
<td>2.6 (1.0)</td>
</tr>
<tr>
<td>When I feel uneasy about those around me.</td>
<td>2.6 (1.0)</td>
</tr>
<tr>
<td>When I don’t want to gain weight.</td>
<td>2.5 (1.1)</td>
</tr>
<tr>
<td>Items</td>
<td>Scoree</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>When disliked food is offered.</td>
<td>2.3 (0.9)</td>
</tr>
<tr>
<td>When the meal tastes terrible.</td>
<td>2.3 (0.9)</td>
</tr>
<tr>
<td>When I am full.</td>
<td>2.0 (0.9)</td>
</tr>
<tr>
<td>When I have no appetite.</td>
<td>1.9 (0.9)</td>
</tr>
<tr>
<td>When I am not well.</td>
<td>1.7 (0.8)</td>
</tr>
</tbody>
</table>

aIf you leave meals uneaten, the following may occur. How much are you concerned about these things? Responses are based on a scale ranging from 1 = (not concerned) to 4 = (very concerned).
bHow do you think those around you think about PW? Responses are based on a scale ranging from 1 = (strongly disagree) to 4 = (strongly agree).
cHow sure are you to be able to finish your meal in the following situations? Responses are based on a scale ranging from 1 = (have no confidence) to 4 = (have a lot of confidence).
dPW indicates plate waste.
eThe mean (standard deviation) values.
fThe mean (standard deviation) values of all items on each scale.
g“Mottainai” is a Japanese word referring to a sense of regret concerning waste when the intrinsic value of an object or resource is not properly utilized.

Of the items measuring attitudes toward PW, “If I leave meals uneaten, I feel sorry for those who cooked the meals” had the highest score, followed by “If I leave meals uneaten, I feel sorry for those living in poor countries” and “If I leave meals uneaten, food is ‘Mottainai’.” This result suggests that children perceive that finishing meals is important because of considerations related to others, rather than because of considerations related to themselves.

Of the items addressing subjective norms, “My teachers think it is wrong to leave meals uneaten” had the highest score, followed by “People think it is wrong to leave meals uneaten.” This data may reflect the fact that children completed the questionnaire at their school, and children generally consider teachers to be authorities in school settings.

The scores for “When I have no appetite” and “When I am not well” were lower than scores for other items related to perceived behavioral control. The authors considered these lower scores reasonable for these items.

A significant difference in total scores for attitudes toward PW according to gender was observed. Girls scored higher than boys [mean values (SDs), boys 31.9 (5.7) vs. girls 34.2 (5.0), t(103) = -2.123, p = 0.036], although the total scores for subjective norms [boys 13.9 (2.4) vs. girls 13.8 (2.5), t(103) = 0.218, p = 0.828] and perceived behavioral control [boys 25.0 (6.8) vs. girls 23.1 (5.8), t(99) = 1.544, p = 0.126] did not differ significantly by gender.

Since the scores on attitudes toward PW were higher for girls than for boys, this may suggest that education to develop children’s attitudes toward PW should involve consideration of gender differences. However, there were no significant differences in actual PW behavior according to gender. A previous study among adolescents also found that females reported more positive attitudes toward healthful eating and less caloric intake than did males, but that no significant differences related to gender in other healthful eating behaviors (Backman, Haddad, Lee, Johnston, & Hodgkin, 2002).

Association Between PW Behavior and TPB Variables
The simple associations between the total scores for PW behavior variables and those for TPB variables were examined. PW behavior was found to be significantly associated with perceived behavioral control (r = 0.535, p< 0.001).
The results of stepwise multiple regression analysis suggested that only perceived behavioral control had an influence on PW behavior (standardized $\beta = 0.593$, $p < 0.001$), and that attitudes (standardized $\beta = 0.109$, $p = 0.225$) and subjective norms (standardized $\beta = 0.072$, $p = 0.408$) had no influence, with an adjusted $R^2$ of 0.332.

The results indicate that perceived behavioral control was the best predictor of children’s PW. A previous study showed that the consumption of milk for breakfast among Swedish children aged 11–15 could be predicted by perceived behavioral control (Berg, Jonsson, & Conner, 2000). Perceived behavioral control was also a significant predictor of healthy eating (Hewitt & Stephens, 2007). On the other hand, soft drink consumption among adolescents aged 12–18 was significantly associated with attitudes and subjective norms (de Bruijn, Kremers, de Vries, van Mechelen, & Brug, 2007). The particular TPB variable(s) that affect a particular behavior seem(s) to differ according to the behavior. In the case of PW behavior, this study suggests that perceived behavioral control has the greatest impact.

The results of this study suggest that perceived behavioral control has the greatest impact on children’s PW and that significant gender differences characterize attitudes toward PW. Appropriate interpretation of these results, however, requires consideration of the four limitations of this study. First, the generalizability of these findings may be limited because the sample was small and the participants in this study included only fifth- and sixth-grade children at one school in Tokyo. Second, this study relied on a self-report questionnaire for information, such as the height and weight of students. However, because Japanese schools record body measurements at regular intervals, it seems likely that fifth- and sixth-grade students would be able to self-report their height and weight with reasonable accuracy. Third, a pilot test was not conducted. However, participants were able to complete the questionnaire, the response rate was sufficiently high, and the internal consistency was confirmed. Fourth, causal relationships were not clear due to the cross-sectional nature of the study.

Despite the above limitations, this is the first study concerned with PW to utilize behavioral science. The finding that perceived behavioral control is an important contributor to children’s PW suggests that nutrition education encouraging children’s confidence is needed.

In Japan, PW is considered an undesirable behavior and education to reduce PW is popular. In particular, children are taught to consume their entire school lunch, which is portioned based on the School Lunch Implementation Standard (Ministry of Education, Culture, Sports, Science and Technology, 2009b). This standard is based on national averages by age and requires flexible application. Since the energy and nutritional value of a meal is calculated based on this standard and only a single portion of each meal is provided to each child, the authors conclude that children will not exceed energy recommendations if they consume the entire meal, although it is inappropriate to force children to eat in any situation. However, it is important to help children eat the food needed for their healthy growth and to encourage them to eat a variety of foods, rather than engage in picky eating.

In Japan, statements to reduce children’s PW such as “Don’t leave your food unfinished, or you will not be well nourished,” or “If you leave food uneaten, the person who made it will feel sad,” have been used to influence attitudes toward PW. The latter phrase is often used to nurture “Gratitude for Food,” which is mentioned in the “Basic Act on Food Education” (Cabinet Office, Government of Japan, 2011) and in the Guidelines for Food Education Programming in Schools formulated by Japan’s Ministry of Education, Culture, Sports, Science and Technology (2011). Evaluations of these educational approaches have not been conducted, and the extent of the impact on children’s PW has not been examined.

**CONCLUSIONS AND APPLICATION**

The results of this study suggest that perceived behavioral control has the greatest impact on PW behavior, rather than attitudes toward PW. Subjective norms also had no significant impact on PW behavior. This result is based on the very high scores for attitudes toward PW and subjective norms, which indicate these variables did not have a significant impact on children’s PW (Table 1).
Participants may have developed attitudes toward PW because of education emphasizing not leaving PW, which intends to reduce PW and is popular in Japan. In contrast, children appear to lack perceived behavioral control, including confidence that they will be able to finish their meals. Education that focuses specifically on enhancing children’s confidence in finishing their meals, in addition to current education focusing on attitudes, should be provided to help reduce PW.

Further studies of teaching materials and methods of instruction that may help children gain confidence should be conducted, and more effective nutrition education about PW should be provided to children in the future.

ACKNOWLEDGEMENTS

This work was supported by Grant-in-Aid for Scientific Research C (No.23500952). The authors thank all participants and teachers for their cooperation and the students at Ochanomizu University for their assistance.

REFERENCES


**BIOGRAPHY**

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