Do Parents Benefit from School Health Risk Reduction?

Phumsith Mahasuweerachai*

Faculty of Management Science, Khon Kaen University, Khon Kaen, Thailand

The choice experiment method was applied to determine parent's preferences and monetary values of risk reductions on three related health issues in school, lead contamination in school drinking water, diarrhea from food contamination, and accident from outdoor playground. Data were obtained from face-to-face interview of 672 respondents in three regions of Thailand. Lead contamination is the greatest concern among parents as reflected by the largest coefficients of risk reduction levels and the highest amount of monetary values elicited from parent's preferences. The other two issues are considered of equal importance. However, parents seem insensitive to the changes of risk reductions of these two issues revealing the scope insensitivity. Given the scope insensitivity, choice experiment may be seen as a promising method to determine preferences and monetary values of health related issues that have no appropriate or precise financial proxy available.

Keywords: Non-market valuation, safety in school, health risk reduction
JEL Classification: D61, I10, I31

Introduction

Children in Thailand are in school at least 200 days a year thus the school is considered as their second home. Their health and safety would be impacted by the school environment. Of a number of issues in school environment that impact on children's health and safety monitored by the Office of the Basic Education Commission, three have been paid high attention, namely, lead contamination in school drinking water, diarrhea from

* Corresponding author: Phumsith Mahasuweerachai, Ph.D., Esaan Center for Business and Economic Research, Faculty of Management Science, Khon Kaen University, Khone Kaen, 40002, Thailand. Tel: +66 43 202401 ext. 223, Fax +66 43 202402, E-mail: mchit@kku.ac.th

school food contamination, and accident from outdoor playground. These issues are the main concerns because their incidence is relatively high with serious effects on children health. Lead contamination in school drinking water on average exceeds the standard level at least 100 days from 200 days children go to school (Department of Medical Science, 2008). Lead poisoning from drinking contaminated water may permanently dilute children's IQ (Canfield et al., 2003; Lanphear et al., 2005). The Office of the Basic Education Commission has launched several measures to mitigate the risks from these hazards in schools which include ensuring that the water dispenser coolers are equipped with purification systems that remove lead and checking on the safety features of equipment and the outdoor playgrounds more frequently.

To ensure the benefits of risk reductions from the program are not underestimated, the impacts of the program should be incorporated into economic analysis, which reveal them in monetary terms. There are some monetary valuation methods recommended to value benefits of health risk reduction measures. These can be divided into two groups. The first group, later called financial proxy method, relies on appropriate financial proxy that mirrors the gains from the programs. One of the direct benefits from reducing lead in school drinking water that can be measured by this approach is improved human capital, which could be reflected by an increase in income earnings in the future of children when they enter the job market (Canfield et al., 2003; Gould, 2009; Grosse, Matte, Schwartz, & Jackson, 2002; Lanphear et al., 2005; Nevin, Jacobs, Berg, & Cohen, 2008). However, this method has some drawbacks: Firstly, the estimated monetary value of this method depends on a projection of future earnings of children when they engage in the job market, which outcomes could be uncertain; secondly, the estimated monetary values may not reflect all benefits generated from the risk reduction programs because some benefits may not be traded explicitly in the market and hence no financial proxy is available.

This leads to the second method, the stated preference method, which is the focus of this study. Instead of using financial proxy to value the improvement, the monetary values are directly elicited from the preferences of individuals. Eliciting preferences and the values they place on risk mitigation measures may be direct or indirect. In our case, support for such values is exclusively based on parental values who usually assume the highest responsibility

for the well-being of children. They may also receive benefits generated from the project (Cockerill, Chilton, & Hutchinson, 2007; Dickie & Messman, 2004; Dockins, Jenkins, Owens, Simon, & Wiggins, 2002; Lutter, 2000). Some studies found that willingness to pay to avoid or reduce risks to children's health stated by parents is twice as much as the same issues for themselves. Such values may include secure feeling, financial costs saving, and time costs saving of caring for their ill children. (Cockerill et al., 2007; Dickie & Messman, 2004; Liu, Hammitt, Wang, & Liu, 2000).

The stated preference methods usually employed to elicit such values are contingent valuation (CV) and choice experiment (CE). In CV method, individuals are directly asked to provide the values of improving some circumstance such as risk reduction of diarrhea and lead contamination in drinking water in school. However, this study used CE. Instead of asking individuals to directly state their values on risk reduction programs, they are asked to choose different hypothetical scenarios of some circumstances. The reasons for the preference to CE over CV in this study are as follows. Firstly, we are able to elicit parents' preferences on multi-issues of risk reduction program. CE thus provides relative preference of parents among issues and their characteristics. This would be costly with the use of CV. The second advantage is that reduction in health risk of children in school may not be applicable by CV because money may be much less important on the parent's agenda. Therefore, CE, which focuses less on money, would be more suitable in this context (Smith & Wright, 1994; van den Berg et al., 2005). Finally, parents are not directly asked to express their monetary values on the programs but to make tradeoff between different aspects of the scenarios presented, which decreases attention of parent on money and increases attention on other aspects of the program resulting in a lower probability of protest answers and strategic answers compared to CV.

The paper is organized as follows. The next section the concept and the econometric model for choice experiment are described. Then the method used in this study is presented; this contains the choice set design and the details of survey implementation. This is followed by the results of econometric model and monetary valuation, and then discussion of results and conclusions.

Concept and Model

In preference approach, it is assumed that an individual wishes to maximize utility subject to income, *y.* The utility function of a parent is shown by equation (1):

$$U(X_0, y) = U(X_1, y - WTP) \tag{1}$$

where *X* represents the vector of factors related to health risk reductions in school, and $X_1 \geq X_0$. Improving in *X* increases utility of parents, i.e. $\partial U / \partial x > 0$. An individual's stated preference willingness to pay (WTP) is the amount of income that the parent is willing to pay for reducing health risks in school.

To elicit the parent's preference on reduction of risks in school as well as their values, a random utility model (RUM) was applied. As shown by Adamowicz, Boxall, Williams and Louviere (1998), under the RUM, parents will choose the choice (program) that provides them with the highest utility. The choice of an alternative represents a discrete choice from a set of alternatives. Each alternative is represented with a utility function that contains an indirect utility function of the parent denoted as *V*, and the unobservable part or stochastic component of the utility that is unknown denoted as ε. Therefore, the utility can be represented as in the following:

$$U_i = V_i + \varepsilon_i \tag{2}$$

where *U* is the utility function. A parent will select choice *i* if $U_i > U_j$ for all $j \neq i$. The indirect utility function would be observed by choice experiment questions in which the attributes are arguments. Hence, *V* can be expressed as a function of attributes accompanying each alternative:

$$V_i = \alpha_i + \beta_k X_i, \qquad \forall_i \in C \tag{3}$$

where *X* is the vectors of *k* attributes related to degree of health risk reductions and changes of tuition fee parents faced in the choice set, β is a coefficient vectors, α is alternative specific constant (ASC), and *i* is an alternative in choice sets *C*. The probability that choice *i* will be selected by a parent is equal to the probability that the utility gained from selecting choice *i* is greater than that from other choices. It is assumed that the distribution of stochastic component is independently and identically distributed (IID) according to Gumbel random variable with the irrelevance of independent alternatives assumption (IIA), so the probability of choosing choice *i* among those available $(1, 2, …, k) \in C$ can be expressed in closed form as:

$$P_i = \frac{exp\left(\mu\left(\alpha_i + \beta_k X_i\right)\right)}{\sum_{k \in C} exp\left(\mu\left(\alpha_k + \beta_k X_k\right)\right)} \tag{4}$$

where μ is a scale parameter, which is inversely related to the variance of the error term. The log likelihood functions of conditional logit model applied in this study can be represented as:

$$InL_r = \sum_{n=1}^{N} \sum_{i \in C_n} y_{in} InP_{in}\left(X_{in} | \alpha, \beta\right) \tag{5}$$

where $y_{in} = 1$ if a respondent selects choice i, and $y_{in} = 0$ if otherwise. n represents the index of respondents from CE data, and $P_{in}\left(X_{in} | \alpha, \beta\right)$ is the probabilities of a respondent choosing choice i.

In such models the scale parameter, μ, is typically set equal to 1 because it is unidentifiable within any particular data set (Boxall, Englin, & Adamowicz, 2003; Haener, Boxall, & Adamowicz, 2001; Lusk, Roosen, & Fox, 2003). However, in our case there are three data sets, which were collected from different regions. Therefore, the scale parameter could be identified.[1] In addition, identification of the scale parameter is important in this study because we may not be certain to assume the equivalent preference among respondents of three regions. This due to the fact that without accounting for the scale factor, if the estimated results represent preference's heterogeneity among regions, we cannot certain whether differences in parameter estimates are a result of differences in scale factor or differences in true underlying preferences. This study therefore employ the combined data set estimation purposed by Louviere et al. (2000) to account for the relative scale factors, which the log likelihood function of the combined data model is the sum of the conditional log likelihoods of the Northeast, the North, and the Central region that is showed as follows:[2]

$$InL_j = \sum_{r=1}^{3}\left(\sum_{n=1}^{N} \sum_{i \in C_n} y_{in}^r InP_{in}^r (X_{in}^r | \alpha, \beta, \mu^r) \right) \tag{6}$$

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[1] According to Louviere, Hensher and Swait (2000), the ratio of scale factor is inversely related to the ratio of variance between the data sets.

[2] In order to find the relative scale parameters, we normalize the inclusive value of parameter associated with Central data to unity.

where r represents with three regions, Central (C), North (N), and Northeast (NE).[3] Full information maximum likelihood method is employed to simultaneously optimize equation (6) with respect to all parameters including relative scale parameters of Northeast and North, μ^{NE} and μ^{N}, respectively.

In case of WTP estimation, following Hanemann (1999), welfare measures obtained from the conditional logit random utility model can be calculated as a marginal rate of sub-stitute (MRS) between interested attribute and marginal utility of income presented as follows:

$$WTP = -\frac{\beta_k}{\beta_p} \tag{7}$$

where β_p is the marginal utility of income, and β_k is coefficient of interested attribute.

Method

To estimate the preference of parents on child safety in school programs, we introduce hypothetical child safety in school programs consisting of three issues of safety. Table 1 shows an overview of the attributes used and the levels within each attribute.

Table 1 Attributes and attribute levels in the choice experiment question

Attribute	Level
Reduce risk of lead contamination in drinking water	None
	50 %
	100 %
Reduce risk of diarrhea due to food contamination	None
	50 %
	90 %
Reduce risk of accident from outdoor playground	None
	50 %
	90 %
Increase in tuition fee per year	1,000 Baht
	1,500 Baht
	2,000 Baht

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[3] The dummy code is applied for transformed the qualitative responses in the questionnaire to the data set used to run the models.

Real estimates of risks of suffering from diarrhea and accident from outdoor playground in school are not available for Thailand. We therefore gathered current incidence rates reported by some schools and calculated average incidence values resulting in 14 out of 1,000 students affected by diarrhea from food contamination and 6 out of 1,000 students suffering from an accident from outdoor playground in school. For lead contamination in school drinking water, we constructed the risk based on the data from the Office of the Basic Education Commission and Thai Health, which reported that in about 100 out of 200 days lead contamination in school drinking water exceeded the safe standard level (Department of Medical Science, 2008).

After setting up the current situation of risks for these issues, we designed fictive risk reduction levels of each issue. As shown by Table 1, the attribute levels of risk reduction of lead contamination in drinking water are somewhat different from those of other risk reduction programs. In particular, the highest risk reduction level of lead contamination in drinking water is 100%, while those of diarrhea and accident situations are 90%. This is due to the fact that the main cause of lead contamination in drinking water in school in Thailand is from the purified water dispenser coolers, which use solders containing lead for soldering some parts of the machine such as water container and water pipe. Therefore, complete elimination of lead from drinking water in school is possible. This could be done by changing all water dispenser coolers with ones that are not soldered.

However, the risks to diarrhea caused by food contamination and the hazards in an outdoor playground could not be completely eliminated even with the best measures. There were reasons cited by interviewed experts, physicians, teachers, and officers of Thailand health administration why children may still face some degree of these risks even if the environments in schools were already improved to the most secure condition possible. There are many food-borne microbes, for example, that may contaminate the food served to students during production and preparation, which the school could not have complete control. Another example is that even thought playground is covered by 12 inches deep of shredded rubbers or fine sand; students may still have risk to get spinal chord injury or paralysis from falling off equipments. As it is impossible to eliminate these risks by 100%, we decided to use reduction in risks by 90% as maximum bounds of diarrhea and accident issues.

For increasing the annual tuition fee, the attribute levels were first specified by asking respondents to directly state how much they would be willing to pay more for the annual tuition fee if these risks were reduced. The response was elicited with an open-ended question during the first questionnaire's pretest. The amounts given by respondents during pretest were used to determine the lower and upper bounds of an increase in annual tuition fee. Next, in the second pretest, we included lower bound, upper bound, and the middle value calculated from the first pretest into the choice experiment questions. We found that respondents had no problem and no complains about the values we used for an increased annual tuition fee.

The four attributes with their levels create 3^4 = 81 possible combinations. We reduced these possible combinations to 36.[4] Next, we randomly paired them to form a choice set, each set containing two different combinations while a third choice allows the respondent to select if he/ she does not like the first two choices; this is usually called status quo or do nothing option.[5] This resulted in 18 different choice sets. We then randomly divided them to two groups with each group having nine choice sets. Thus we ended up with two different sets of questionnaire that contained different choice sets, which were randomly distributed to respondents. Table 2 presents the example of choice set asked in the questionnaire.

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[4] This is called fractional factorial designs. The design is able to estimate the main effects, but not for the interaction effects. The design has properties of orthogonality and balance, which each attribute's level occurs in the same or similar frequency as other levels (Zwerina, 1997). We used the macro module developed for choice experiment, experimental design, and conjoint choice analysis in SAS software to arrange this design (see Kuhfeld, 2005).

[5] Availability of this option allows respondents to opt out from the first two choices if they do not like or want to pay extra cost for improving the safety situation in schools. In addition, this option is included to the choice set for welfare – consistent estimates to be produced.

Table 2 Example of choice experiment question

Attribute	Choice A	Choice B	Choice C
Reduce risk of lead contamination in drinking water	100 %	50 %	
Reduce risk of diarrhea due to food contamination	None	90 %	I would not want either choice A or B.
Reduce risk of accident from outdoor playground	None	90 %	
Increase in tuition fee per year	2,000 Baht	1,500 Baht	
I would choose (please select only one)	☐	☐	☐

The data for this study were collected from face-to-face interviews in six provinces in the North, the Northeast, and the Central region of Thailand during the second week of April to the first week of November 2012. The provinces are Chiang Mai, Phitsanulok, Khon Kaen, Ubon Ratchathani, Udon Thani, and Rayong. The samples are parents who have at least one child attending school from prepared kindergarten to grade 9. Our sampling was scoped to this group of student because children with this age range had the highest vulnerability to these risks in school especially lead contamination (Canfield et al., 2003; Lanphear et al., 2005; Rogan & Ware, 2003).

The questionnaire has three parts. The first included the evaluation section of the risk reduction for the three issues of safety. The second contained questions about, e.g. parent's concern over lead contamination in drinking water, and about how a parent would react to prevent their children from contracting lead in school drinking water. The third part includes socio-demographic information of the respondents such as age, household income, and level of education.

The survey was carried out in places with high concentration of people such as parks, shopping malls, and markets. Respondents were randomly selected in each place in which every third person was selected to conduct the interview. If an individual refuses

to participate or has no children as the scope of study, the random process was restarted again. For an individual who agreed to participate, he/she was given the information sheets containing the information of the issues, which are risk level information, and injury that may occur to children if they encountered these hazardous situations. Since the information sheet of each issue provided to the respondent consists of many details of the issue, the respondent might give the most attention to the first issue and less or none to the last one. This would cause bias on their choice selection, in which they may tend to select choices that favor the issue they read first and ignore the rest. To avoid this problem, the orders of the information sheets given to the respondents were random. Some respondents, for example, may start with lead contamination in school drinking water followed by schoolyard accident and food contamination. Others may have a different sequence. After the participants have read and understood the situation, they were provided information on risk reduction measures along with three figures illustrating the influence of risk reduction on annual incidence rates on each issue. Participants were then asked to answer the nine choice set questions presenting risk reduction measures in different degrees. After finishing the first part with choice experiment questions, respondents were asked to finish the other two parts of the questionnaire. Following the steps of implementation, 672 participants participated in the survey; 318 from the Northeast, 234 from the North, and 120 from the Central region. Table 3 shows the characteristics of the respondents.

Table 3 Descriptive statistics of survey respondents

Characteristic	Region		
	North	Northeast	Central
Gender			
Male	30.98%	29.25%	66.67%
Female	69.02%	70.75%	33.33%
AGE[1/]	39.15	40.31	41.99
Number of children under 18[1/]	1.56	1.59	1.59
Education			
No education	7.61%	1.26%	0.83%
Primary school	22.83%	27.99%	22.50%
High school	21.74%	31.13%	31.67%

Table 3 (Continued)

Characteristic	Region		
	North	Northeast	Central
Vocational school	6.52%	9.12%	14.17%
College degree	28.26%	26.10%	25.83%
Masters degree	3.26%	3.77%	2.50%
Higher than masters degree	0.00%	0.63%	0.00%
Other	9.78%	0%	2.50%
Occupation			
Paid job	81.52%	77.04%	76.66%
Unemployed	2.17%	1.57%	1.67%
Retired [2/]	1.09%	3.46%	0.00%
Other [3/]	15.22%	17.92%	21.67%
Monthly household income			
<10,000 Baht	14.68%	20.82%	15.00%
10,001-20,000 Baht	30.44%	28.39%	26.67%
20,001-30,000 Baht	14.67%	18.93%	12.50%
30,001-40,000 Baht	14.67%	13.56%	19.17%
40,001-50,000 Baht	7.06%	6.62%	5.83%
>50,000 Baht	18.48%	11.67%	20.83%

Note: [1/] Average numbers

[2/] Retired people in our sample have taken care their grandchildren due to their parents migrated to other cities.

[3/] Most of other occupation is housewife.

Results

The initial step is to test for preference regularity across the regions. The null hypothesis is $\beta^{NE} = \beta^{N} = \beta^{c}$. First, separate models for each region were estimated with the following equation (5) and log likelihood values, lnL_r, which were -8,859.29, -6,673.38, and -1,590.62 for Northeast, North, and Central regions, respectively. Next, all data were pooled and equation (6) were estimated by imposing parameter equality among regions, but allowing for differences in scale parameters across regions. The log likelihood, lnL_j, for this model was -18,904.9. Following Louviere et al. (2000), the test for preference regularity is $-2\left(L_j - \sum L_r\right)$, which is distributed χ^2 with $K\left(M\text{-}1\right)$ degrees of freedom, where K is the

number of restrictions and *M* is the number of data sets. The test result strongly rejected preference regularity among the regions (p=0.01) suggesting that differences in parent's preferences of risk reductions on school environment across the three regions are not simply because of differences in variances of the data sets, but they are actually different in true underlying preferences.

According to reject preference regularity, regional models were estimated to elicit the marginal utility of each attribute separately for all three regions. However, to account for differences in variances, log likelihood functions (represented by equation (5)) of each region were multiplied by the relative scale parameters identified by combined data model. The scale parameters multiplied to the log likelihood function were 1.441, 1.229, and 1.000 for North region, Northeast region, and Central region, respectively. These values represent smaller error variances for the North and Northeast regions relative to the Central region responses. Following these steps, coefficient vectors of each region model were controlled for differences in variance, so they can be directly compared. Table 4 shows the estimated results of combined models and regional models.

Table 4 Estimation result

Variable	Combined model	Individual model		
		North	Northeast	Central
Choice A	0.060	-0.278*	0.141	-1.604*
	(0.091)	(0.083)	(0.091)	(0.390)
Choice B	0.229**	-0.192**	0.163***	-0.056
	(0.100)	(0.096)	(0.099)	(0.366)
Risk reduction in lead contamination				
50% reduction	0.662*	0.411*	0.510*	1.158*
	(0.054)	(0.048)	(0.050)	(0.161)
100% reduction				
	0.984*	0.591*	0.809*	2.295*
	(0.062)	(0.053)	(0.048)	(0.341)
Risk reduction of diarrhea from food contamination				
50% reduction	0.612*	0.359*	0.321*	2.764*
	(0.060)	(0.046)	(0.044)	(0.341)
90% reduction	0.483*	0.347*	0.270*	1.479*
	(0.055)	(0.051)	(0.045)	(0.239)

Table 4 (Continued)

Variable	Combined model	Individual model		
		North	Northeast	Central
Risk reduction of accident from outdoor				
playground				
50% reduction	0.498*	0.440*	0.298*	3.036*
	(0.056)	(0.048)	(0.051)	(0.413)
90% reduction	0.515*	0.427*	0.345*	1.795*
	(0.049)	(0.045)	(0.045)	(0.275)
Increase in annual tuition fee	-0.0001**	-0.0001*	-0.0001*	-0.0006**
	(0.000)	(0.000)	(0.000)	(0.000)
North scale factor	1.441*			
	(0.106)			
Northeast scale factor	1.229*			
	(0.082)			
Scale factor		1.441	1.229	1.000
Number of choice	18,144	6,318	8,586	3,240
Log likelihood	-18,904.9	-6,673.38	-8,859.29	-1,590.62

Note: Numbers in parentheses are standard error. * ** and *** indicate significant level at 1%, 5%, and 10%, respectively. Number of respondents in Northeast, North, and Central regions are 318, 234, and 120, respectively.

For each region, the coefficient of tuition fee and other attributes are as expected. In addition, the coefficients estimated for the North and Northeast regions are somewhat similar to each other, while those of the Central region are significantly different.

Since risk reduction attributes have three levels, none, 50%, and 90% (100%), the none level was applied as reference for every attribute. Therefore, the coefficients of each attribute level presented in Table 4 reveal changes of respondent's utility due to reduction of risks relative to that of no risk reduction applied.

Starting with risk reductions in lead contamination in drinking water, both levels, 50% and 100% reductions in risk, are significantly different from zero with positive attitude in all three regions meaning that compared to no risk reduction, reducing risk to a certain degree may improve parents' utility in which they may feel more secure as their children face lower risk of lead contaminated drinking water when they are in school. In addition,

reducing risk by 100% seems to increase parent's utility more than that of just 50% because the coefficient of 100% risk reduction is significantly higher than that of 50% reduction. This result was expected because in the latter option, children still have a chance to be impacted by lead contained in drinking water, while that probability dropped to zero in the first case. Comparing the regions, Central region's parents seem to be more concerned with lead contamination in school drinking water issue than the parents in the North and Northeast regions. This can be seen by relatively significant larger coefficients of both 50% and 100% risk reductions in lead contamination.

In case of diarrhea from food contamination and accident from outdoor playgrounds, the results are similar to lead contamination in school drinking water. In particular, parents would gain from risk reductions of both issues in both degrees provided in the choice experiment survey. However, 50% risk reduction seems to provide more utility gain than that obtained from 90% reduction in some cases. This can be seen from the coefficients of 50% risk reduction being slightly larger than those of 90% reductions in North and Northeast models for risk reduction of diarrhea from food contamination, and significantly larger in the Central model in both cases. We applied a test to determine whether or not the differences in risk reduction levels cause differences in changes of parent's preferences in both cases. The results revealed that coefficients of 50% and 90% risk reduction levels in both issues were insignificantly different for the North and Northeast models suggesting that utility gains from 50% risk reductions and that of 90% risk reductions may not be different.[6] However, for Central model, the coefficients of 50% risk reduction were significantly larger than those of 90% risk reduction.[7] These situations may reveal the impact of scope insensitivity in which respondents did not sensitively respond to improvement of risk reductions (Brown et al., 2008; Goldberg & Roosen, 2007; Lew & Wallmo, 2011).

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[6] Wald test was applied to test the equality of these two coefficients. In case of diarrhea from food contamination the chi – square tests are: χ^2 = 0.09 and 1.69 for North and Northeast models, respectively. Similarly, the chi – square tests of risk reductions of accident from outdoor playground are as follow: χ^2 = 0.12 and 1.22 for North and Northeast models, respectively. Hence, we fail to reject the null hypothesis of no difference between two coefficients at 5% significant level.

[7] Wald test was also applied with resulting in χ^2 = 47.31 and 21.90 for diarrhea from food contamination and accident from outdoor playground, respectively.

Scope insensitivity issue may occur when people do not have clear preference on goods or the goods are unfamiliar to them (Olsen, Donaldson, & Pereira, 2004). In addition, even familiar goods such as in this study respondents may not be able to provide consistent preference because respondents were asked to choose a combination of risk reductions with price, tuition fee, that maximizes their utility; however, they may have tended to select choice by paying all or most of their attention to the attributes that are most preferred, while the careless attributes may have attracted less or no attention resulting in an insensitive reaction to the extent of risk reduction.[8] The results of this study may support this contention because, Table 4 shows, respondents are somewhat sensitive to risk reduction in lead con-tamination of the school's drinking water. This indicates significant concern among parents for lead contaminated drinking water issue of parents, which makes them sensitive to risk reduction in this issue to some degree. On the other hand, they may simply lack interest or not care much about the program outcomes of reducing risks of diarrhea from food con-tamination and accident from outdoor playground, so they may tend to just approve risk reductions in general resulting in lack of differences of preference gains between different risk reduction levels (Goldberg & Roosen, 2007).

The variable "increase in annual tuition fee" is also significantly different from zero with correct sign in all individual models, so that its coefficient was use to calculate WTP, as presented by equation (7).

The WTP for risk reduction of the three risks was calculated by setting up two scenarios for each region. The first scenario was medium risk reduction or 50% risk reduction in all issues. The other scenario was maximum risk reduction in which 90% risk reduction was employed for diarrhea from food contamination and accident from outdoor playground, and 100% risk reduction for lead contamination in drinking water. This resulted in eighteen values to be estimated (six for each region), which are presented in Table 5.

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[8] This issue may be the main cause of inconsistent preference on risk reduction of diarrhea from food contamination and accident from outdoor playground because we also employed pair comparison method to elicit preference of parents on the same issues. The result from pair comparison clearly showed the consistent preference of respondents on the issues in which there was no in-group inconsistency preference occurs. In addition, the first two most preferred and the least preferred attributes elicited by pair comparison method were the same as those given by choice experiment in this study.

Table 5 Monetary values of risk reduction (unit in Baht/year/household)

Risk reduction	North	Northeast	Central
Lead contamination			
50%	3,418.94*	3,522.61*	2,016.95**
	(1,004.87-5,959.02)	(1,460.90-5,584.31)	(94.84-3,939.07)
100%	5,012.75*	5,595.89*	3,998.46**
	(1,447.79-8,577.72)	(2,466.38-8,725.39)	(364.59-7,632.33)
Diarrhea from food contamination			
50%	3,045.67*	2,222.20*	4,815.30*
	(857.28-5,234.05)	(838.02-3,606.38)	(1,193.44-8,437.16)
90%	2,942.98*	1,869.05*	2,576.57*
	(833.97-5,001.99)	(641.16-3,096.95)	(711.21-4,441.92)
Accident from outdoor playground			
50%	3,734.52*	2,059.75*	5,288.45**
	(1,256.34-6,212.71)	(640.47-3,479.04)	(1,078.21-9,498.70)
90%	3,616.67*	2,387.51*	3,127.27*
	(1,165.95-6,067.38)	(913.65-3,861.37)	(972.99-5,281.56)

Note: Numbers in parentheses represent 95% confidence level of estimated values. * and ** indicate significant level at 1% and 5%, respectively. The WTP of 50% and 90% risk reductions of diarrhea from food contamination and accident from outdoor playground are not statistically different.

The WTP was estimated by delta method, which provided 95% confident interval of the values.[9] Starting with lead contamination in school drinking water, parents on average are willing to pay about 2,016 to 3,522 baht per household per year to reduce risk of lead contamination in drinking water by 50%. In the same manner, parents would pay more if lead can be completely eliminated from school drinking water. This is shown by the WTP of 100% reduction that range between 3,998 to 5,595 baht per household per year, which is on average about 1,872 baht higher than that of 50% reduction.

For diarrhea from food contamination, the WTP of this situation in all models seem ambiguous. This is due to the fact that the coefficient of 50% risk reduction level is larger than that of 90% risk reduction, showing a higher WTP from 50% risk reduction than from 90% risk reduction level, which is an anomaly. However, the WTP of 50% and 90% risk

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[9] See Greene (2003, p. 913) for more detail of the delta method.

reductions are statistically indifferent in the North and Northeast models suggesting that parents see no difference between a 50% and a 90% risk reduction.

In case of accident from outdoor playground, the patterns of WTP from reducing risks are similar as those calculated from diarrhea from food contamination. In particular, the WTP calculated from the North and Central models are questioned because the WTP from a 50% risk reduction is higher than that from a 90% risk reduction. However, the North model's WTP of these risk reduction levels are insignificantly different. Similarly, even the WTP of Northeast model seems to be reasonable because the value of 90% risk reduction is higher than that of 50%; statistically they are not significantly different. Similar to risk reduction of diarrhea from food contamination case, parents favor risk reduction in the program, but do not perceive any difference in the levels of risk reduction.

Another special case is the result of the Central model in which the WTP for a 50% risk reduction is significantly higher than for a 90% risk reduction in both diarrhea from food contamination and accident from outdoor playground issues. This may be due to the fact that lead contamination in drinking water is one of the most concern issues in this area and given intense coverage by the mass media a month before we began the survey. Due to this reason, respondents may pay all or most of their attention to the lead contamination in school drinking water issue and ignore the other ones resulting in ambiguous results of risk reductions of diarrhea from food contamination and accident from outdoor playground.

All in all, all the risk reduction measures to improve child safety in school are important to parents because all improvements have positive and significant WTP, as reflected the parents' tradeoff between income and safety for their children. In addition, a parent's welfare is also significantly improved by their children being safer in school. Parents were more concerned with lead contamination in school drinking water than the two other hazards. This could be tracked by the highest amount of willingness to pay for risk reduction in both levels. Our result is consistent with recent research on benefit gained from preventing lead poisoning among children (Canfield et al., 2003; Gould, 2009; Grosse et al., 2002; Lanphear et al., 2005; Nevin et al., 2008). In case of diarrhea from food contamination and accident from outdoor playground, notwithstanding the ambiguous results of the Central model, reducing risk on both 50% and 90% levels would benefit parents to some degree

because the values estimated are significant. However, parents on average insensitively react to the extent of the issue's risk reduction.

Conclusion

Improving child safety in school directly benefits students in several ways that enhance the health of students and thus the nation's human capital. Other than the students, parents benefit from safety programs in schools. The results suggest that increasing child safety in school by reducing risks of lead contamination in drinking water, diarrhea from food contamination and accident from outdoor playground significantly increase parents' welfare. The gain in welfare may be in the form of the feeling of security of parents (Cockerill et al., 2007). However, this benefit may not be appropriate to value in monetary terms by applying financial proxy methods such as the opportunity cost method and the proxy good method because there may not be an appropriate monetary proxy that could precisely reveal a parent's secure feeling (van den Berg et al., 2005).

In this paper, the choice experiment method was employed to determine the preference of parents on child safety in school programs as well as the monetary values the parents placed on them. The results show that parents are willing to pay for reducing the three types of risk to improve school safety environment, which would directly benefit their children and themselves. Relatively speaking, lead contamination in school drinking water seems to be the top concern of parents, gaining the most attention from them. The evidence is that the issue is represented by the largest coefficients in both 50% and 100% risk reductions. Furthermore, the monetary values in terms of WTP for reducing risk at both levels are also, on average, the highest amount. Diarrhea from food contamination and accident from outdoor playground are also of grave concern to parents although their degree of attention to these two risks is lower than to lead contamination in drinking water. Relatively in these two cases, parents may give them equal importance, as the parent's preference and WTP for these two issues are similar. Furthermore, parents seem to be indifferent to the different levels of risk reductions in both issues revealing the scope insensitivity issue. The scope insensitivity observed may be due to the value placed by the parents on the risk reduction of these issues in general or they may simply have no interest on the differences of outcomes from

different risk reductions. However, the causes of scope insensitivity are beyond the scope of this study, but would be worth exploring further.

In sum, given unclear values of WTP due to scope insensitivity for some risk reduction issues, the choice experiment method may be a promising method in valuing the benefits of risk reduction on health and safety-related issues, especially when there are several dimensions of the benefits that render them without an appropriate financial proxy because of the high uncertainty of outcomes.

Acknowledgments

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