

# Perceived risks and safety concerns about fluid milk among Chinese college students

*Rizika a problémy bezpečnosti vnímané vysokoškolskými studenty v Číně ve vztahu ke spotřebě tekutého mléka*

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**Abstract:** The study uses the questionnaire information collected through personal interviews with college students at a large university in Beijing, China to discuss the students' perceived milk risks and their milk safety concerns. We analyzed the milk risks perceived by students and found out that the top three listed risks are: (1) the use of low quality materials in milk packaging; (2) bacteria contaminations in milk production and processing; and (3) unsafe milk caused by the use of cow antibiotics. The binomial probit regression analysis shows that the health conscious milk consumers who consume milk frequently are likely to be worried about the safety of milk. Wealthy students from a household of three members or more are likely to be concerned about the milk safety. This study demonstrates that the current government efforts to raise milk consumption among college students are insufficient. Policies that reduce the perceived risks can be an effective strategy to raise milk consumption among the educated youth.

**Key words:** perceived milk risks, milk consumption behaviour, Chinese college students' milk consumption, milk safety regulations

**Abstrakt:** Studie využívá informací získaných z dotazníkového šetření provedeného formou osobních interview s univerzitními studenty jedné z velkých university v Pekingu (Čína), v jehož rámci byla zkoumána rizika vnímaná studenty ve vztahu ke konzumaci mléka a mléčných výrobků. Analyzovali jsme rizika, která studenti vnímají ve vztahu k mléku, a dospěli jsme k závěru, že mezi tři hlavní z nich patří 1) spotřeba tekutého mléka v různých formách obalu, 2) kontaminace bakteriemi v procesu produkce a zpracování mléka, 3) nebezpečí způsobená použitím antibiotik u dojnic. Binomiální probit regresní analýza ukázala, že studenti-spotřebitelé mléka, kteří se zajímají o zdravotní rizika a konzumují mléko, pravidelně vykazují nejvyšší obavy o bezpečnost mléka. Tato studie dále poukazuje na to, že současné snahy čínské vlády zvýšit spotřebu mléka u vysokoškolských studentů jsou nedostatečné. Politiky snižující vnímaná bezpečnostní rizika by mohly být efektivními nástroji ke zvýšení spotřeby mléka mezi vzdělanou mladou generací.

**Klíčová slova:** rizika vnímaná při spotřebě mléka, chování spotřebitelů mléka, spotřeba mléka vysokoškolských studentů, opatření k bezpečnosti mléka

China is in the midst of a campaign to change its milk supply system and to improve the milk safety standards. The issues of food safety and public health are attracting greater attention from the China's

1.2 billion citizens. A decade ago, milk safety was subject to less government regulations. Fluid milk was perceived by most Chinese as a luxury nutrition supplement and was provided primarily to children

and the elderly (Fuller et al. 2006). The growth in the household income, the enhanced food nutrition knowledge, the rising demand for animal protein, and the greater accessibility to modern food retailers, among other factors, helped to change the milk consumption patterns among the Chinese (Fuller et al. 2004; Fuller and Beghin 2004; Beghin 2006; Dong 2006). Remarkably, fresh milk consumption rose from 1.1 gallons per capita in 1998 to 11 gallons in 2006 (Fuller and Beghin 2004; Chinese Ministry of Agriculture 2006). Besides economic factors, the Chinese government has actively promoted milk to Chinese households including school milk programs, beginning in 2000, which has successfully raised milk consumption among urban children and adolescents (Fuller et al. 2004; FAO 2005; Dong 2006). As a part of the strategy, subsidized milk was supplied to urban elementary schools to stimulate the daily consumption among urban children. Another effort, called the 2<sup>nd</sup> Hope Project, supplied milk to children throughout the China's poor rural regions (FAO 2005). The government efforts to promote milk consumption have consequently influenced the public perceptions about milk, popularizing it among various consumer groups, particularly the college age youth. A recent survey of college students revealed that 44% of the sampled students consumed milk at least once per day (Xu et al. 2009).

The growing awareness of food safety issues has only recently attracted the public attention in China. In the international market, China's food exports are frequently rejected for failing to meet the strict food safety standards in Japan, Europe, and other countries. This has propelled the Chinese government to improve the food safety standards to expand exports (Calvin et al. 2006). Within China, the negative publicity surrounding food contaminations has generated widespread public concerns. The academic research has noted that the food poisoning incidents in China have affected 200 to 400 thousand people yearly (Xie and Yu 2002, as cited by Wang et al. 2008). The China Ministry of Health Statistics revealed that the microbial food poison incidents have affected 15 to 20 thousand people during the period between 2003 and 2005 (Wang et al. 2008). "Pesticide and antibiotic residues, intensive use of growth hormones, heavy metals pollutions, air and water pollutions, carcinogenic dyes, and adulterated foods have resulted in a generally heightened level of concern about food safety" (Wang et al 2008, p. 28). Under such circumstances, the Chinese government has taken immediate actions to establish the national food safety standards, to impose strict food certification inspections, and it has introduced the

international standard quality and safety management systems (Calvin et al. 2006).

With respect to the milk-related safety issues, a number of incidents have been uncovered in the recent years, most of which were caused by microbial contaminations. Several cases were publicized, including a staphylococcus pollution incident in Wuxi, a mid-sized city in Southern China (Fu et al. 2002); a high iodine infected milk incident in Beijing in 2005 (Sohu news); and a bacteria contaminated milk incident in the Southern city Zhuhai, which caused illness of 119 children in 2008 (Southern China News 2008). These incidents have shaken the faith of milk consumers and have aroused intense discussions about the milk safety issues.

This study examines college students' perceived milk risks, their concerns about milk safety issues, and the factors influencing their milk safety concerns. We focused on college students for three main reasons. First, college students are frequent consumers of dairy products and have become an important market segment for them. A survey of college students revealed that 44% of the students consume milk, and 46% consume yogurt or ice-cream at least once per day (Xu et al. 2009). Certainly, the China's school milk programs have contributed to this dietary habit among students. Second, college students spend a significant amount of their family household income – the urban college students spend 40% and the rural students spend 87% – and much of this spending goes to food (Yu and Yang 2004). Third, the number of college students has grown rapidly in the past decade, reaching the point where seven out of every 100 residents in Beijing are attending college. The Census statistics report 565.8 thousand students enrolled in 80 universities in 2006 (National Bureau Statistics of China 2007).

Our study uses the questionnaire information collected through personal interviews with college students at a large university in Beijing to discuss the students' perceived milk risks and their safety concerns. We analyzed students' perceptions of milk hazards in the use of pesticides in the production of cow feed, the application of antibiotics and growth hormones in cows, and the incidence of bacteria contaminations. We then examine the students' milk safety concerns and the impact of the following factors on their safety perceptions: (1) milk consumption; (2) health concerns; (3) taste; (4) price; (5) household size; and (6) demographics. This study demonstrates that the current government efforts to raise milk consumption among college students are insufficient. The policies that reduce the perceived risks can be an effective strategy to raise consumption.

## LITERATURE REVIEW

The study of the food-related health risks has been approached from different angles and different disciplines. Food nutritionists pioneered the research and proposed different types of health risks related to food (Wandel 1994). According to them, food risk or food hazard is “an event or occurrence associated with an activity or process, which can result in negative consequences and thereby provide a source of risk to a receiving environment or population” (Yeung and Morris 2001, p. 172). The sources of food risk are found in agricultural chemical residuals, food additives, growth hormones, antibiotic residues and environmental pollutions. All food hazards caused by bacteria are categorized as the “microbiological hazards” (Yeung and Morris 2001). Consumers are sensitive to this source of food risk as it can cause the food spoilage and possibly the food poisoning. Food chemical hazards are associated with the use of chemical additives in the production and processing of food. Typical chemical hazards originate from agricultural chemicals, growth hormones, feed enhancers, and anti-biotic treatments, which are used by producers to protect or increase the yield (Yeung and Morris 2001). Chemical hazards also include the general environmental pollutants that leave unwanted residues in food. Another type of the listed food hazard is the technological hazards, such as the food irradiation and the genetically modified (GM) food. Concerned about the safety of such products, many consumers are unwilling to accept the controversial technological advancements, owing to their limited understanding of the GM foods and the complex technology underlying it (Ho et al. 2006).

Social psychologists have differentiated the physical properties of risk from its “social interpretations,” which they call the “perceived risk” (Slovic et al. 1980). The research has shown that the consumer behaviour is determined significantly by the “psychological characteristics” or the “perceived risk” of a food hazard rather than the actual risk per se. According to the social psychologists, the social interpretations of food risk form the basis of the consumers’ concerns about a specific food they eat (Slovic et al. 1980). Social psychologists also report that the public’s perceived risk level differs from its actual acceptable risk level. In one study, the selected consumers revealed that their perceived risk was three times higher than their actual acceptable level of the risk from food colouring and food preservatives, indicating a high consumer reluctance to accept the perceived food risks (Fischhoff et al. 1978). The previous studies have noted that the consumers perceive a

higher food-related risk if they are not well informed about the risk, a fact which compromises their right to the free choice. The public risk perception is also found to be affected by the lifestyle profile, such as the individual consumption of fat and sugar, the individual acceptable level of the hygiene standard and tolerance of food additives (Miles et al. 2004). Given that much of the public’s reaction to food risk could be attributed to the “social interpretations” of hazard, questionnaires have been employed as an efficient approach to gathering the expressed preferences to measure the public’s attitudes and behaviour towards food risks (Fischhoff et al. 1978).

Consumers’ perceived food-risk in milk was found to change with the addition of preservatives, the level of fat content, and the packaging materials used. For example, Mitsostergios and Skiadas (1994) revealed that low preservatives in milk drive the consumers’ preference for fresh pasteurized milk in Chania, a city in Greece. More recently, increased incidents of chemical and bacterial contaminations of milk have raised the public attention about human health and social economic consequences. Consumers’ considerations of milk quality have changed and the factors such as how the product is produced, e.g. using organic production methods or with regard to animal welfare (Grunert et al. 2000), have become more influential in changing the consumption decisions.

Though the per capita consumption of milk in China is far below the United States and Europe, the demand, particularly in urban regions, is notably growing. Agricultural economists have pointed out that “the potential exists for further increases in consumption as more consumers, especially the younger generations; develop a taste for dairy foods” (Ma and Rae 2004, p. 3). Young, educated Chinese consumers are an emerging and important market segment of dairy products as a result of the improved family incomes and their willingness to patronize the western style food suppliers, which generally provide dairy products. In addition, the self-perceived health consciousness also explains their milk consumption (Xu et al. 2009). The enhanced government food inspections and monitoring systems, the enforced food safety laws, and the increased availability of product information, such as the “pollution free” or “green food” logos, have provided an important assistance in facilitating the purchase among young consumers in China. Though previously perceived to be a relatively more price sensitive compared to other Asian consumers, younger generations of Chinese consumers have shown the willingness to pay a modest premium for the certified safe milk products (Wang et al. 2008).

## RESEARCH METHODOLOGY

### Survey design

In this study, a 9-page questionnaire was used to collect information from college students. The questionnaire was pre-tested with two college students in Beijing and it was revised accordingly to adjust the comments from the two pre-test takers. Questions regarding the students' milk consumption, health concerns, worries about milk risks, factors affecting milk consumption decisions, and demographics were collected. The milk risk worries questions were based on the previous findings from a UK food safety standard study (UK Food Standards Agency, as cited by Miles et al. 2004). Questions about the consumption decision shifters were suggested by a milk market research report published by the China Dairy Industry (in Chinese, as cited by Luo 2002). The question about the students' monthly food expenditures was adjusted using the information on college students' consumption behaviour (Statistics Department of China Nanjing University, Research Report, as cited by Yu and Yang, 2004). The question about the students' monthly milk expenditure was categorized and adjusted based on the published students' milk expenditure in the university bulletin board system (<http://www.glf.cn/html/54/n-9454.html>) and a telephone interview with two college students in Beijing (telephone interview with Miss Yang, at 8 p.m. on May 1<sup>st</sup>, 2008 and a telephone interview with Miss Xu, at 9 p.m. on May 1<sup>st</sup>, 2008).

### Data collection

Personal interviews were conducted with college students from a large university in Beijing, China (the total enrolments: 22 000 in 2008) in June and July, 2008. Students taking an economics course were provided the questionnaire at the end of the class and they were asked to complete the questions voluntarily. Teaching assistants administered the survey and answered the questions raised by the respondents. The questionnaire's designer was available by phone to address the respondents' concerns and questions. The total of 196 useful observations was collected.

### Variable selection

This study employs five categories of variables: (1) milk consumption; (2) demographics; (3) milk safety concerns and risk worries about selected risks sources; (4) health concerns; and (5) other factors affecting milk consumption. The following section discusses

the variable selection procedure and presents the basic statistics information.

*Milk consumption:* The respondents were asked to report the frequency of their milk consumption on the scale from one to six. As shown in Table 1, 19% of our respondents consumed milk once or more often per day. An additional 47% of them consumed milk on the weekly basis, varying from once per week to six times a week. The rest of 34% seldom had milk, with 15% consuming milk less than once per month.

*Demographics:* The college students' food consumption was influenced by their demographic structure such as age, gender, household income, food expenditures, and household size. Age was found to have an important impact on the food consumption of college students. A recent study using 2 579 college students from seven Chinese cities found that the college students aged 18 or above had a high level of stress, which resulted in a high frequency in the consumption of unhealthy fast-food and a reduced consumption of fruits (Liu et al. 2007). Table 2 shows the age distribution of our surveyed respondents.

The impact of gender on the college students' food consumption behaviour was examined by a group of

Table 1. Reported frequency of milk consumption by surveyed respondents

Frequency of milk consumption	Number of respondents (total $n = 196$ )	Percentage of respondents
< 1 time/ month	29	15
1–3 times/month	37	19
1–3 times/week	57	29
4–6 times/week	35	18
1 time/day	27	13
2 times/day or more	11	6

Table 2. Age distribution of survey respondents

	Total ( $n = 196$ )	Percentage of respondents
18 years and under	4	2
19	23	12
20	53	27
21	65	33
22	25	13
23	15	8
24	5	2
25	4	2
26 or older	2	1

Taiwan nutritionists who found out that male students drunk milk more often (0.81 times/day) than female students (0.66 times/day) (Wong et al. 1999 a, b). The public health researchers also discovered that male adolescents have a higher daily intake of milk than females (Larson et al. 2006). In our sample, 38% were males and we found out, to the contrary, that the female respondents were more likely to consume milk (mean  $3.31 \pm 1.39$ ) compared to the male respondents ( $2.83 \pm 1.42$ ). Consistent with our results, a recent research on the Chinese college students' dairy products consumption showed that the female students were more likely to consume ice-cream and yogurt than males (Xu et al. 2009). A higher concern for the body weight by the females perhaps explains this intended higher milk consumption. An information search on a popular Chinese health website indicated that many health professionals suggested that milk consumption contributes to the weight loss (women.soho.com).

The socio-economics variables, such as the students' household income, the monthly food expenditures, the monthly milk expenditure, and the size of the household, were included in the questionnaire (Table 3). A previous study found that the Chinese consumers' demand for fresh milk was positively affected by the household income. Particularly, when the income increases by 1%, the consumption of milk increases by 1.29% (Zhang and Wang 2003). The increased household income and thus food expenditure allows students to afford milk on a regular basis. Our sample

suggests that the students drink milk at least once per week if their household income is above \$583/month, in contrast to a lower consumption by those with the household income of \$583 or below (1 USD = 6.86 Chinese Yuan, the published exchange rate on June 30, 2008, the mid-point date during the month the personal interviews were conducted). Concerning the impact of the students' monthly food expenditure on milk consumption, the descriptive statistics suggest that among the 62 respondents who rarely drink milk, 42 of them (68%) reported relatively low monthly food expenditures of less than \$73 per month. A recent study showed that the college students' household size negatively affected their propensity to consume milk (Xu et al. 2009). Our sample revealed similar results: among the 38 students who consumed milk at least once per day, 30 were from a small household of three people or less.

*Milk safety concerns and risk worries:* The respondents were asked to rate, on a 5-point likert-type where one represents the least concern and five the highest concern, how sensitive they were about the safety of milk they consumed (Figure 1). Among the 196 respondents, 64% were moderately to highly worried about the safety of the milk (they selected 3, 4 or 5 for the likert-type question), and 36% indicated a relatively low concern (they selected 1 or 2). The respondents were then asked to indicate, on a likert-type scale of 1 to 5, the extent to which they were worried by 9 selected types of milk risks. Among these, four were associated with milk production and five with milk processing. Of the sample, 86% were highly or extremely worried about bacteria contaminations caused by the low sanitary standards in milk production and processing. A total of 77% were worried about the application of antibiotics on cows which they believed would create residuals in milk; 76% were concerned about chemical residuals in milk caused by the exposure of cow feed to environmental pollutants; 75% were concerned about the use of growth hormones on cows; and 65% indicated worries about unsafe milk due to the pesticides in cow feed. The surveyed respondents also indicated a great deal of worries about risks stemming from the improper milk processing. Eighty-six percent of our respondents reported that they were highly worried about the use of the deleterious materials to the packaged milk; 76% were disturbed by the high usage of food colouring and preservatives; 71% perceived milk as unsafe because of its high cholesterol content; and 56% were worried about the high sugar content. According to a dairy marketing survey with seven large food retailers in Beijing, the market share of low or non-fat milk (0.5% or less fat content) is as low

Table 3. Survey respondents' monthly household income, monthly food expenditure, monthly milk expenditure and household size

Household monthly income		
	definition	total in % (n = 196)
Low	less than \$637	34
Medium	\$637–\$874	37
High	\$875 or more	29
Students' monthly food expenditure		
Low	less than \$58	35
Medium	\$58–\$87	40
High	\$88 or more	25
Students' monthly milk expenditure		
Low	less than \$3	28
Medium	\$3–\$9	48
High	\$9.1 or more	24
Students' household size		
3 members or less	67%	
More than 3	33%	

as 9% of the total milk sales of the selected retailers (Milande Information 2000). The same report also disclosed that 31% of all milk products sold by the selected food retailers were sweetened, and 21% had an additive food colouring. This high portion of the regular and whole fat milk and milk with food additives and sugar may explain the worries our respondents had about these factors in milk.

*The impact of milk safety related factors on milk consumption:* The survey also included questions to assess the impact of the milk safety certifications, brand, shelf life and retail price on the consumers' milk purchase. Chinese consumers have been found to use the above factors to gauge the safety of milk. A previous survey showed that Chinese consumers believed that the shelf life (89%), brand (59%), and safety certifications (37%) are the indicators of safer

milk. Consumers were also found to be willing to pay a small premium for the certified milk brands (Wang et al. 2008). Our present study tested the importance of these factors on the respondents' milk consumption decisions and found that these factors remarkably affect the purchase decisions of many respondents (Figure 2). As suggested by the previous studies, we added a taste factor to examine its impact on consumption decisions (Fuller et al. 2004; Wang et al. 2008) and found out that 84% of our respondents felt that the taste of milk was important in shifting their consumption decisions. Interestingly, fewer respondents felt that the price and aroma of milk affected their purchase.

*Health concerns:* Three variables were used to examine the respondents' health concerns (Table 4). These variables include v students' concerns about their

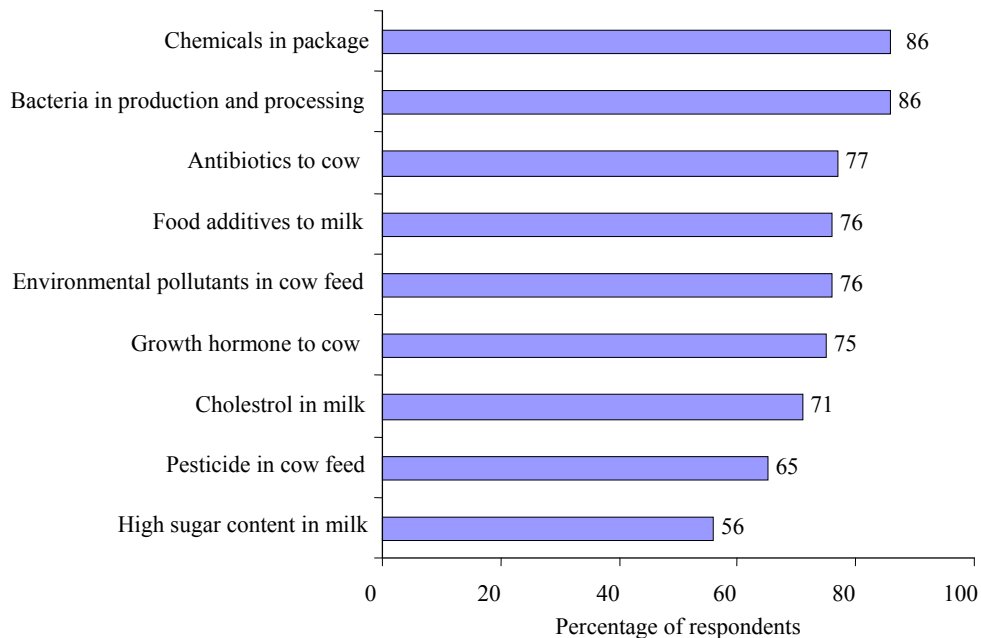


Figure 1. Selected sources of milk risks and the percentage of respondents who were worried about the risk ( $n = 196$ )

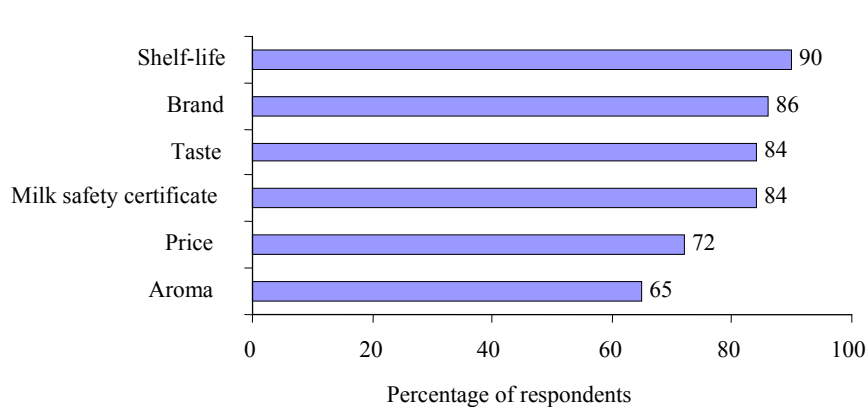


Figure 2. Safety-related factors on the milk purchase decision (% respondents rates the factor is important  $n = 196$ )

Table 4. Survey respondents reported concerns about health-related factors

Health factors	Percentage respondents concerned ( $n = 196$ )
Eating healthfully	81
Bone health	76
Body weight	74

bone health, eating healthily, and the body weight. Chinese college students have been educated about the importance of milk intake on the bone health since elementary school. The Chinese government has recently begun a school milk program to reinforce the consumption of milk among the elementary and middle school students to enhance the bone health of students (Fuller et al. 2007). As a consequence, the students' consciousness of bone health may influence their milk consumption and their willingness to seek the milk safety information, a factor which could change their perceptions of the milk-related food risks. The students' concerns about eating healthily were examined based on the suggestions from a previous study which revealed that only a small percentage of Chinese college students had the knowledge to identify healthy foods (7%), though many of them were aware of the importance of having nutritionally balanced diets and a great majority of them were willing to learn the ways to improve their dietary habits (Sakamaki et al. 2005). The study also discovered that a great number of Chinese college students (56%) believed that "thin or slim is beautiful" and a high percentage of the students had a dieting experience to control the intake of all foods because of a high consciousness of the body weight. Of our sample, 81% were highly concerned about the healthiness of the foods they consume; 76% respondents indicated a high concern about their own bone health; and 81% were concerned about their body weight.

### Regression analysis

A binary Probit regression was used to estimate the impact of the selected factors on the surveyed students' safety concerns:

$$SAFETY\ CONCERNS_i = x_i' \beta + \varepsilon_i = \beta_1(AGE_i) + \beta_2(GENDER_i) + \beta_3(HOUSEHOLD\ SIZE_i) + \beta_4(FAMILY\ MONTHLY\ INCOME_i) + \beta_5(FOOD\ EXPENDITURE_i) + \beta_6(MILK\ CONSUMPTION_i) + \beta_7(EAT\ HEATY_i) + \beta_8(PRICE\ CONCERNS_i) + \beta_9(TASTE\ PREFERENCE_i) + \varepsilon_i$$

The binary feature of the dependent variable determined that the application of a probit regression, as opposed to an ordinary least square regression, is appropriate. The probit regression's functional form accommodates the binary dependent variables and is therefore well-suited to this application.

Let the reported response from a specific respondent be equal to  $n_i$ :

$n_i$  = the reported safety concern of a specific respondent

$N_i$  = the predicted safety concern of a specific respondent

$N_i = 1$  if it is predicted that a respondent is concerned about milk safety

$N_i = 0$  if it is predicted that a respondent is not concerned about milk safety

The probability that a respondent is concerned about milk safety or not is a function of the selected parameters,  $\beta_j$

$$P[(n_i = 1)] = G(x_i' \beta) = G[\beta_1(AGE_i) + \beta_2(GENDER_i) + \beta_3(HOUSEHOLD\ SIZE_i) + \beta_4(FAMILY\ MONTHLY\ INCOME_i) + \beta_5(FOOD\ EXPENDITURE_i) + \beta_6(MILK\ CONSUMPTION_i) + \beta_7(EAT\ HEATY_i) + \beta_8(PRICE\ CONCERNS_i) + \beta_9(TASTE\ PREFERENCE_i)]$$

In this binary probit regression,  $G(\cdot)$  is the probit identity function which ensures that the computed probability is between 0 and 1.

$$P[(n_i = 1)] = G(x_i' \beta) = \int_{-\infty}^x g(v) dv$$

where  $g(v)$  is a standard normal density:

$$g(v) = (2\pi)^{-1/2} \exp(-v^2/2)$$

One important feature of the binary probit regression is the computed MLE (maximum likelihood estimator) which is consistent, asymptotically normal, and asymptotically efficient (Wooldridge 2002, p. 458). Based on the log (odds) function (Greene 2000), the maximum likelihood estimator is computed for each predictor (explanatory) variable. The estimated coefficients are presented in Table 5.

To further quantify the impact of each predictor on a respondent's probability of having safety concerns, marginal effects were computed. Marginal effects measure the change in a respondent's decision to choose a specific category, induced by a unit change in the predictor variable, holding all other variables constant (Wooldridge 2002). Marginal effects were computed using the "mfx" procedure in STATA, which calculates the marginal effect at the sample mean of each explanatory variable. The results of the marginal effect are presented in Table 5.

The overall model goodness-of-fit was tested using the likelihood ratio chi-square test (Greene 2000). A high chi-square value was obtained (LR = chi-square = 19.14) suggesting that the fitted model is significantly better than the restricted model, in which all estimated coefficients were set to zero (Table 5).

## RESULTS

Judging from the Probit results, four factors exhibit a significant impact on the respondent's milk safety concerns. These factors are: (1) frequency of milk consumption (CONSUMP at  $\alpha = 0.05$ ); (2) importance of eating healthy foods (HEALTH at  $\alpha = 0.1$ ); (3) family monthly income (INCOME at  $\alpha = 0.1$ ); and (4) family size (SIZE at  $\alpha = 0.1$ ). Our sample suggests that, compared to a respondent who does not consume milk often, a respondent who consumes milk several times per week or more was by 12% more likely to be concerned about the milk safety (marginal effects

in Table 5). This may be explained by the additional attention the frequent consumers paid to the subject. The frequent milk consumers were previously found to be more likely to choose the certified brands (Wang et al. 2008). Chinese consumers perceive food safety as an indicator of quality (Gale and Huang 2007). A survey of the urban Chinese consumers discovered that the brands transfer quality information and are used by many frequent consumers to gauge the quality of milk (Lou 2002). Another recent study reports that other factors Chinese consumers use to judge the safety of milk are, in the decreasing importance, the shelf life information printed on the product package, the reputation of a producer, and the reputation of a retailer (Wang et al. 2008). The frequent milk consumers were also found to use their previous experience to judge the quality of a specific brand and were found to be less likely to switch brands, if they are satisfied with the current one (Lou 2002). A frequent milk consumer has more knowledge, compared to a less frequent milk consumer, to identify a certified brand, to understand the shelf life information, and to differentiate a reputable milk producer or retailer from other suppliers. Such safety concerns by the frequent milk consumers suggest a critical role for the government to reduce the perceptions of risk. The government actions to impose more strict inspection standards, to publicize the inspection reports for the brands available in the market, and to display the milk safety-related information on product labels are the strategies that can raise the consumer confidence in milk. Moreover, given that our respondents were relatively well-educated college students who can understand the inspection technologies and procedures, the government agencies and the interested health organizations may consider creating educational programs to help the students to learn how milk is tested and what standards are used to regulate its quality. This may serve to reduce the perceived risks and to raise consumption.

We discovered that an average respondent who was worried about eating healthily was by 16% more likely to concern about the milk safety issues. The students' general desire for a balanced nutritious diet explains their preference for safer milk. Our sample demonstrated that the students' worries about milk hazards further led to the irregular consumption of milk. Among those who did not consume milk regularly (less than once per week), 52% indicated a high anxiety about milk safety, which, at least to some extent, discouraged them from consuming milk. Those who expressed a particular desire for a healthy diet were even more cautious to drink milk, given the apprehension about the potential milk hazards. In fact,

Table 5. Estimated coefficients and marginal effects: selected factors that affect the surveyed students' perceived milk risks

Variables	Coefficient	Marginal effects
AGE (Age)	0.1988 [0.33]	0.0397 [0.34]
GENDER (Gender)	-0.6576 [-1.49]	-0.1357 [-1.5]
INCOME (Household income)	0.7071* [1.72]	0.1460* [1.73]
FOODEXP (Student monthly food expenditure)	0.0236 [0.06]	0.0049 [0.06]
SIZE (Household member)	0.7771* [1.8]	0.1680* [1.75]
CONSUMP (Milk consumption)	0.5803** [1.97]	0.1198** [1.99]
HEALTH (Eating healthy)	0.7525* [1.92]	0.1558* [1.93]
PRICE (Impact of price)	0.5986 [1.24]	0.1156 [1.34]
TASTE (Impact of taste)	0.5414 [1.34]	0.1102 [1.37]
N	$n = 146$	
LR chi-square	19.14	
Prob > chi <sup>2</sup>	0.0241	

Standard errors are reported in brackets; \*represent a statistical significance at  $\alpha = 0.1$  to 0.05; \*\*represent a statistical significance at  $\alpha = 0.05$  to 0.01



the concept of “a balanced nutritious diet” has just recently become popular among the Chinese college students, indicating an elevated desire for a better health. According to the previous studies, milk has been perceived by college students as a healthy food and many students have consumed milk on a regular basis (Wang et al. 2008; Xu et al. 2009). Only lately, the adverse publicity about milk contaminations and the improved public awareness about milk hazards have affected the students’ consumption decisions. The concern about milk safety, as demonstrated by our sample, has become an important driver of the students’ milk consumption patterns. The adverse effects of the actual health risks about milk will require substantial efforts to eradicate. According to the published information, the Chinese government has raised the domestic food safety standards and established a national framework to ensure that the actual risk of milk is low (Wang et al 2008). However, the effectiveness of these regulations would be aided by the increased consumer awareness about the new regulations to reduce their perceived milk risks. Unfortunately, less attention is paid to change the consumers’ perceived milk risks, a factor which determines the consumption decisions. In fact, a recent survey has revealed that only a small percent (16%) of consumers had heard about the food hazard management system (HACCP) in 2005, two years after the regulation was implemented, and by the time most food processors had attained the certificate. Our study also shows that improving the signals sent to the college student groups concerning the safety of milk can reduce the uncertainty students face when it comes to drinking milk. Thus, the government can take actions to publicize its efforts to strengthen the milk safety standards to the student groups in order to change their milk perceptions and to improve their milk consumption.

The students’ family income was found to have significantly affected their milk safety concerns. Our sample suggests that those who reported a family income of \$583/month or higher were by 15% more likely to have expressed a high safety concern, compared to the less wealthy respondents. Our sample shows that the milk’s greater consumption among the wealthier households drives the concern for safety among the household’s children. In fact, the family members’ milk-drinking habits were found to influence the students’ consumption decisions. A recent study has revealed that, compared to a student without daily milk-consuming family members, a student with daily milk-drinking family members is more likely to consume milk frequently (Xu et al. 2009). Certainly, students with a higher household income were more

likely to afford milk on a regular basis, and more readily switched to other food items to avoid unsafe milk, given the high food expenditures they have.

The family size also matters. An average respondent from a household of more than three family members was found to be by 17% more likely to have a higher concern about the milk safety, in contrast to those who came from a smaller household of three members or less. This may indicate that the members of larger Chinese households were more likely to worry about the food safety issues and tended to communicate this concern to their children. Though the surveyed college students are independent and autonomous regarding their own consumption choices, their perceptions about milk safety were likely to be changed with the family members’ perceptions, if the size of the household is large. Interestingly, other research using subjects from the North America showed, to the contrary, that the household size has a negative impact on the food safety concerns, giving the fact that, as the household size increases, the consumers tend to practice a less safe refrigeration of food (USDA 2008).

## CONCLUSION

The frequent publicity about contaminated food has damaged the Chinese consumers’ faith in their food supply, prompting the government officials to improve and better enforce the overall food safety standards. To assist the policy decision making, empirical studies about food safety have emphasized the producer welfare (Zhang 2008); the government standards for safer food (Calvin et al., 2006); and more recently also the food supply channels and food exports (Chen et al. 2008; Huang et al. 2008). Consumer perceptions and awareness of food safety have received less attention from academic researchers, though the government officials have sought research results to inform about the appropriate food safety regulations and to guide the public health organizations’ health promotional programs. Among the food safety-related concerns of consumers, one common complaint centres on milk safety. Chinese consumers are unfortunately wrong to assume that they are immune from the milk hazards, placing too much faith in the government inspections of milk producers and the strict regulation of milk suppliers by the State Ministry of Agriculture. This was painfully demonstrated with the outbreak of several milk contamination incidents in Southern China, in early 2008, causing severe illness in hundreds of children (Southern China News 2008). In the wake of such events, the government has taken

remarkable steps to strengthen the regulations on production and processing to eliminate the sources of risk and to improve the quality control. However, these efforts must be matched by an equivalent government campaign to better inform the consumers about the reality of the risks they face. Questions such as which groups of consumers are risk sensitive and what risks worry them are important to help creating efficient support programs to reduce the public risk worries. The objective of our survey is to provide insights to the above questions by highlighting the college student group, a newly emerged and important segment, and examining their perceived risks associated with milk. We can draw three critical conclusions from our study.

First, the majority of surveyed students (64%) indicated an overall high concern about the safety of milk. The top listed concern was adverse chemical pollutants in milk caused by the use of the low quality materials in packaging (86%). In fact, 62% of the fluid milk sold in the Beijing market uses paper materials and the rest plastic materials (Milande Information 2000), a fact which worries consumers since the low quality packaging is connected to chemical pollutants in milk, as expressed by our respondents. Certainly, these articulated worries about the low quality packaging materials should catch the attention of the milk safety policy makers. Moreover, bacteria contaminations in production and processing of milk worried 86% of our respondents, and caused 52 respondents (27%) to seldom consume or to stay away entirely from milk. In addition, we found the use of cow antibiotics also highly concerns our respondents. Though the Chinese government has implemented a strict system since 2005 to ensure zero antibiotics in milk, and advanced technologies have been widely applied in milk processing to reduce bacteria to a safe level, the consumers lack awareness of that and are constantly worried about antibiotics and bacteria in milk. This absence of a sufficient public understanding about the already implemented milk safety regulations should signal the need for the additional government efforts to convey the safety features of milk to the consumers to change their safety perceptions.

Second, our sample suggests that the consumers' improved health awareness has shifted the pattern of milk consumption. A decade ago, Chinese consumers were less aware of the adverse health effects caused by food preservatives, a high cholesterol, and high sugar content in milk. Thus the consumption of the whole fat and high sugar milk found a substantial share of the overall milk consumption. With the improved health consciousness, a shift in consumption prefer-

ences to the low-fat and skim milk has appeared. Our sample shows that the majority of respondents are worried about food additives (76%), high cholesterol (71%), and high sugar (56%). Though the awareness of the harmful effects of these factors emerged only recently among the Chinese consumers, these factors have mattered to the western consumers since the early 1990s. A study on the Norwegian consumers' food choices found that many were cautious about fat and food additives (Wandel 1994). Our results indicate a relationship between the health consciousness and the milk safety concerns. We envision the demand for healthy milk by college students to be satisfied by milk suppliers who offer the lower-fat, less-sweetened and lower food additive-treated milk. Currently, the low fat and non-fat milk only form a small share (9%) of the overall milk supply in Beijing, while the sweetened milk was sold by many food retailers (20% market share) (Milande Information 2000), and food additives are widely used to extend the shelf life of many milk products (Food Safety 2007). Milk safety policy makers can take actions to adjust the market supply to meet the new demand for healthier milk.

Third, our survey demonstrates that the frequent milk consumers from large households with high incomes are more likely to be concerned about the safety of milk. Initially, our survey has shown that a significant percentage of the respondents were worried about different risk hazards in milk. This worry was found to be substantially higher for those who drink milk on a daily basis. Without sufficient assurances of milk safety, the frequent milk consumers are likely to move in the opposite direction and to reduce or quit their milk consumption. High household incomes can afford available substitutes. In fact, price has already been shown to be less important, compared to the safety concerns, in influencing the milk consumption of our respondents. The elevated concerns about milk safety can to a great extent be attributed to the repeated milk safety incidents which have resulted in the widespread detrimental effects on the public health. Unless policy makers take immediate actions to communicate information to reduce these worries, the public faith in milk is less likely to be restored soon and the consumption of milk may continue to decline. While the government must remain vigilant in raising and enforcing the quality standards in milk, it must also recognize the important role of conveying the milk safety information to reduce the consumers' perceived risks. Despite the demonstrated significance of the public perceptions of milk safety, to date, nothing significant towards this objective has been done.

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