Children's Health Behavior and New Preventative Health Products in Rural China*

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Abstract

How to help children develop correct health habits and improve people's health to eventually promote the quality of labor productivity is an important issue for the population of developing countries. Understanding how consumers adopt and demand new health products can also help governments or NGOs design more effective interventions. This study utilizes surveys and randomized field experiments conducted in a rural village in China to study the impact of oral health promotion education on children's demand for dental floss picks and their health behavior. Preliminary results show that children are highly sensitive to price. Children who learned the oral health promotion intervention – learning to sing Tooth Brushing Song – are willing to pay higher on dental floss picks, but the actual quantity bought in the experiment was not significantly higher than the control group. In a follow-up survey, we find that students increase the frequency of tooth brushing on average, but the spillover effects are not as strong as in the literature. More risk-loving students are more likely to adopt the new product but less likely to tell their family about the product. We find no evidence that time preference affects the demand or the health behavior.

1 Introduction

Preventive health products have been proved to be much more cost-effective than cures after infection for most diseases. Under the assumption of rationality, people should invest in preventive health products to avoid high cost of curing diseases or even death in the future. However, current disease prevalence shows that the preventive behaviors have not reached the optimal level, especially in developing countries with lower life expectancy and poorer health conditions. Many studies have shown that investment in preventative health products is generally low among poor households and tends to fall off rapidly at even small positive prices (Ashraf, Berry and Shapiro 2010; Cohen and Dupas 2010; Dupas 2009, 2014). How to promote the demand for preventive health products becomes important for policy design to improve the health condition, which will have further impacts on the quality of labor force and economic development.

Recent medical and development economics literature have proved the high benefit of low-cost preventative health products, such as chlorine for water (Arnold and Colford 2007; Fewtrell, Kaufmann, Kay, Enanoria, Haller and Colford 2005), insecticide-treated bed nets (Lengeler 2004), and iron supplementation (Bobonis, Miguel and Puri-Sharma 2006; Thomas, Frankenberg, Friedman, Hakimi, Ingwersen, Jaswadi, Jones, McKelvey, Pelto, Sikoki, Seeman, Smith, Sumantri, Sumantri and Wilopo 2006). In this paper, our focus on oral health and more specifically, dental floss picks, suggests a new direction for health promotion in developing countries.

Oral health has received relatively little attention in development economics compared with other diseases such as AIDS, malaria, etc. Nevertheless, according to WHO, "despite great achievements in oral health of populations globally, problems still remain in many communities all over the world − particularly among under-privileged groups in developed and developing countries... At present, the distribution and severity of oral diseases vary among different parts of the world and within the same country or region. The significant role of socio-behavioural and environmental factors in oral disease and health is evidenced in an extensive number of epidemiological surveys."[1] Especially, people in developing

[1] `http://www.who.int/oral_health/disease_burden/global/en/`. Retrieved on 2015/10/3.

countries are burdened excessively by oral diseases, aggravated by poverty, poor living conditions, ignorance concerning health education, and lack of government funding and policy to provide sufficient oral health care workers (Pack 1998).

Flossing is an effective adjunct to toothbrushing because it cleans the considerable area on the proximal surfaces of teeth, which cannot be reached by the bristles of the toothbrush (Bass 1948; Sambunjak, Nickerson, Poklepovic, Johnson, Imai, Tugwell and Worthington 2011). The American Dental Association (ADA) recommends brushing twice a day and cleaning between teeth with floss (or another interdental cleaner) once a day.[2] Two debates are still on-going: first, a recent investigation by the Associated Press (AP) suggests that research about flossing is severely lacking;[3] second, some studies argue that using other interdental cleaners might be better than flossing (Slot, Dörfer and Van der Weijden 2008; Imai, Yu and Macdonald 2012). However, it is generally agreed that floss helps cleaning between teeth, which cannot be done effectively by toothbrush bristles alone, and flossing is still a low-risk and low-cost practice essential to the daily oral hygiene routine.

This study utilizes surveys and randomized field experiments conducted in a rural village in Henan Province of China to study the impact of oral health promotion education on children's demand for dental floss picks and their health behavior. Children usually develop the ability to floss on their own around the age of 10 according to the ADA.[4] The students in our sample are all 4th to 6th graders, and 96% of the sample are at least 10 years old, who are just the right age to learn flossing. Targeting on school children and youth is also one of WHO's priority actions areas.[5]

Although using children as the subject of economics experiments is relatively rare, evidences have shown that children from 8 years and older can report meaningfully on their health (Riley 2004). Children's consumption demand is almost neglected except

[2] `http://www.ada.org/en/science-research/ada-seal-of-acceptance/product-category-information/floss-and-other-interdental-cleaners`. Retrieved on 2015/10/3.

[3] `http://bigstory.ap.org/article/f7e66079d9ba4b4985d7af350619a9e3/medical-benefits-dental-floss-unproven`. Retrieved on 2016/8/12.

[4] `http://www.ada.org/~/media/ADA/Science%20and%20Research/Files/cavity_prevention_tips.ashx`. Retrieved on 2015/10/3.

[5] `http://www.who.int/oral_health/action/en/`. Retrieved on 2015/10/3.

for some rare examples such as beverage (Yen and Lin 2002), but the hypothesis that children may have influence on their mothers' consumption preferences has been examined theoretically and empirically (Bocker 1986). Understanding the consumption preference of children thus can be important not only because it is relevant to their demand after they grow up but also because they may affect their parents' demand at present.

Preliminary findings show that children who learned the Tooth Brushing Song are willing to pay higher on dental floss picks, but the actual quantity bought in the experiment was not significantly higher than the control group. Some students increase their frequency of tooth brushing, but the spillover effects are not as strong as in the literature.

2 Experimental Design

Our study was conducted in a rural village in Henan Province of China in July 2015. Among 31 provinces in China, Henan has the third largest population (77,688,000) and ranked 22nd in GDP per capita.[6] The rural village is near the Yellow River, the third-longest river in Asia.

Our sample came from an English summer camp taught by Taiwanese college students. The summer camp has been held in the same village in the two previous years and has established a good reputation in the area. The registration fee is 10 RMB (Chinese currency, around 1.50 USD), which is very affordable at the local standard. The camp lasted for eight days from eight in the morning to around five in the afternoon with a lunch break from twelve to two. During the regular academic year, all students from the 3rd grade are required to study English at school for about one hour per week. The primary aim of the camp is to teach English songs as a supplement to students' English learning and to increase their motivation of learning English. The curriculum is also designed to teach students good manners and living habits. The oral health promotion is a new element this year and is designed to be analyzed in this paper.

The timeline of the whole research design and data collection is described as below.

[6] `http://data.stats.gov.cn/english/easyquery.htm?cn=E0103`. Retrieved on 2015/10/12.

- Day 1: All students filled out a basic survey and then learned the importance and techniques of using toothbrushes and dental floss picks.
- Day 2:
  - In the morning, students were randomly assigned to Group A (treatment) and B (control). Group A learned the Tooth Brushing Song, an English song about brushing teeth with gestures, on the second day morning.
  - In the afternoon, all students gathered together and participated in the experiment, which will be explained in detail in the next paragraph.
- Day 3: Group B learned the Tooth Brushing Song for the first time.
- Day 4:
  - Group B reviewed the Tooth Brushing Song.
  - At the end of the day, all students gathered together and participated in a follow-up experiment.
- Days 5-7: All students reviewed the Tooth Brushing Song without being divided into Groups A and B.
- Day 8: All students filled out a follow-up survey.

Several recent papers estimate experimental demand curves by providing households with coupons for randomly selected discounts that could be redeemed in exchange for a given health product (such as Ashraf et al. (2010); Cohen and Dupas (2010); Dupas (2009); Kremer and Miguel (2007); Meredith, Robinson, Walker and Wydick (2013)). For the experiment on Day 2, we modified this method by designing a game where students can buy either notebooks or dental floss picks, both were represented by stickers. At the beginning of the game, each participant received tokens of 9 RMB (Chinese currency, around 1.50 USD) as endowment. Both products cost 3 RMB (Chinese currency, around 0.50 USD), equivalent to the market price of a 30-day use. We randomly distributed coupons for 0.5, 1, 1.5, 2, or 2.5 RMB. Coupons could only be used for buying dental

floss picks. All students received the coupons by lottery at the same time, and then they were asked to choose between floss picks and a notebook. Once the decision had been made, the student received a sticker of the chosen good, and the transaction ended. The same transaction was repeated for three times. Each student recorded the coupon values they received and the consumption decisions they made on his or her game sheet. After three transactions, students were asked to write down a price which they are willing to pay for a 30-day package of dental floss picks. All students received 5 dental floss picks as the reward of participating the game. On Day 4, students received the game sheet they filled out on Day 2. Students were asked to examine again the three coupons they received on Day 2 and to choose again.

The descriptive statistics and the randomization check of the two groups are shown in Table 1.

[Table 1 about here.]

The household size is 4.7 on average, similar to the size of a nuclear family in either developing or more developed countries. However, only 63% of the sample live with the father and 75% with the mother, which reflects that many fathers or both parents work in cities and leave the children behind with the grandparents. 29 out of 68 students have at least one parent not living together and among these students, 20 live with at least one grandparent. The Chinese one-child policy is not very strictly enforced in rural China so only 16% of the students are the only child living in this house, and the average number of siblings is 1.3.

Regarding the oral health behavior, only 17.65% of the sample brush their teeth twice a day or more. This is much lower than a 1996 national representative study, which shows 31% of the 12-year-old rural Chinese children brush their teeth twice a day or more (Zhu, Petersen, Wang, Bian and Zhang 2003).[7]

The dental floss pick is almost a totally new product for the students in this study. In our sample of 68 students, only one student has seen and used a floss pick before (in

[7] The national study includes 11 provinces, Beijing, Shanghai, Tianjin, Gansu, Shandong, Yunnan, Liaoning, Zhejiang, Hubei, Guangdong, Sichuan, not including Henan, the province of our study.

Fujian). Only three students have seen floss and only two have used it before. None of them has the habit of flossing.

A hypothetical card game scenario was described in the Day 1 survey to estimate the student's risk and time preference.

- Risk Preference: *"Now we are giving you 10 cards, and you can decide how many cards to bid. The teacher is going to toss a coin. If it shows head, you will get double number of the cards you bid. If it shows tail, you will lose the cards you bid. The person with most cards is the winner. How many cards would you bid?"*

- Time Preference: *"Which one would you choose – to get 10 cards NOW or to get 15 cards at the end of the English camp if you are willing to wait?"*

A higher number of cards reflects a higher risk tolerance. The students in our sample are not very risk-loving, with an average 3.1 out of 10. The time preference is a binary variable with 1 being students who choose to wait and 0 for those who want to get it now. 77.9% of the sample chose to wait.

Some additional information was collected at registration and during the camp. All students are between 4th to 6th grade, and the age ranges from 9 years old to 13 years old. This is the third year that the English summer camp was held in this village. 50% of the students joined the camp in previous year(s). A parent's meeting was held to share the mission of the camp with student parents, and 60% of the student have at least one parent or guardian attending the meeting.

There are a bit more girls (56%) than boys (44%) in the camp. Several reasons might contribute to this unbalanced gender ratio. First, due to traditional son preference in China and the one-child policy is not strictly enforced in the area, some parents continue to give births until getting a son so more girls were born. Second, although parents might want to invest more in sons, girls are generally more motivated and well-performed in learning English than boys. As we see from the registration record, 50% of the girls reported their English level as excellent or good, while only 34.5% of the boys fell in this category and the rest claimed to do worse or even fail in English. Third, parents who are

migrant workers in cities might take the sons with them but leave the daughters in the village to invest more in sons. Unfortunately, we do not have the birth records or census statistics to make further conclusions.

10% of the students did not join the camp from the very beginning, 8:00 am on Day 1, but all students received the basic oral health information before they were randomly assigned into Group A or B.

Across all variables, p-values from the t-test are all larger than 5% so there is no significant difference between Group A and B before the intervention.

3 Empirical Methodology

Since all treatments were randomized, we can obtain an unbiased effect of the main intervention, learning Tooth Brushing Song, on outcome variables of interest with the following specification:

$$Y_i = \alpha + \beta Treat_i + \gamma X_i + \epsilon_i \tag{1}$$

where Y_i are the outcome variables of interest, including the willingness to pay for floss picks, the total number of floss picks bought on Day 2, whether the student brushed teeth more frequently during the camp, whether the student taught his or her family members about using toothbrushes or dental floss picks, and the number of times the student used dental floss picks during the camp. $Treat_i$ is 1 if the student belongs to Group A and 0 if Group B. X_i is a set of control variables, including the gender, age, household size, whether the student brushed teeth at least once a day before the camp, whether the student has seen the floss or floss picks before, the student's measures of risk and time preference, whether the student's parent(s) or guardian attended to the parent's meeting, whether the student has ever joined the camp in previous year(s), and whether the student joined the camp late.

4 Preliminary Results

4.1 Demand for Dental Floss Picks

Our first main result is to estimate the demand curve for dental floss picks. We present this graphically in Figure 1. Panels (a) and (b) pools all transactions in Day 2 and 4. As can be seen, demand falls off relatively quickly with the price. Panel (b) shows that Group A, who learned the brushing teeth song earlier, has a higher demand than Group B, who learned the song later. Panels (c) and (d) show that this difference becomes larger on day 4 after Group B learned the brushing teeth song.

[Figure 1 about here.]

We also focus on the game results on Day 2 to examine the willingness to pay and total number of floss picks bought by equation (1). The regression results are presented in Table 2. Group A are willing to pay 2.6 RMB more than Group B, and the coefficient is statistically significant. There is no significant difference on the total number of floss between the two groups. For both measures, boys are less willing to buy dental floss picks. Higher risk preference is associated with higher demand for dental floss picks, which makes sense that more risk-loving people are more interested in a new product.

[Table 2 about here.]

4.2 Oral Health Behaviors

After the 4th day, no more treatments were added, and all students practiced singing and dancing the Tooth Brushing Song for numerous times. We use the survey conducted on Day 8 to understand the behavioral change compared with the Day 1 survey. Figure 2 shows an obvious increase in tooth brushing during the English camp. Figure 3 shows the change in each group, and Group A shows a larger improvement despite the strengthening design of Group B.

[Figure 2 about here.]

[Figure 3 about here.]

More results of the Day 8 survey are summarized in Table 3. We also construct a binary variable to show whether the student increase its frequency and see that 45.9% of the students increase the frequency during the English camp. The share of the students brushing teeth twice a day increased by 26.61 percentage points. 96.72% of the students has tried to use the dental floss pick since they received the first dental floss pick on Day 1 and five more on Day 2. Regarding the spillover effect, 57.4% taught other family members how to (correctly) use the toothbrush, and 75.4% taught their family how to use the floss picks. This spillover effect is not as positive as a Brazilian study where 90.5% of parents report that they learned something related to oral health from their preschool children and 87.3% thought there has been some change in oral habits of family members (Garbin, Garbin, Dos Santos and Lima 2009).

[Table 3 about here.]

The estimation results using equation (1) are displayed in Table 4. The two groups are not significantly different in brushing more frequently, family spillover or the use of floss picks. Students who brushed teeth at least once a day before the camp are less likely to improve in the brushing frequency, which makes sense by definition, but are more likely to teach other family members how to brush correctly and use floss picks for more times. More risk loving students are less likely to teach their family about using floss picks. This is different from their own decision on higher willingness to pay and higher quantity demanded on Day 2, which suggests that the more risk-loving nature might increase adoption of a new product at the individual level but might not have further spillover effects.

[Table 4 about here.]

5 Conclusions

In this study, we use surveys and randomized field experiments in a Chinese rural village to study the impact of oral health promotion education on children's demand for a new

health product, dental floss picks, and their health behavior. Preliminary results show that children who learned the Tooth Brushing Song are willing to pay higher on dental floss picks but the actual quantity bought in the experiment was not significantly higher than the control group. Some students increase their frequency of tooth brushing but the spillover effects are not as strong as in the literature. More risk-loving students are more likely to adopt the new product but less likely to tell their family about the product. We find no evidence that time preference affects the demand or the health behavior. These findings should be treated with care due to the small sample size and the short time period.

Short-term camps for children in poor areas have been a popular intervention to improve educational performance and living habits. This study performed one of the earliest randomized controlled trails on the outcomes of the children's camp.

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Tables

Table 1: Descriptive Statistics and Randomization Check

Variable	Overall mean	Std. Dev.	Min	Max	Group A	Group B	p-value for t test
number of household members	4.662	1.205	2	8	4.697	4.629	0.82
living with dad's dad	0.338	0.477	0	1	0.303	0.371	0.56
living with dad's mom	0.382	0.490	0	1	0.424	0.343	0.50
living with mom's dad	0.074	0.263	0	1	0.061	0.086	0.70
living with mom's mom	0.088	0.286	0	1	0.030	0.143	0.11
living with dad	0.632	0.486	0	1	0.667	0.600	0.58
living with mom	0.750	0.436	0	1	0.758	0.743	0.89
number of older brothers	0.132	0.341	0	1	0.121	0.143	0.80
number of older sisters	0.368	0.596	0	2	0.333	0.400	0.65
number of younger brothers	0.471	0.610	0	3	0.576	0.371	0.17
number of younger sisters	0.324	0.531	0	2	0.333	0.314	0.88
number of siblings	1.294	0.865	0	4	1.364	1.229	0.52
number of other members	0.132	0.420	0	2	0.091	0.171	0.43
frequency of brush use a week	2.382	1.051	1	5	2.364	2.400	0.89
...(1) twice a day or more	17.65%				15.15%	20.00%	
...(2) once a day	50.00%				54.55%	45.71%	
...(3) several times a week	10.29%				12.12%	8.57%	
...(4) sometimes	20.59%				15.15%	25.71%	
...(5) never	1.47%				3.03%	0.00%	
brush at least once a day	0.676	0.471	0	1	0.697	0.657	0.73
have you ever seen a floss pick? (1=yes)	0.015	0.121	0	1	0.030	0.000	0.31
have you ever used a floss pick? (1=yes)	0.015	0.121	0	1	0.030	0.000	0.31
have you ever seen floss? (1=yes)	0.044	0.207	0	1	0.091	0.000	0.07
have you ever used floss? (1=yes)	0.029	0.170	0	1	0.061	0.000	0.14
risk preference (10 the most risk-loving)	3.103	2.711	0	10	2.667	3.514	0.20
time preference (1=patient)	0.779	0.418	0	1	0.788	0.771	0.87
male=1, female=0	0.441	0.500	0	1	0.424	0.457	0.79
grade year	5.029	0.810	4	6	5.091	4.971	0.55
age	11.088	1.058	9	13	11.121	11.057	0.81
joined the English camp in previous year(s)	0.500	0.504	0	1	0.576	0.429	0.23
self-reported English level (1 the poorest, 4 the best)	2.358	1.055	1	4	2.438	2.286	0.56
joined the English camp late	0.103	0.306	0	1	0.152	0.057	0.21
parent came to the parents' meeting	0.603	0.493	0	1	0.667	0.543	0.30
number of observations	68				33	35	

Table 2: Game Results

	(1) willingness to pay for 30-day floss picks	(2) total number of floss bought on Day 2
treat (Group A)	2.632***	0.155
	(0.945)	(0.166)
male	−2.866**	−0.399**
	(1.117)	(0.196)
number of household members	−0.511	−0.0170
	(0.408)	(0.0715)
brush teeth at least once a day	0.406	−0.0727
	(0.960)	(0.168)
have seen floss picks	−2.990	−1.292
	(4.743)	(0.831)
have seen floss	−0.764	0.286
	(2.654)	(0.465)
risk preference	0.468**	0.0653*
	(0.201)	(0.0352)
time preference	−1.409	−0.220
	(1.149)	(0.201)
parents' meeting	−0.441	0.232
	(1.045)	(0.183)
age	0.506	−0.0723
	(0.462)	(0.0809)
joined in previous year(s)	−1.409	−0.283
	(1.062)	(0.186)
joined the camp late	−3.812**	−0.158
	(1.647)	(0.288)
constant	1.373	3.297***
	(6.266)	(1.097)
observations	65	65

Notes: Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Table 3: Descriptive Statistics at the End of the Camp

Variable	Overall mean	Std. Dev.	Min	Max	Group A	Group B	p-value for t test
During the English camp (past week),							
how many times did you use the toothbrush?	9.443	4.745	0	17	10.156	8.655	0.22
how often did you use the toothbrush?	1.770	0.902	1	5	1.719	1.828	0.64
...(1) twice a day or more	44.26%				50.00%	37.93%	
...(2) once a day	42.62%				37.50%	48.28%	
...(3) several times a week	6.56%				3.13%	10.34%	
...(4) sometimes	4.92%				9.38%	0.00%	
...(5) never	1.64%				0.00%	3.45%	
brush at least once a day	0.779	0.418	0	1	0.849	0.714	0.19
brush more frequently than before (constructed)	0.459	0.502	0	1	0.438	0.483	0.73
how many times did you use the dental floss picks?	5.246	3.438	0	16	4.906	5.621	0.42
how often did you use the dental floss picks?	2.738	1.182	1	5	2.625	2.862	0.44
...(1) twice a day or more	16.39%				18.75%	13.79%	
...(2) once a day	32.79%				31.25%	34.48%	
...(3) several times a week	14.75%				21.88%	6.90%	
...(4) sometimes	32.79%				25.00%	41.38%	
...(5) never	3.28%				3.13%	3.45%	
did you teach your family about using							
...toothbrush?	0.574	0.499	0	1	0.500	0.655	0.23
...dental floss picks?	0.754	0.434	0	1	0.750	0.759	0.94
number of observations	61				32	29	

Table 4: Oral Health Behavior at the End of the Camp

During the English camp,	(1) brush more frequently	(2) taught family about using toothbrush	(3) taught family about using dental floss picks	(4) # of times used dental floss picks
treat (Group A)	−0.0118	−0.113	−0.0717	−0.986
	(0.137)	(0.135)	(0.119)	(0.956)
male	−0.0926	−0.227	−0.154	0.631
	(0.160)	(0.158)	(0.139)	(1.118)
number of household members	−0.00748	0.0230	−0.0311	−0.267
	(0.0586)	(0.0576)	(0.0508)	(0.408)
brush teeth at least once a day	−0.427***	0.345**	0.147	2.223**
	(0.141)	(0.138)	(0.122)	(0.980)
have seen floss picks	0.570	−0.834	0.670	2.401
	(0.675)	(0.664)	(0.585)	(4.707)
have seen floss	−0.0922	0.0376	0.00228	−0.580
	(0.378)	(0.372)	(0.328)	(2.636)
risk preference	0.00619	0.0245	−0.0544**	0.0135
	(0.0308)	(0.0302)	(0.0267)	(0.215)
time preference	0.0126	0.193	−0.112	1.192
	(0.165)	(0.162)	(0.143)	(1.152)
parents' meeting	0.0067	0.107	0.0305	−0.539
	(0.156)	(0.153)	(0.135)	(1.086)
age	−0.0886	−0.0567	−0.0157	0.254
	(0.0695)	(0.0684)	(0.0603)	(0.485)
joined in previous year(s)	−0.239	−0.119	−0.121	0.267
	(0.157)	(0.155)	(0.137)	(1.098)
joined the camp late	−0.189	−0.145	0.264	2.733
	(0.242)	(0.238)	(0.210)	(1.685)
constant	1.931**	0.823	1.325	1.308
	(0.931)	(0.916)	(0.808)	(6.496)
observations	61	61	61	61

Notes: Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Figures

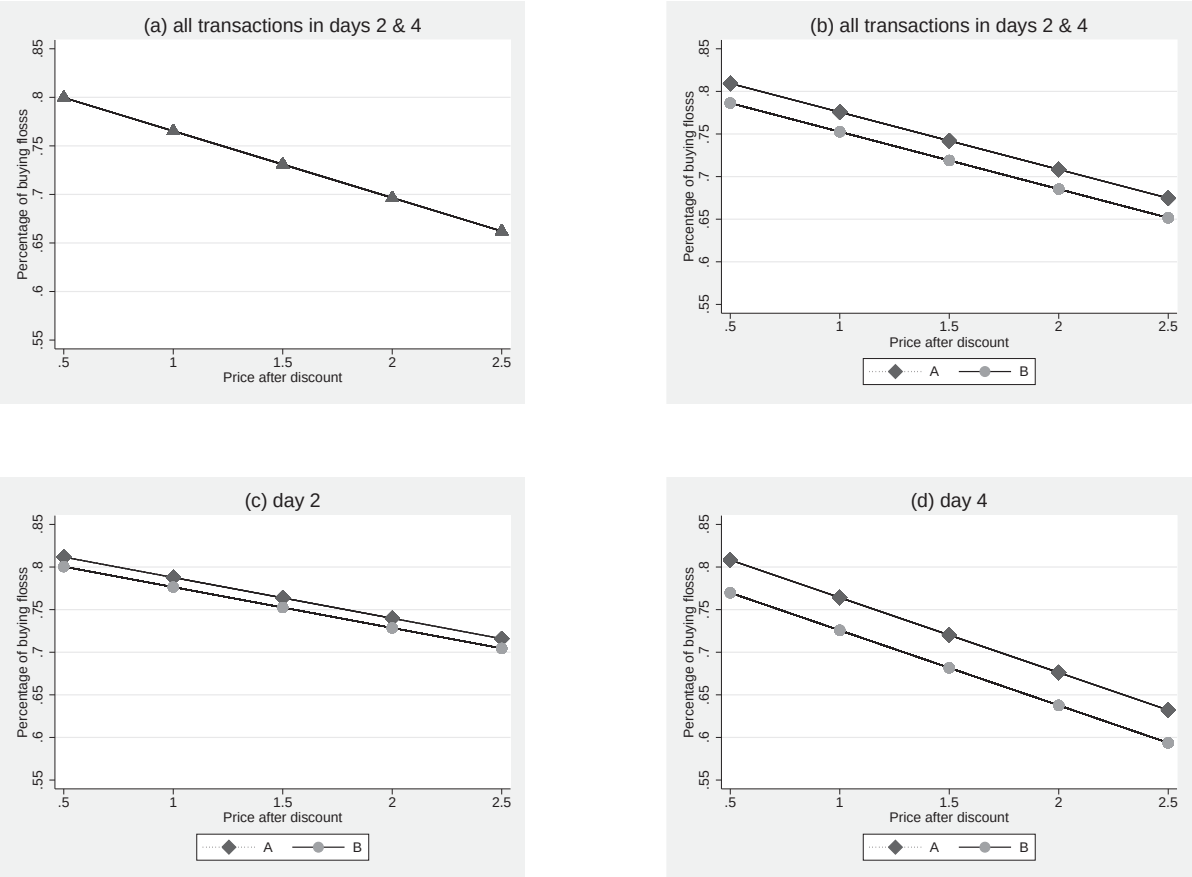
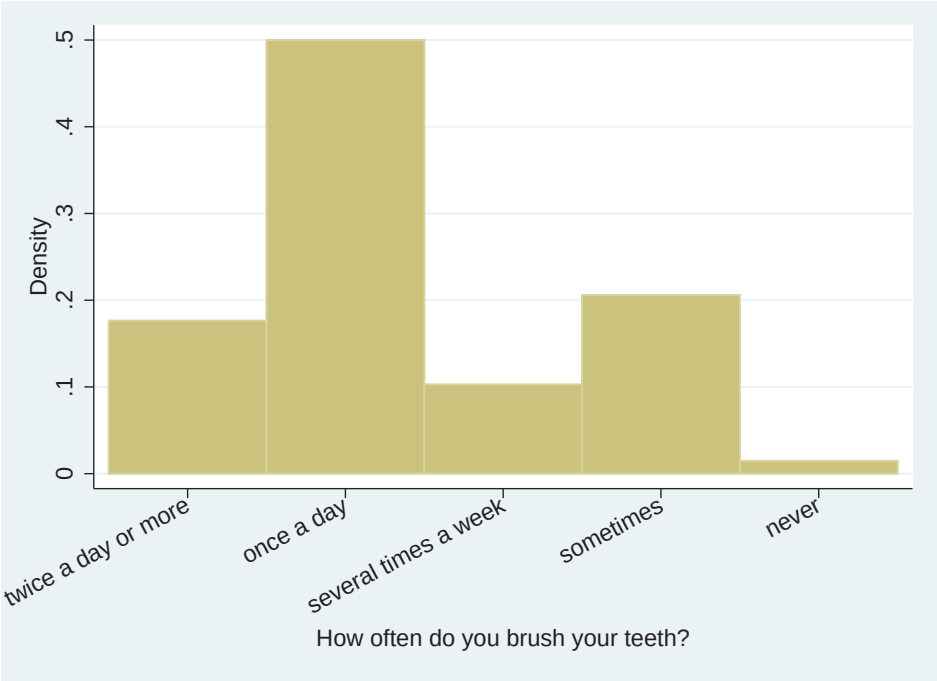


Figure 1: Demand for Floss



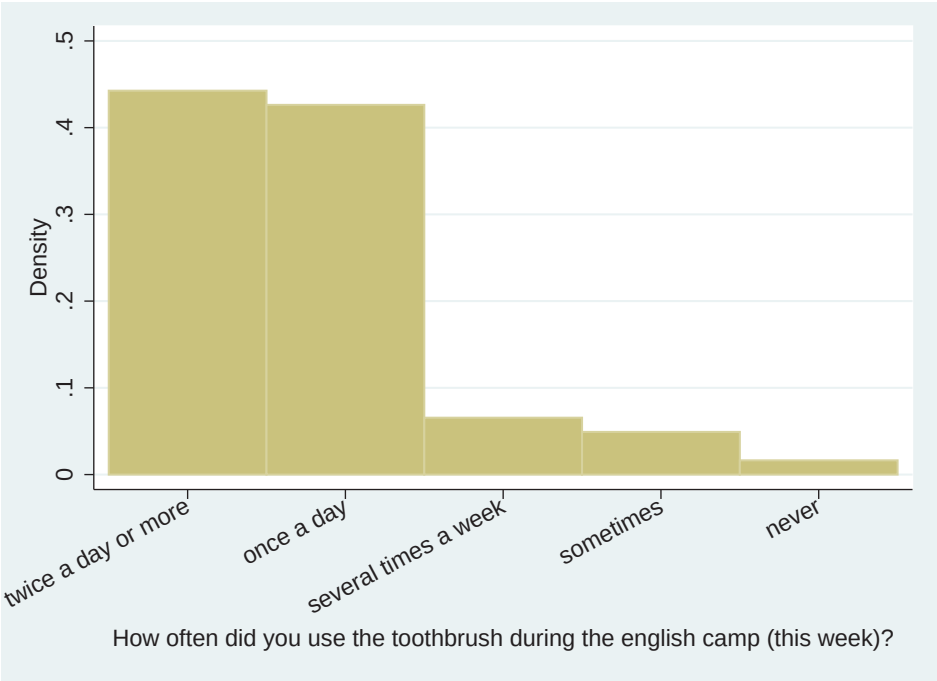
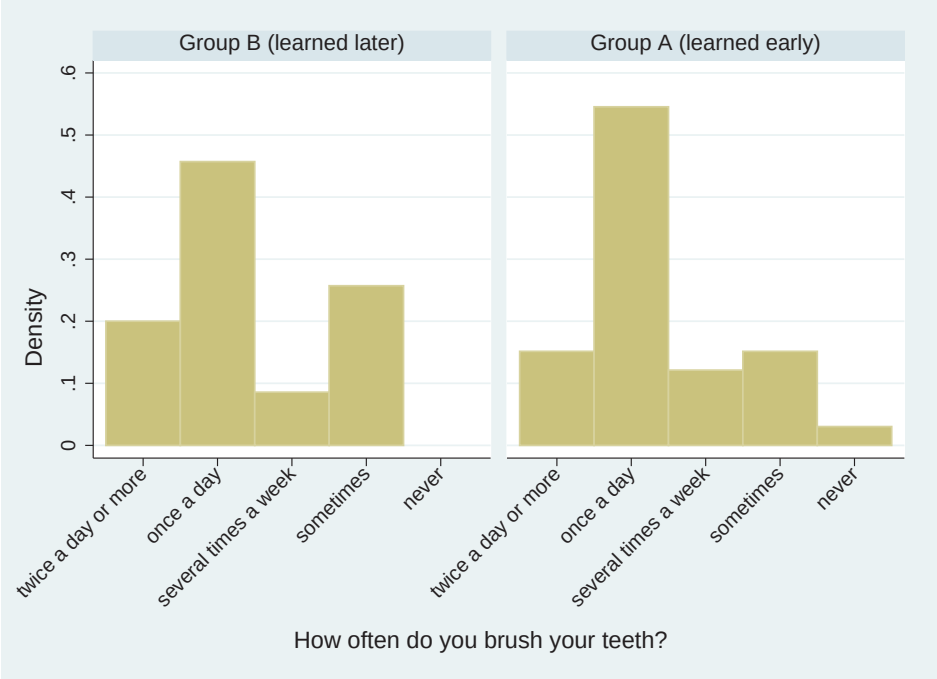


Figure 2: Frequency of Brushing Teeth, before and after the Camp



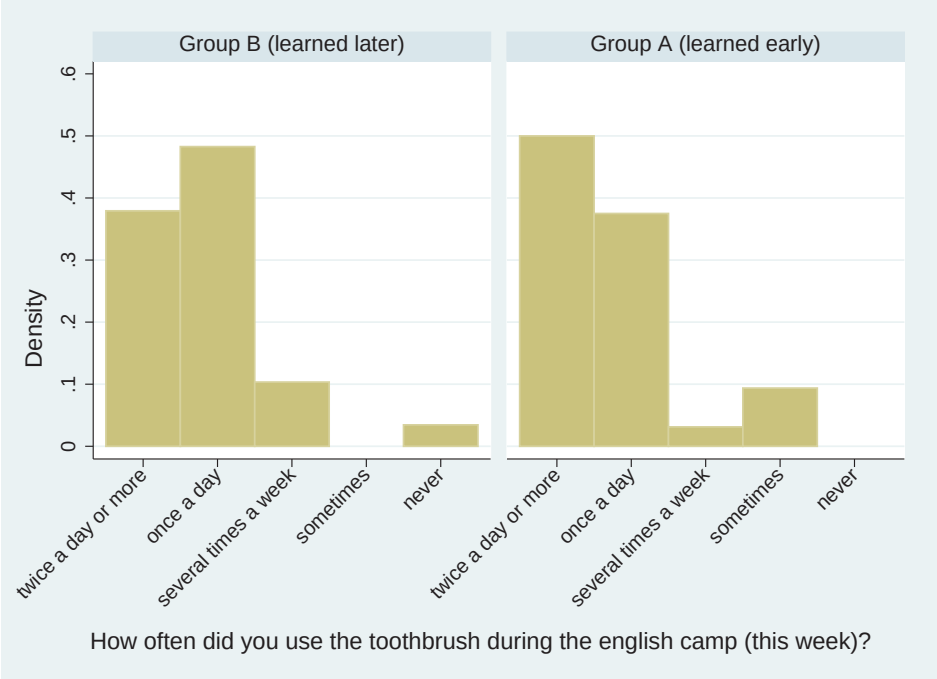


Figure 3: Frequency of Brushing Teeth, before and after the Camp by group