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## The educational potential of alcohol-related flushing among Chinese young people

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### Abstract

**Aim:** This paper describes Chinese university students' understanding of the meaning of the alcohol-related flushing response and how they reacted to their own and someone else's flushing in a group drinking situation. **Method:** The researcher surveyed 530 Chinese university students about their understanding of flushing and their perception of how people respond to a person who visibly flushes while drinking alcohol. **Findings:** Most students did not know about the physiological cause of flushing. There were significant gender differences in both reactions to and perception of responses to a person who flushes. There was no direct relationship between flushing and drinking behaviour. **Conclusions:** This description of flushing behaviour and responses to a flushing person is discussed in terms of educational opportunities to change behaviours that could reduce the cancer related risks of this visibly at-risk group.

### Keywords

ADH, alcohol, ALDH, college students, drinking, education, flushing, gender

### History

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### Introduction

This paper describes the beliefs and behaviours of a group of Chinese young people who are visibly at risk for cancer of the esophagus and of the upper aerodigestive tract. The group at visible risk is East Asians whose skin turns noticeably red after drinking alcohol. An estimated 30% (Brooks, Enoch, Goldman, Li, & Yokoyama, 2009) to 50% (Zakhari, 2006) of East Asians experience this reaction. Physiologically this is the result of irregular metabolism of alcohol by the body, which causes an accumulation of acetaldehyde. Acetaldehyde is carcinogenic (Brooks et al., 2009; Zakhari, 2006), and repeated exposure can cause liver damage (American Liver Foundation, 2012) and is associated with esophageal and aerodigestive cancer (International Agency for Research on Cancer, 2012, p. 412).

Because this risk group's distinctive reaction to alcohol is visible, it raises questions about how they and others respond to facial flushing and how the responses contribute to the risk or moderate the risk from alcohol.

This study sought answers to the following questions:

- What is the meaning of flushing?
- Is there a relationship between flushing and drinking?

- What is the relationship between parental flushing and student flushing?
- How do flushers respond to their own flushing?
- How do students respond when someone else flushes when drinking?
- What do students believe about how the other students in their group will respond to someone who flushes when drinking?

### Background

The World Health Organization estimates that in 2010, in China, 58.4% of the males and 28.9% of the females aged 15 and older had drunk alcohol in the previous year. Of the drinkers, males consumed 18.7L of pure alcohol and females consumed 7.6L. Based on studies of per capita consumption, drinking is increasing. In 2003–2005, the estimated consumption of pure alcohol was 4.9L, and in 2008–2010 estimated consumption was 6.7L (World Health Organization, 2014). Among these drinkers, there are a significant number of people who flush after drinking alcohol, who are the focus of this paper.

### Flushing

Alcohol is absorbed into the bloodstream through the stomach and intestines and then removed from the bloodstream mainly by the liver. In this process, the enzyme alcohol dehydrogenase (ADH) converts alcohol into acetaldehyde, which the enzyme aldehyde dehydrogenase (ALDH) then converts into acetic acid, and eventually into water and carbon dioxide (Brooks et al., 2009). Variable small amounts of acetaldehyde

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are also present in the alcoholic beverage itself. An accumulation of acetaldehyde in the body can lead to facial flushing, tachycardia, headache, heart palpitation, shortness of breath (dyspnoea), hyperventilation, hypotension, vertigo, nausea and vomiting (Brooks et al., 2009; Goldman, 1995).

Genetic variations in genes for the enzymes ADH and ALDH influence an individual's metabolism of alcohol. A person who inherits two copies of the gene for the more active form of ADH converts alcohol to acetaldehyde faster, while a person who inherits two copies of the less active form of ADH converts alcohol to acetaldehyde slowly. A person with one active and one inactive gene has a somewhat inefficient enzymatic conversion of alcohol to acetaldehyde. Likewise, with the enzyme ALDH, a person's body can metabolize acetaldehyde very efficiently, somewhat inefficiently or very inefficiently, depending on genes inherited.

If an individual has inherited the trait of fast metabolizing of blood alcohol or the slow metabolizing of acetaldehyde, or both of these traits, the individual is likely to feel the effects of acetaldehyde accumulation in the body, indicated by flushing.

Flushing has been suggested as an inherited protective factor against excessive drinking. Studies note that Asian populations tend to drink less alcohol and that there are fewer alcohol-dependent persons in this population (Assanangkornchai, Noi-pha, Saunders, & Ratanachaiyavong, 2003; Cook & Gurling, 2001; Fromme et al., 2004; Luczak, Elvine-Kreis, Shea, Carr, & Wall, 2002; Luczak et al., 2006; Wall & Ehlers, 1995a,b). However, other studies failed to find a clear relationship between flushing and drinking patterns (Chao, 1995; Cheung, 1993; Johnson et al., 1984; Johnson, Nagoshi, Ahern, Wilson, & Yuen, 1987; Li & Rosenblood, 1993; Oze et al., 2010; Schwitters, Johnson, McClearn, & Wilson, 1982; Slutske et al., 1995).

Certainly individuals who are homozygous for fast metabolism of alcohol and for slow metabolising of acetaldehyde experience reactions to acetaldehyde and typically will not drink, but homozygous individuals are a small proportion of the population.

It is also possible that the lower rates of alcohol dependence among Asians are a result of strongly held cultural values that dictate drinking patterns that have evolved over centuries to minimise the negative effects of alcohol (Newman, 2002). Lee (1987) and Cheung (1993) theorised that Chinese drinking patterns evolved over centuries in response to the genetic trait; that is, evolving drinking customs accommodated the slower metabolism of alcohol and, in turn, supplied social and cultural meanings for physiological reactions, such as flushing. Traditions surrounding alcohol dictate when, where, what, how and with whom alcohol is consumed and what is the acceptable behaviour during and after drinking. Drinking patterns were routinised, and behaviours during and after drinking were clearly proscribed. People who consumed alcohol and then acted inappropriately for the occasion incurred social sanctions (Newman, 2008).

For the person who flushes it is possible that both physiologic and social pressures are at play. Parrish et al. (1990) have suggested that lower consumption among flushers might result from social factors, such as embarrassment over flushing. Li and Rosenblood (1993) compared alcohol use patterns among Chinese and Caucasians and

concluded that cultural norms were a better predictor of alcohol consumption than physical symptoms. Johnson et al. (1984) found no significant differences in average alcohol consumption among non-flushers, fast flushers and slow flushers. Lee (1987), Cheung (1993), Chao (1995) and Newman et al. (2013) all throw doubt on the connection between flushing and protection from alcohol harms because (1) drunkenness, dependence and heavy drinking can be observed even among flushers and (2) one cannot extrapolate a protective effect from the subset of the population that has the particular genotype to the majority of the population that does not.

### Prior studies of social responses to flushing in drinking situations

A few studies have described the beliefs and behaviours surrounding alcohol-related flushing. In 2007, Zhang, Merrick, Newman, and Qian reported that out of 442 university students, half (50.4%) believed that flushing indicated that the person should not drink any more alcohol, one quarter (24%) believed flushing indicated that a person could drink a lot of alcohol, and the other quarter (25.6%) believed the flushing reaction had no significance. Newman et al. (2013), with a different sample ( $N = 725$ ), reported that 26.8% of the students said the flusher should stop drinking, 13.9% said flushing meant the person could drink more, 59.3% said drinking had no special meaning.

Newman et al. (2013) found that males and females behaved differently toward the flusher depending on their gender and the gender of the person flushing. When a male flushed 49.0% of the males and 72.0% of the females said they would encourage the male to stop drinking or drink less, 14.7% of the males and 3.4% of the females said they would encourage the male flusher to drink more, and 36.3% of the males and 24.6% females said they would do nothing. On the other hand, if the flusher was a female, 84.7% of the males and 92.7% of the females would encourage her to stop or drink less, 6.5% of the males and 1.0% of the females would encourage more drinking, and 8.8% of the males and 6.2% of the females would do nothing.

This study contributes new information about individual reactions to a flushing person, flushers' feelings about their own flushing, gender differences in social responses to flushing, parental flushing and attitudes to their child's flushing, and suggests ways in which flushing response may present opportunities, within the cultural context, for education to moderate alcohol use and thus reduce cancer risk.

## Methods

### The sample

A total of 587 students attending university in either Beijing or Zhengzhou in randomly selected classes completed the questionnaire under the supervision of trained data collectors. Fifty-seven questionnaires were excluded from the analysis because answers were inconsistent or there was a missing value in one or more of the demographic or drinking behaviour questions, leaving a sample of 530 (90.3%). A description of the sample is provided in Table 1.

Table 1. Description of the sample.

	Male		Female		Total	
	N	%	N	%	N	%
Age						
≤19	44	22.9	101	29.9	145	27.4
20	61	31.8	119	35.2	180	34.0
21	42	21.9	81	24.0	123	23.2
22	45	23.4	37	11.0	82	15.5
Total	192	100.0	338	100.0	530	100.0
Year in university						
Freshman	89	46.4	158	46.8	247	46.6
Sophomore	67	34.9	99	29.3	166	31.3
Junior	36	18.8	80	23.7	116	21.9
Senior	0	0.0	1	0.3	1	0.2
Total	192	100.0	338	100.0	530	100.0
Location of university						
Zhengzhou	111	57.8	158	46.8	269	50.8
Beijing	81	42.2	180	53.3	261	49.3
Total	192	100.0	338	100.0	530	100.0
Home town						
Urban	93	48.4	222	64.7	315	59.4
Rural	99	51.6	116	34.3	215	40.6
Total	192	100.0	338	100.0	530	100.0

## Questionnaire

The 53-item questionnaire contained 10 demographic questions, 21 questions about drinking behaviours, 17 questions about flushing and the flushing response of different people and five questions about other health behaviours. The questionnaire had been developed by a team that included Chinese and non-Chinese educators, social scientists and Chinese language specialists at the Nebraska Prevention Center for Alcohol and Drug Abuse and the Chinese Center for Health Education in Beijing and faculty from several regional Chinese health education institutes. The questions about drinking behaviours had been used previously with different samples in China (Newman, Qian, Shell, Qu, & Zhang, 2006a; Newman, Shell, Qu, Xue, & Maas, 2006b; Qian, Hu, Newman, & Hou, 2008; Xue, Newman, Shell, & Fang, 2005). The questions about flushing and reactions to other people's flushing were based on two earlier questionnaires (Newman et al., 2013; Zhang et al., 2007). Questions were written first in Chinese and then translated into English, back translated to Chinese and then back-translated into English. Discrepancies in meaning were resolved by the team. The back translation was to assure the English/non-Chinese speaking members of the research team and the Chinese members were in accordance with their interpretation of the meaning of the questions. A committee of Chinese native speakers then reviewed questions and made further refinements.

The study was approved by the Institutional Review Board of the University of Nebraska-Lincoln (#2009059889EP).

## Results

### Drinking behaviour

Alcohol quantity is difficult to measure in drinking studies in China because there is no commonly agreed upon "standard" alcohol serving. Alcohol is consumed in containers of various sizes, drinks are "topped up," and beverages contain

Table 2. Drinking classification of sample.

	Male		Female		Total	
	N	%	N	%	N	%
Non-drinker	19	9.9	116	34.3	135	25.5
Occasional drinker	53	27.6	134	39.7	187	35.3
Regular drinker	120	62.5	88	26.0	208	39.2
Total	192	100.0	338	100.0	530	100.0

anywhere from 4 to 60% alcohol by volume (Newman et al., 2004). As a consequence, based on our experience, drinking frequency is the best indicator of drinking patterns (Newman et al., 2006a,b, 2013; Qian et al., 2008). For this analysis we divided the students into three groups. Students who had not used alcohol in the past year were classified as "non-drinkers", students who had used alcohol in the past year but not in the past month were classified as "occasional drinkers", and students who had used alcohol in the past month were classified as "regular drinkers". Student drinking behaviour by category is presented in Table 2. There was a significant gender difference in student drinking pattern ( $\chi^2(2, N = 530) = 87.710, p < 0.0001$ ).

There were more occasional drinkers among the Zhengzhou students (57.2%) than the Beijing students (42.8%), and more regular drinkers among Beijing students (61.5%) than the Zhengzhou students (38.5%) ( $\chi^2(2, N = 530) = 16.110, p < 0.001$ ). Drinking frequency was not related to age, grade in school or home town.

### Flushing experience

Of the respondents who had ever drunk alcohol in their lifetime, 52.7% self-reported flushing. Students were divided into three groups depending on their flushing characteristics (Johnson et al., 1984; Newman et al., 2013; Park et al., 1984). Students who had drunk alcohol and who reported they never flushed were classified as "non-flushers". Students who flushed while drinking the first glass of alcohol or right after drinking the first glass and before the second glass were classified as "fast flushers". Students who turned red while drinking the second glass of alcohol or afterwards were classified as "slow flushers" (Nakawatase, Yamamoto, & Sasao, 1993). Fast flushing indicated lower capacity to metabolize alcohol, while non-flushing indicated higher capacity to metabolize alcohol. Flushing classification was not related to gender, age, hometown, grade or residence.

### The meaning of flushing

Table 3 shows that 29.9% of the sample believed flushing had no meaning, 23.2% did not know what it meant; 10% believed it meant the drinker could drink more; and 36.9% said flushing meant the flusher should stop drinking. Beliefs about the meaning of flushing differed significantly by drinking behaviour. More non-drinkers (45.1%) believed that flushing meant the person should stop drinking, compared to occasional drinkers (33.9%) and regular drinkers (34.2%). More regular drinkers (16.1%) believed flushing meant the flusher could drink more compared to 4.5% of the non-drinkers ( $\chi^2$

Table 3. Meanings of flushing by drinker type.

	Non-drinkers		Occasional		Regular		Total	
	N	%	N	%	N	%	N	%
Flushing means ...								
Stop drinking	60	45.1	62	33.9	70	34.2	192	36.9
Drink more	6	4.5	13	7.1	33	16.1	52	10.0
No meanings	26	19.6	68	37.2	62	30.2	156	29.9
I have no idea	41	30.8	40	21.9	40	19.5	121	23.2
Total	133	100.0	183	100.0	205	100.0	521	100.0

$\chi^2$  (6,  $N = 521$ ) = 29.158,  $p = 0.000$ .

Table 4. Relationship of student flushing and parental flushing.

	Non-flushers		Slow flushers		Fast flushers		Total	
	N	%	N	%	N	%	N	%
Mother flushes when drinking alcohol? <sup>a</sup>								
Yes	35	24	52	57.1	34	54.8	121	40.5
No	111	76	39	42.9	28	45.2	178	59.5
Total	146	100.0	91	100.0	62	100.0	299	100.0
Father flushes when drinking alcohol? <sup>b</sup>								
Yes	99	54.4	91	68.9	63	77.8	253	64.0
No	83	45.6	41	31.1	18	22.2	142	36
Total	182	100.0	132	100.0	81	100.0	395	100.0

<sup>a</sup> $\chi^2$  (2,  $N = 299$ ) = 32.303,  $p = 0.000$ ; <sup>b</sup> $\chi^2$  (2,  $N = 395$ ) = 15.367,  $p = 0.000$ .

(6,  $N = 521$ ) = 29.158,  $p < 0.0001$ ). The meaning of flushing did not differ between slow flushers, fast flushers and non-flushers ( $\chi^2$  (6,  $N = 440$ ) = 11.158,  $p = 0.084$ ).

### Flushers' responses to their own flushing

When students who flushed were asked what they typically do when they themselves flushed, one-third (32.7%) said they stopped drinking, 21.9% continued drinking and 44.1% continued drinking but drank less. Gender differences were significant. Seventeen percent of the males who flushed (17.4%) would stop drinking compared to 44.1% of the females; 29% of the males would continue drinking compared to 16.7% of the females; and 52.2% of the males and 38.2% of the females said they would drink less when they flushed. Four respondents said they would drink more (The four were excluded from the analysis:  $\chi^2$  (2,  $N = 324$ ) = 26.275,  $p < 0.0001$ ).

### Flushing and drinking

The proportion of students who had used or not used alcohol in the last year did not differ significantly by their flushing type: 86.7% of the non-flushers had consumed alcohol in the last year, as had 91.2% of the slow flushers and 83.9% of the fast flushers.

Compared to non-flushers, both slow flushers and fast flushers were more likely to report being drunk in the last year ( $\chi^2$  (2,  $N = 456$ ) = 7.784,  $p = 0.020$ ).

### Parents

Alcohol-induced flushing was strongly associated with parents' flushing; student drinkers whose parents flushed after drinking alcohol were themselves more likely to experience flushing (Table 4).

In a family drinking situation, most of the students believed their mothers (95.4%) and their fathers (98.3%) would ignore their [the child's] flushing and allow them to continue drinking if they flushed.

### Gender-specific social responses to flushing in drinking situations

A set of questions were asked to students how they would respond if a student flushed while drinking in their social situation. The questions identified whether the flusher was a male or a female. Table 5 shows that females were more likely than males to encourage a *male* friend who flushed to reduce or stop drinking. Males were more likely than females to encourage a *male* friend who flushed to drink more ( $\chi^2$  (2,  $N = 527$ ) = 30.272,  $p = 0.001$ ).

Table 6 shows that males and females were equally and highly likely to encourage a *female* friend who flushed to stop drinking or drink less (88.0%; 90.7%). Very few of either gender were likely to do nothing or to encourage a female friend to drink more,  $\chi^2$  (2,  $N = 525$ ) = 13.465,  $p = 0.001$ .

### Social response to flushing by drinking type and flushing type

Student responses to a *male* friend who flushed were analysed by drinker type and flusher type. Non-drinkers (73.1%) were more likely than regular drinkers (54.8%) to encourage a male friend who flushed to drink less. Regular drinkers were more likely (14.9%) than non-drinkers (6.7%) to encourage a male friend who flushed to drink more ( $\chi^2$  (4,  $N = 457$ ) = 18.443,  $p = 0.001$ ). Non-flushers, slow-flushers and fast-flushers did not differ in how they responded to a male friend flushing.

There were no significant differences in responses to a *female* friend who flushed by drinker type or flusher type:

Table 5. Respondent's reaction to a male's flushing response by gender.

	Male		Female		Total	
	N	%	N	%	N	%
What do you do when a male friend flushes?						
Do nothing	52	27.1	100	29.9	152	28.8
Encourage him to drink more	37	19.3	15	4.5	52	9.9
Encourage him to drink less or stop drinking	103	53.7	220	65.7	323	61.3
Total	192	100.0	335	100.0	527	100.0

$\chi^2 (2, N = 527) = 30.272, p = 0.000.$

Table 6. Respondent's reaction to a female's flushing response by gender.

	Male		Female		Total	
	N	%	N	%	N	%
What do you do when a female friend flushes?						
Do nothing	11	5.7	28	8.4	39	7.4
Encourage her to drink more	12	6.3	3	0.9	15	2.9
Encourage her to drink less or stop drinking	169	88.0	302	90.7	471	89.7
Total	192	100.0	333	100.0	525	100.0

$\chi^2 (2, N = 525) = 13.465, p = 0.001.$

88–91% of all students, whether analysed by gender, drinking type or flushing type, said they would encourage a female who flushed to drink less or to stop.

### How students believed other people would respond to flushing

The previous section described how students predicted that they themselves would respond to a flushing student. Another series of questions asked students to describe how they thought *other people* would respond when someone flushed in a social drinking situation. Once again the questions identified whether the flusher was a male or a female.

#### *If a male friend flushed*

Approximately half of students (42.7% of the males and 57.7% of the females) believed the other males in the group would ignore a male friend's flushing, 15.6% of the males and 12.1% of the females believed males would encourage the flushed male friend to drink more, and 41.7% of males and 30.2% of females believed males would encourage the flushing male friend to drink less or stop drinking ( $\chi^2 (2, N = 523) = 11.001, p = 0.004$ ). There was no significant gender difference in how males and females predicted the other females in the group would respond when a male who flushed: 14.1% of the males and 15.0% of the females believed the other females in the group would ignore the flushing male, 3.5% of males and 2.1% of females thought the other females in the group would encourage the flushed male to drink more, and 82.4% of males and 82.9% of females believed the females in the group would encourage the flushing male friend to stop or drink less ( $\chi^2 (2, N = 504) = 0.958, p = 0.619$ ).

#### *If a female friend flushed*

There was no gender difference in the way males and females thought that males would respond to a flushing female. The

majority of both males (74.1%) and females (75.6%) thought the other males in the group would encourage the flushing female to stop drinking or drink less, 14.2% of both the males and females surveyed thought the other males in the group would ignore the flushing female, and 11.6% of males and 10.2% of females thought the other males in the group would encourage the flushing female to drink more. There was a small gender difference in the way males and females thought females would respond to a female flushing: 82.6% of males and 92.2% of the females thought the other females in the group would encourage a flushed female to stop or drink less, 12.8% of the males and 6.9% of the females thought the other females would ignore the flushing female, and 4.7% of the males and 0.9% of the females thought the other females in the group would encourage the flushing female to drink more ( $\chi^2 (2, N = 506) = 12.997, p = 0.002$ ).

## Discussion

The results are discussed in terms of educational opportunities. By necessity educational opportunities are framed by local culture, and alcohol cultures differ from east to west, so some brief comments about Chinese alcohol culture provide a context for the discussion.

### How common is flushing?

In this sample, 52.7% of the drinkers flushed when drinking alcohol (42.7% of the total sample). This percentage is similar to that reported by Zakhari (2006, 50%) and differs from those reported earlier by Brooks et al. (2009, 36%) and Newman et al. (2013, 68%). There are a few possible reasons for these different results. Zakhari did not report how flushing was defined. Brook et al. and Newman used different self-report questionnaires. The differences might also be explained by how flushing seems to be routinely ignored in some situations, as was the case in these data when boys were asked what other boys would do when a boy in their drinking

group flushed: 52.2% said they would ignore it. Also, irregularities in alcohol metabolism may not be uniformly manifest in facial flushing. Some individuals experience skin irritation and red blotchy skin in places other than the face.

### The meaning of flushing

More than half (53.1%) of the students in this study thought flushing did not mean anything or they “do not know” what it meant, results similar to those of Newman et al. (2013), 59.3%. Ten percent of the students thought flushers could drink more. This finding is not surprising in its cultural context. Except for drinking and driving, Chinese look upon drinking alcohol as a pleasurable activity with very low risk. There is a longstanding attitude that alcohol is good for friendship, relaxation, hospitality, health and it is widely used in Chinese medicine and cuisine. For a discussion about different alcohol cultural typologies, see Room and Mäkelä (2000).

From an educational perspective, Chinese beliefs about alcohol mean that most people would be skeptical of attempts to link drinking directly to disease, such as cancer. This is where alcohol-related flushing presents an interesting educational opportunity. Identifying facial flushing as the sign of inherited irregular metabolism of alcohol provides an opportunity to introduce the idea of alcohol connected to a disease without blaming the alcohol or the alcohol-sensitive individual. In fact, since cancer has been shown to be mainly a risk of the metabolite acetaldehyde, a culturally sensitive educational plan could identify acetaldehyde as the likely causative agent, while still promoting the information that people who turn red in the face while drinking should stop or reduce their drinking as well as recommending that their drinking companions encourage them to slow down or stop drinking.

This study found a significant number of people who attach no special meaning to flushing (53.1%), which suggests there are no widespread misconceptions that would need to be overcome by any educational program. Only 10% believe flushing is a sign of the ability to drink more, a belief that leads to higher risks, suggesting the need for education to focus corrective information on the small percentage drinkers with this mistaken belief. Among the flushers themselves 32.7% believe they should stop drinking and 21.9% believed their drinking should be reduced. This suggests an opportunity for education to reinforce both the stop-drinking belief and the reduce-drinking belief, with the goal of moving some of the reduced-drinking believers into the stop-drinking group.

### Flushing and drinking

This study found no moderating relationship of flushing on drinking in the past year, a finding similar to Johnson et al. (1984) and other studies (Chao, 1995; Cheung, 1993; Johnson et al., 1987; Li & Rosenblood, 1993; Oze et al., 2010; Schwitters et al., 1982; Slutske et al., 1995). The findings in this study suggested that cultural and social factors override physiologic discomfort resulting from drinking, as has also been suggested by Parrish et al. (1990), Li and Rosenblood (1993), Lee (1987) and Cheung (1993).

The slow and fast flushers also reported being drunk in the past year more often than non-flushers. Drunkenness,

however, is a tricky measure in a population of people who flush. Drunkenness may not be a sign of the quantity of alcohol consumed in one sitting, but of the extent of the person's irregular metabolism of alcohol. Due to their irregular metabolism of alcohol, we would expect flushers to feel drunk more quickly than non-flushers.

In general, flushing does appear to provide protection against drinking too much, but the protection is not necessarily in the form of the physiological response to alcohol, as much as from the social response to facial flushing, especially for women. From an educational perspective, alcohol-related flushing presents an opportunity to reinforce the low drinking rates and sensitivity towards women's drinking. The information that flushing is linked to cancer risk may also be a socially acceptable and useful excuse for men to avoid the social expectations of some male-type drinking.

### Parental flushing and attitude

The finding that more of the students who flushed had parents who flushed was expected for this genetically-determined trait. “Flushing families” are more at risk for alcohol-related cancers. The finding that parents rarely tell a flushing child to drink less or stop may be due to the strong cultural values connected to drinking and to ignorance of the relationship between flushing and cancer. In Chinese culture, young people learn how to drink and the social expectations about drinking in their family at family meals, celebrations and drinking with family friends (Newman, 2002). Since the extended family exerts strong control over individual behaviours, including drinking behaviours, a well-designed educational programme for “flushing families” may contribute to lowering drinking rates for several generations of a family.

### How flushers respond to their own flushing

The percentage of students in this sample who flushed and who said they would stop drinking or drink less was 76.8%, and the tendency to stop drinking when they flushed was higher for females than for males. There appears to be some connection between beliefs about flushing and behaviour when flushing, though this questionnaire did not ask about motives or reasons why flushers stopped drinking or drank less. There is an educational opportunity to increase the percentage of flushers who believe that flushing means they should stop drinking.

### How students say they will respond to a drinker who flushes

Individual beliefs appear to be open to suggestions that flushing is a risk factor, and, therefore, an educational programme may have some prospect of moderating behaviour. However, it is well known that the social environment is often a more important determinant of behaviour than an individual's beliefs. These results suggest that the social environment is different for males and females and that support for a female flusher willing to stop or reduce drinking is much stronger than support would be for a male. If a female flushes 89.7% would support her in stopping or drinking less, but if a male flushes only 61.3% would support him. This

finding suggests cultural values are protecting females more than males. These cultural values toward woman's drinking are evident almost equally among females and males. This is an important protective factor that should be nurtured in any educational programme, especially considering that alcohol risks for woman occur with lower doses and carry special hazards related to pregnancy and assault.

These results suggest that male-type drinking expectations among about one-fifth of the males present a special educational challenge. Of the males, 19.3% said they would encourage a flushing male to drink more and 15.6% said they thought other males would do the same. Among the woman, 12.1% believed other males would encourage a flushing male to drink more. For this small group, the educational challenge is changing their underlying beliefs to accept the inherent danger in encouraging a flusher to continue drinking. For this group, the option to acknowledging the role of acetaldehyde may be helpful because it avoids challenging either positive beliefs around alcohol and society or the social expectations about the drinker.

### How students believed other people would respond to flushing

In general, the gender differences reported by the respondents for themselves were similar to those they reported when they were asked how they believed other students would react.

### Limitations

Studying the social meaning of alcohol-related facial flushing is a new area of research and there is much to learn from these initial studies. This study considered drinking by flushers in a social setting where there was moderate pressure to drink more. It does not consider drinking by flushers in other settings where the drinking pattern may be more leisurely and less pressured and, therefore, less risky. Nor does it consider flushing in the context of high-pressure drinking situations, such as business drinking, toasting or drinking games.

The questionnaire used in this study is in its third iteration (prior versions used in Zhang et al., 2007, and Newman et al., 2013), and the reliability and validity issues were not yet fully explored. The translation of the questions has been validated, and answer patterns have been generally consistent across the three studies. As a result, we believe that the questionnaire has demonstrated adequate validity for the level of analysis presented here.

The survey did not take into account the quantity of consumed alcohol. It would be desirable to more precisely link flushing responses to actual consumption levels, but as discussed previously, no method currently exists for obtaining valid consumption information (Newman, Qian, & Xue, 2004). The sample was a convenient sample and the sample size is adequate for this analysis but should not be considered as a representative of larger groups of young people in China. Gender, age and rural–urban differences were not well represented. Nevertheless, the findings reported here are consistent with findings from earlier studies (Newman et al., 2013; Zhang et al., 2007) with samples from different regions in China.

### Summary

This paper described beliefs about and reactions to alcohol-related facial flushing. Our findings suggest some of our sample's beliefs and reactions lowered drinking, thus lowering risk of cancers associated with alcohol. Conceivably, education can reinforce these specific beliefs and actions. Where people's beliefs and reactions concerning flushing tend to increase risks we have considered educational opportunities to inform and change actions for both the individual flusher and the people around them who can encourage them to slow down or stop drinking.

### Declaration of interest

Ian Newman is a senior consultant to the International Center for Alcohol Policies, which is funded by a consortium of alcohol producers. Through a private consulting company, Ian Newman has received fees and travel support to attend meetings, to speak, and/or moderate panels, sponsored or co-sponsored by ICAP.

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