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Knowledge, Attitudes and Practices Regarding Raw Milk Consumption in the Pacific Northwest

ABSTRACT

Currently, the majority of foodborne outbreaks associated with milk products are due to the consumption of raw milk. Relatively little knowledge is available as to why consumers choose to drink raw milk instead of pasteurized milk. To determine the knowledge, attitudes and practices related to raw milk consumption, a survey was performed using questionnaires distributed via online ads targeting users in the Pacific Northwest. Descriptive statistics were generated to characterize the study population and bivariate analyses were performed to determine differences in knowledge, attitudes and practices among identified consumption groups (i.e., current, former, never). We further identified current consumers as exclusive or non-exclusive. A total of 227 questionnaires were completed. Former raw milk consumers most often cited convenience (35.8%) as the reason for not consuming raw milk. Current raw milk consumers most often cited the reason for drinking raw milk as taste (72.4%) and perceived holistic health benefits (67.2%). Also, 67.9% of current consumers reported not

trusting state health officials' recommendations regarding food safety. Raw milk consumers, particularly those who consume raw milk exclusively, reported health benefits and concerns about the safety of pasteurized milk as reasons for consuming raw milk, providing themes for future interventions to address.

INTRODUCTION

In the United States, the rise in consumer demand for natural food products has led to raw (e.g., unpasteurized) milk consumption reemerging as a public health issue (5, 10). Pasteurization is the process of rapidly heating a liquid (e.g., milk) to high temperatures to eradicate potentially pathogenic organisms, increasing the safety of the product (4). Raw milk is defined as milk that has not undergone pasteurization and marketed as a ready-to-eat food product.

Raw milk has been identified as a vehicle for the transmission of foodborne pathogens including *Campylobacter* spp., Shiga toxin-producing *Escherichia coli*, *Salmonella* spp. and *Listeria monocytogenes*, each of which can cause mild to severe illness, and in rare cases, death in infected individuals

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(10). Recently, the Centers for Disease Control and Prevention identified an increase in the number of outbreaks that were attributed to the consumption of raw milk, from 30 in 2007–2009 to 51 in 2010–2012. These outbreaks included a total of 979 illnesses and 73 hospitalizations (no deaths) across 26 states (10). Previous research has found that 96% of foodborne illnesses associated with contaminated dairy products were due to consumption of raw milk (5).

To limit the potential for outbreaks, the sale of raw milk is regulated at both the federal and state levels. At the federal level, regulations by the Food and Drug Administration prevent raw milk from being transported and sold across state lines (11). However, state regulations regarding the sale of raw milk vary. Some states allow the retail sale of raw milk at traditional grocery stores, on the farm from where it is produced or at farmers' markets. Other states do not allow retail sale but have provisions wherein consumers can purchase partial ownership of a cow or goat (e.g., a "cow/goat-share" agreement). Some states simply prohibit any/all sales of raw milk (11). Recently, the number of states that allow the sale of raw milk products has increased, numbering 30 in 2011, and this has increased the access consumers have to raw milk products (5).

Recent studies in Vermont and Michigan reported that raw milk consumers believe it to be healthier and tastier than pasteurized milk (7, 8). These consumers perceived raw milk to provide additional health benefits and as a group do not trust state health officials' recommendations on the products' safety (7, 8). Non-raw milk consumers cited lack of availability, not drinking any milk products, and safety concerns as reasons why they do not consume raw milk (7, 8). In both states, the retail sale of raw milk is restricted, which limits its availability and may change its consumer profile.

Previous studies examining raw milk consumption practices have focused only on two themes; why individuals choose to consume raw milk (i.e., current raw milk consumers) and why individuals do not (i.e., non-raw milk consumers) (5, 7, 8). Further, current raw milk consumers may have different consumption patterns, in which some consume only raw milk (i.e., exclusive raw milk consumers) and others consume both raw milk and pasteurized milk (i.e., non-exclusive raw milk consumers). Previous studies have not examined differences in current versus former raw milk consumers and non-exclusive versus exclusive current raw milk consumers.

Additionally, previous research has been restricted to determining why individuals do not consume raw milk products (8). No previous work has examined why individuals who previously consumed raw milk ceased consumption (i.e., former raw milk consumers). This information is essential in the development of public health campaigns regarding the known health risks of raw milk consumption.

The three states that comprise the Pacific Northwest (Idaho, Oregon and Washington) allow the retail sale of raw milk at some level, creating a larger population that may have more access to purchasing raw milk the populations studied than in previous work. Given the recent increase in states allowing the retail sale of raw milk and the known risks associated with the product, it is critical to understand the demographic profile of consumers and their reasons for drinking raw milk. Therefore, the objective of the study was to determine the knowledge, attitudes, and practices regarding raw milk consumption among never, former, and current consumers in the Pacific Northwest. Additionally, we sought to determine if attitudes and practices regarding raw milk consumption differed between current consumers who drink raw milk exclusively compared to non-exclusive raw milk consumers.

MATERIALS AND METHODS

Eligible participants were individuals 18 years of age and over and residents (self-reported) of Idaho, Oregon, or Washington. Participants were recruited using online advertisements on a social media site that targeted "health conscious" (defined by the social media site; algorithm unavailable) adults in the three states. The anonymous survey was available online between May and July 2014. The study received approval from the Institutional Review Board at Oregon State University, and participants provided informed consent (with a waiver of signature, to retain anonymity and accommodate the online nature of the survey).

The survey instrument was designed primarily using existing instruments that were revised using results from a literature review and expert opinion (1, 7, 8). The instrument included information regarding basic demographics, history and frequency of consuming raw milk, reasons for or against drinking raw milk, source of raw milk, and risk perception of drinking raw milk. The instrument was entered and administered through Qualtrics, a web-based survey program (Qualtrics, ver. 0614191, Provo, UT).

A current raw milk consumer was defined as someone who answered "yes" to the question about currently consuming raw milk. Exclusive current raw milk consumers were current raw milk consumers who reported drinking raw milk only; non-exclusive current raw milk consumers were current consumers who reported consuming raw milk along with pasteurized milk. Former raw milk consumers were identified as consumers who indicated that they had consumed raw milk within the past five years but did not currently consume raw milk. A non-raw milk consumer was someone who reported never consuming raw milk within the past five years.

Responses were coded and analyzed using the R software package (R Development Core Team, ver. 3.2.5, Vienna, Austria). Descriptive statistics were used to create

demographic profiles of the overall population and each consumption group. T-tests, Pearson's Chi-Square tests, or Fisher's exact tests were performed to determine differences in characteristics between consumption groups.

RESULTS

A total of 227 participants in the Pacific Northwest completed surveys during the data collection period. Approximately 51% ($n = 116$) were identified as non-raw milk consumers, 23% ($n = 53$) as former raw milk consumers, and 26% ($n = 58$) as current raw milk consumers. The majority of survey respondents in each group were female, white and on average 43 years of age (Table 1). All survey respondents were between 18 and 80 years old.

Among all current raw milk consumers, most reported taste (72%), perceived holistic health benefits (67%), support for local farms (60%), and disease prevention (50%) as reasons for consuming raw milk (Table 2). Nearly 44% of all current raw milk consumers reported consuming raw milk every day. Approximately 59% of current raw milk consumers reported that consuming raw milk helped with digestive problems, followed by allergies (41%) and intestinal disease (35%) (Fig. 1). Finally, most current raw milk consumers did not trust recommendations made by state health officials regarding which foods are safe to eat (68%), and nearly all (96%) did not believe that consuming raw milk increases the risk of illness due to a foodborne pathogen.

Of current raw milk consumers, 47% were exclusive consumers and 53% were non-exclusive consumers. We found no significant differences in demographics between these sub-consumer groups. However, we found significant differences in their attitudes and beliefs related to consuming raw milk. Exclusive current raw milk consumers more frequently cited holistic health benefits (93% v. 45%; $P < 0.001$) and feeling that processed (i.e., pasteurized) milk is not safe (59% v. 19%; $P = 0.002$), compared with non-exclusive current consumers. Significant differences were found between these sub-groups regarding their perception of health problems that could be minimized by consuming raw milk. A significantly greater proportion of exclusive current raw milk consumers reported that raw milk helps with digestive problems ($P = 0.006$), allergies ($P = 0.01$), intestinal disease ($P = 0.002$), tooth decay ($P = 0.02$) and psoriasis ($P = 0.04$), compared with non-exclusive current consumers.

When we examined reasons for not consuming raw milk among non-raw milk consumers, we found that health risks (48.3%), convenience (33.6%), cost (10.4%) and taste (9.5%) were reported. Among former raw milk consumers, convenience (39.6%), cost (20.8%), health risks (20.8%), and taste concerns (5.7%) were reported as reasons for not consuming raw milk. Non-raw milk consumers were significantly more likely to cite health risks as a reason

for not consuming raw milk, compared with former raw milk consumers (48% v. 21%; $P = 0.001$). Between these consumer groups, no evidence was found to suggest that the cost of raw milk, convenience of getting the product or taste of raw milk differed with regard to being cited as a reason for not consuming raw milk.

DISCUSSION

Overall, we found that respondents who reported currently consuming raw milk were mostly white and middle-aged and held at least a bachelor's degree. All current raw milk consumers lived primarily in a rural or country setting and had an annual household income of at least \$50,000 dollars. These results were similar to those of previous studies that found raw milk consumers to have an annual household income of \$50,000 a year, to hold at least a bachelor's degree and to be middle-aged and live in a rural or country setting in Vermont and Michigan (7, 8). We also found some evidence that raw milk consumption differs on the basis of rurality. This could potentially be related to the availability of raw milk in the Pacific Northwest compared with Vermont and Michigan (6).

Respondents who reported never consuming raw milk were significantly more likely ($P = 0.001$) than former raw milk consumers to cite health risks as a reason for not consuming raw milk. The consumption of raw milk has been linked with outbreaks of foodborne illness caused by multiple microbiological pathogens. While raw milk is routinely tested for quality with Grade "A" standards by somatic cell counts and coliform bacterial plate counts, these results do not guarantee that the product is not contaminated with pathogens. These tests are typically not run daily and the results are often available only after the raw product has been purchased and consumed. To overcome these public health risks, if raw milk is to be sold legally, rapid testing kits and microbiological standards of all products sold are needed to identify possible contamination of raw milk products prior to their distribution (11).

Also, we found that over 30% of both former and non-raw milk consumers cited lack of convenience as a reason for not consuming raw milk. While we did not examine the source of the inconvenience, state laws may play a role. Current state laws vary significantly in how raw milk can be sold and by whom (6). Relaxing state laws to more readily allow the retail sale of raw milk may lead to an increase in raw milk consumers and potentially an increase in reported outbreaks of infectious diseases. Recently, Costard et al. projected that the average number of outbreak-related illnesses would increase by 96% in the United States if the consumption of unpasteurized dairy products were to double (5).

All current raw milk consumers frequently reported taste and holistic health benefits as reasons for consuming

TABLE 1. Demographics of study participants by raw milk consumption status

Variable	Consumption Status				P-value ^a
	Overall (n = 227)	Non-Raw Milk Consumers (n = 116)	Former Raw Milk Consumers (n = 53)	Current Raw Milk Consumers (n = 58)	
Age (years); mean (sd)	42.7 (14.8)	41.4 (14.9)	41.9 (14.7)	46.3 (14.4)	0.12
Gender; % (n)					0.63
Female	76.7 (161)	79.1 (87)	72.9 (35)	75.0 (39)	
Male	23.3 (49)	20.9 (23)	27.1 (13)	25.0 (13)	
Race; % (n)					0.31
White	85.7 (180)	87.2 (95)	77.6 (38)	90.4 (47)	
Asian/Pacific Islander	4.3 (9)	5.5 (6)	4.1 (2)	1.9 (1)	
American Indian/Native American	1.9 (4)	2.8 (3)	2.0 (1)	0 (0)	
Black/African American	0 (0)	0 (0)	0 (0)	0 (0)	
Other	2.4 (5)	1.0 (1)	6.1 (3)	1.9 (1)	
No answer	5.7 (12)	3.7 (4)	10.2 (5)	5.8 (3)	
Latino Ethnicity; % (n)	4.3 (9)	5.5 (6)	2.0 (1)	4.0 (2)	0.80
Level of Education; % (n)					0.04
Some High School/High School/GED	10.9 (23)	10.9 (12)	16.3 (8)	5.8 (3)	
Some College/Technical School	21.8 (46)	19.1 (21)	34.7 (17)	15.4 (8)	
College Graduate	38.4 (81)	39.1 (43)	22.5 (11)	51.9 (27)	
Advanced Degree	28.9 (61)	31.0 (34)	26.5 (13)	26.9 (14)	
Location; % (n)					0.06
Rural/Country	37.7 (79)	33.9 (37)	28.6 (14)	53.8 (28)	
Urban/City	36.7 (77)	41.3 (45)	40.8 (20)	23.1 (12)	
Suburbs	25.7 (54)	24.8 (27)	30.6 (15)	23.1 (12)	
Income Level; % (n)					0.13
< \$20,000	14.3 (30)	17.4 (19)	20.4 (10)	1.9 (1)	
\$20,000–\$49,999	23.3 (49)	24.8 (27)	20.4 (10)	23.1 (12)	
\$50,000–\$74,999	18.1 (38)	16.5 (18)	20.4 (10)	19.2 (10)	
> \$75,000	29.5 (62)	28.4 (31)	24.5 (12)	36.6 (19)	
No answer	14.7 (31)	12.9 (14)	14.3 (7)	19.2 (10)	

^aP-values indicate whether a significant difference exists between the predictor variable by consumption group status.

TABLE 2. Attitudes, perceptions and practices among all current raw milk consumers

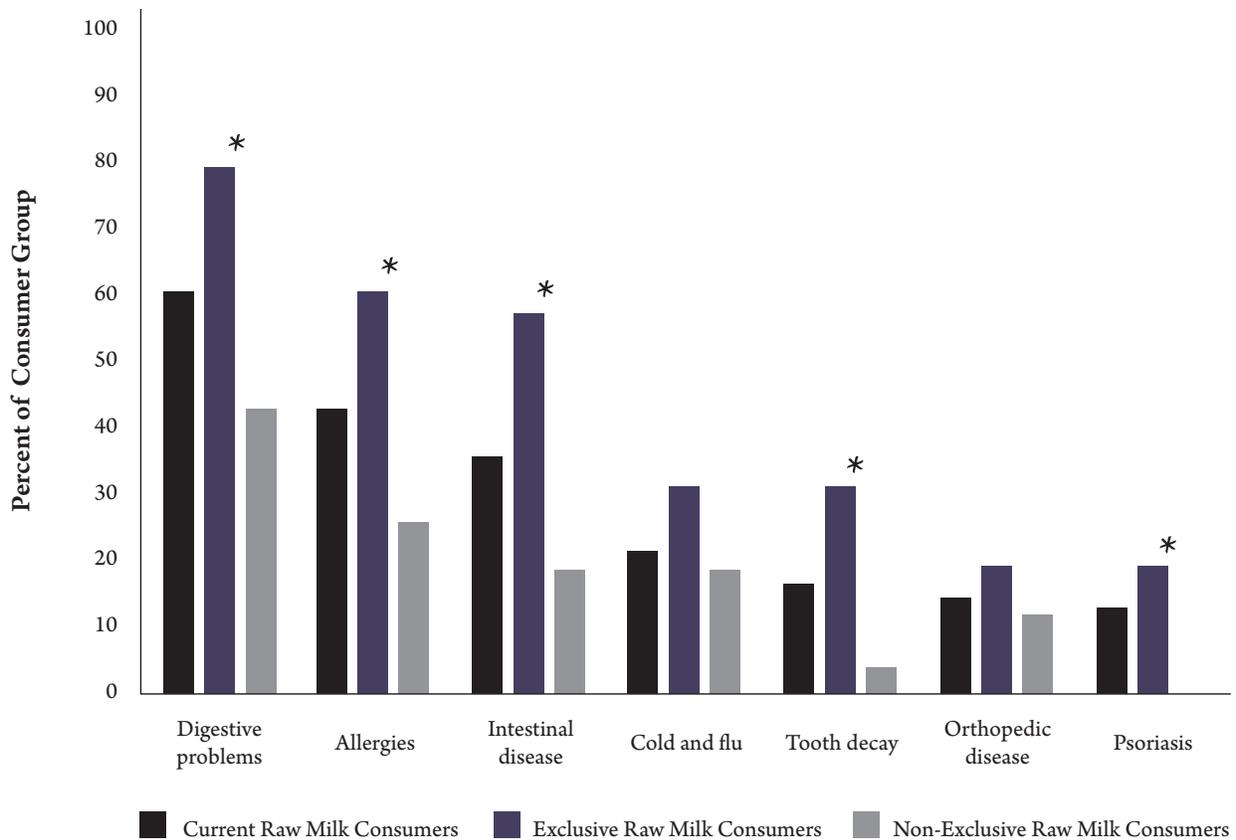
Item	Overall (n = 58)	Exclusivity		P-value ^a
		Exclusive Current RM Consumers (n = 27)	Non-Exclusive Current RM Consumers (n = 31)	
Days per week consuming raw milk; % (n)				< 0.001
< 1 day/week	17.5 (10)	0.0 (0)	33.3 (10)	
1–3 days/week	19.3 (11)	14.8 (4)	23.3 (7)	
4–6 days/ week	19.3 (11)	14.8 (4)	23.3(7)	
Every day	43.9 (25)	70.4 (19)	20.0 (6)	
Source of purchasing raw milk; % (n) ^b				
Local farm/Ranch	50.0 (29)	51.9 (14)	48.4 (15)	0.79
At home	48.3 (28)	59.2 (16)	38.7 (12)	0.12
Retail store	12.1 (7)	11.1 (3)	12.9 (4)	1
Dairy	8.6 (5)	14.8 (4)	3.2 (1)	0.17
Farmers' market	8.6 (5)	7.4 (2)	9.7 (3)	1
Reasons for drinking raw milk; % (n) ^b				
Taste	72.4 (42)	74.0 (20)	71.0 (22)	0.79
Holistic health benefits	67.2 (39)	92.6 (25)	45.2 (14)	< 0.001
Support local farms	60.3 (35)	66.7 (17)	54.8 (17)	0.36
Disease prevention	50.0 (29)	59.2 (16)	42.0 (13)	0.19
Feel processed milk is not safe	37.9 (22)	59.3 (16)	19.4 (6)	0.002
Convenience	15.5 (9)	18.5 (5)	12.9 (4)	0.72
Cost	8.6 (5)	11.1 (3)	6.5 (2)	0.65
Does not trust recommendations made by state health officials regarding which foods are safe to eat; % (n)	67.9 (36)	81.5 (22)	53.9 (14)	0.03
Does not believe that drinking raw milk increases the risk of getting sick; % (n)	96.2 (50)	92.0 (23)	100 (27)	0.23

^aP-values indicate whether a significant difference exists between the predictor variable by consumption group status.

^bParticipants could indicate all applicable responses.

raw milk. These results were consistent with reasons given for consumption with a cohort of Michigan raw milk consumers (7). Some evidence from epidemiological studies have shown the consumption of raw milk to be

protective against asthma, hay fever and atopic sensitization (2, 4, 9). Additionally, raw milk is believed to contain more vitamins and minerals prior to pasteurization (3). However, two recent reviews have concluded there is



*Indicates a significant difference ($P < 0.05$) between exclusive raw milk consumers and non-exclusive raw milk consumers in health problems that consuming raw milk are perceived to benefit

FIGURE 1. Health problems that consuming raw milk are perceived to benefit among current raw milk consumers

not enough scientific evidence to support the nutritional or health-related benefits associated with raw milk consumption, thereby creating a need for public health messages to effectively counter these health claims (4, 13). This messaging could be coupled with other food safety information, as raw milk consumers have been identified as having a higher proportion consuming other risky food products, such as undercooked hamburger meat and raw oysters (3).

While state health officials currently disseminate this type of information, they may not be the most appropriate avenue to reach raw milk consumers. A previous report found that only 7% of raw milk consumers trusted state health officials' recommendations on which foods are safe to eat, while 73% were unsure (8). Among current raw milk consumers in the Pacific Northwest, 68% did not trust these types of recommendations, including 82% of exclusive current consumers and 54% of non-exclusive current raw milk consumers. Leamy et al. found that raw milk consumers gained information via

peer-to-peer communication and recommended that educational programs be implemented at the point of retail sale (8). Additionally, previous work has investigated how consumers identify the trustworthiness of websites providing information on raw and pasteurized milk (12). Consumers found websites that presented both sides of the argument for the consumption of raw or pasteurized milk and that presented the information in a clear/concise way to be more trustworthy (12). Overall, more research is needed to determine the most effective way of disseminating information to the raw milk community, specifically among exclusive raw milk consumers.

Strengths of this study include the development of specific case definitions of each consumer group, and identifying the attitudes and practices of previously unknown raw milk consumer groups (i.e., former, exclusive and non-exclusive raw milk consumers). However, the study has limitations that should be noted. First, the study population was not a random sample of residents in the Pacific Northwest, and this may limit generalizability of

our results. Second, while online social media ads targeted users living in the Idaho, Oregon, and Washington based on their profiles with the social media site, we could not confirm the state or residence for subjects, in order to allow them to stay anonymous. Therefore, we do not know the distribution of respondents across the three states. Third, all information was self-reported, and recall bias may have occurred. Additionally, we did not collect information regarding perceived health benefits among former or never raw milk consumers; therefore, our results can only be compared with results obtained from other raw milk consumers. Lastly, approximately three-fourths of our survey respondents were female, possibly indicating a response bias in our results. Our results of consumption practices were similar to those of raw milk consumers in Michigan, where the response rate of females was 43% (7). Given the similarities in our results with different response rates, we believe the difference in response rates has produced a negligible effect on the results. However, future research in consumption practices of this consumer group

should consider whether consumption practices differ based on gender.

CONCLUSIONS

The study's results highlight the wide range of reasons why people consume raw milk, the low (or entirely absent) perception of risk among raw milk consumers, and the lack of trust that current raw milk consumers have in state health officials regarding food safety. Consuming raw milk carries an inherent risk of illness, particularly among at-risk populations, including the chronically ill or immunocompromised. If consumers continue to choose to consume raw milk, more research is needed to address the most effective means of communicating misperceptions and risks to consumers. Additionally, the development of rapid microbiological testing kits are needed to ensure the safety of the products. It is hoped that addressing these topics will decrease the morbidity associated with consuming raw milk products.

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