

## ORIGINAL RESEARCH

## Survey to Determine Why People Drink Raw Milk

确定人类为何饮用未消毒牛奶的调查

## Encuesta para determinar por qué las personas beben leche cruda

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## ABSTRACT

**Background:** Fragility fractures associated with osteoporosis exact a large financial and personal toll on society. Pharmaceutical or dietary calcium intake is needed to increase bone mineral density to prevent fragility fractures. Although dairy products are a good source of calcium, patients who are unable to digest lactose tend to avoid them and are put at a greater risk for fracture than the general population. Anecdotal reports suggest that lactose maldigesters, when consuming raw milk, have a dramatic reduction in symptoms relative to pasteurized milk. The mechanism of the reported reduction in symptoms, if true, is unknown. The purpose of the current study was to survey raw milk drinkers to ascertain their health-related motivations for consuming raw milk, especially as they relate to lactose maldigestion.

**Methods:** An online survey regarding raw milk was completed by 153 of 1527 members of a raw milk-buying community.

**Results:** The primary reason the respondents cited for drinking raw milk was that they believed it was more healthful; 30% reported some gastrointestinal discomfort when drinking pasteurized milk, yet almost all (99%) reported consuming raw milk without discomfort. Despite the reports of gastrointestinal discomfort, only 5% of respondents had been diagnosed as lactose intolerant by a medical professional, and only 1% had been diagnosed as lactose intolerant via the gold-standard hydrogen breath test.

**Conclusions:** The primary motivation for drinking raw milk is its perceived health value, not its digestibility. Although raw milk appears to be more easily digested than pas-

teurized milk in our survey sample, the mechanism of digestibility remains unknown.

## 摘要

**背景:** 与骨质疏松症相关的脆性骨折给社会造成了极大的财务和人力压力。需要服用药物或摄入饮食钙来增高骨密度,以预防脆性骨折。虽然奶制品是钙的良好来源,但不能消化乳糖的患者常常无法吸收奶制品,且这些患者的骨折风险大于一般人群。零星的报告表明,饮用未消毒牛奶时,乳糖消化不良——饮用巴氏消毒奶的相关症状明显减少。如果报告的情况属实,尚不明确所报告的症状减少的机理。本研究旨在调查未消毒牛奶饮用者,确定他们饮用未消毒牛奶的健康相关动机,特别是与乳糖消化不良相关的动机。

**方法:** 未消毒牛奶相关的在线调查由 1527 个购买未消毒牛奶社区中的 153 个完成。

**结果:** 受访者饮用未消毒牛奶的主要原因是他们认为这样更有益于健康; 30% 的人报告饮用巴氏消毒奶时有一些胃肠不适,但几乎所有(99%) 饮用未消毒牛奶的人都没有不适的报告。尽管有胃肠道不适的报告,但仅 5% 的受访者被医疗专业人员确诊为乳糖不耐症,并且通过氢呼吸测试,仅 1% 的受访者被确诊为乳糖不耐症。

**结论:** 饮用未消毒牛奶的主要动机是获得感知到的健康价值,而非其可消化性优势。虽然我们调查的样本中未消毒牛奶似乎比巴氏消毒奶更容易消化,但尚不明确其可消化性的机理。

## SINOPSIS

**Antecedentes:** Las fracturas por fragilidad asociadas a la osteoporosis suponen un gran coste económico y personal para la sociedad. La ingesta de calcio farmacéutico o dietético es nece-

saria para aumentar la densidad mineral y prevenir fracturas por fragilidad. Aunque los productos lácteos son una buena fuente de calcio, los pacientes que no pueden digerir la lactosa tienden a evitarlos y tienen un mayor riesgo de fractura que la población general. Informes anecdóticos indican que las personas que no digieren bien la lactosa, al consumir leche cruda, tienen una gran reducción de síntomas en comparación con la leche pasteurizada. El mecanismo de la reducción notificada en los síntomas, de ser verdad, se desconoce. El propósito del estudio actual era hacer una encuesta a las personas que beben leche cruda para determinar sus motivaciones relacionadas con la salud para consumir leche cruda, sobre todo en relación con la mala digestión de la lactosa.

**Métodos:** 153 de 1527 miembros de una comunidad que compra leche cruda completó una encuesta online en relación a la leche cruda.

**Resultados:** El motivo principal que los encuestados citaron para beber leche cruda fue que creían que era más sano; el 30 % notificó ciertas molestias gastrointestinales al beber leche pasteurizada, aunque casi todos (99 %) notificaron consumir leche cruda sin molestias. A pesar de los informes de molestias gastrointestinales, un profesional médico había diagnosticado intolerancia a la lactosa en solo el 5 % de los encuestados, y solamente al 1 % se le había diagnosticado intolerancia a la lactosa mediante el método de referencia de prueba de hidrógeno en el aliento.

**Conclusiones:** El motivo principal para beber leche cruda es su valor saludable percibido, no su digestibilidad. Aunque la leche cruda parece ser digerida más fácilmente que la pasteurizada en la muestra de nuestra encuesta, se desconoce el mecanismo de digestibilidad.

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## Key Words

Lactose, raw milk, lactase, maldigestion

## INTRODUCTION

The popular media occasionally present anecdotal stories<sup>1</sup> regarding the benefits of consuming raw dairy products. Yet we found no reports in the literature supporting the anecdotal reports that lactose maldigesters are able to consume raw milk without discomfort.

Also unreported or under debate in the literature is the mechanism that allows maldigesters of pasteurized milk to consume raw milk without discomfort. Raw milk may contain lactase naturally,<sup>2</sup> although this contention is controversial.<sup>3</sup> If the enzyme is present in raw milk, it is very heat labile and would be denatured during the milk pasteurization process.<sup>4</sup> Naturally occurring *Lactobacilli* and *Lactococci*, which are killed during pasteurization, may also be responsible for decomposing lactose. Another proposed mechanism of lactose maldigestion is that milk from cows with the A1  $\beta$ -casein variant (commonly European breeds) contains a peptide called  $\beta$ -casomorphin-7 that reportedly can cause an immune response, lactose intolerance symptoms, and other health-related issues.<sup>5</sup> These claims are not well substantiated in the literature and are controversial.<sup>6</sup> Further complicating the issue, raw milk is often produced and sold from small family farms that typically use Jersey or Guernsey cows and pasture their cows on grass. Jersey and Guernsey cows typically have the A2  $\beta$ -casein variant, whereas Holstein cows (primarily used in large industrial dairies) have the A1 variant. Industrial dairies often confine their cows and feed them a premixed ration. So what are perceived by some to be the benefits of raw milk may have as much to do with the type of cow (A1 vs A2) and husbandry (pastured and grass-fed vs confined and ration-fed) as with the manner in which the milk is pasteurized (or not).

We intend to clinically evaluate the digestibility of raw milk vs pasteurized milk, but to guide the design of our study, we need more background information. Therefore, we surveyed consumers of raw milk to determine the health-related motivations for consuming raw milk, especially as they relate to lactose maldigestion.

## MATERIALS AND METHODS

We developed an online survey of 16 questions, which was available from December 7, 2012, until January 31, 2013. The director of a raw milk-buying consortium in Maryland sent an email to its 1527 members, inviting them to complete our online survey. Because trafficking in raw milk intended for human consumption is against the law in Maryland, survey responses were anonymous. This study was approved by our Institutional Review Board, and respondents were informed that completing the survey served as informed consent.

Most of the 153 respondents (response rate of 10%) were females between 30 and 50 years of age (Table). Of the 153 respondents, 74% reported drinking at least one glass of raw milk per day.

We sought to differentiate those who consumed

raw milk because they considered it more healthful than pasteurized milk from those who consumed it because they found it easier to digest. The concept of “easy to digest” was based on the absence of bloating, gas, diarrhea, and cramping. We queried on the digestibility of drinking milk under three conditions: (1) the reaction to drinking pasteurized milk before switching to raw milk; (2) the reaction experienced currently when drinking raw milk; and (3) the reaction of drinking pasteurized milk after having switched to raw milk. We also asked if there was a transition period at the onset of drinking raw milk to identify if some colonic adaptation had occurred as a result of drinking raw milk.

We sought to identify subjects who had been diagnosed by a medical professional as lactose intolerant and if the diagnosis had been confirmed by a hydrogen breath test (HBT). The HBT is considered the gold standard for measuring lactose maldigestion.<sup>7</sup>

We asked about the digestibility of other dairy products, namely yogurt, cheese, and ice cream. It has long been known that in parts of the world where prevalence of lactose maldigestion is high, those populations nevertheless consume large quantities of yogurt.<sup>8</sup> Fermented products such as cheese and dairy products with live cultures (yogurt) are more easily digested than other dairy because of the presence of microbial  $\beta$ -galactosidase.<sup>9,10</sup>

In an attempt to learn more about the potential role the  $\beta$ -casein variant (A1 vs A2) has on milk digestibility, we asked from what breed of cow the raw milk came and what type of diet the cows were fed, if the participants knew.

Lastly, we sought to assess the importance of calcium in the motivation for consuming raw milk. Lactose intolerance is related to reduced milk consumption and therefore reduced calcium intake, which is associated with an increased risk for osteoporotic fractures.<sup>11</sup>

We analyzed differences in reported discomfort from drinking raw vs pasteurized milk and in drinking pasteurized milk before and after drinking raw milk for significance ( $P < .05$ ) using McNemar’s test.

## RESULTS

Of the 16 questions on the survey, only four were answered by all respondents, but all were answered by at least 148 (96.7%) (Table).

Of the 153 respondents, most (86) cited that they consumed raw milk because they believed it to be more healthful and easier to digest. Only two respondents specified solely that it was easier to digest. Thirty-four respondents selected “other reasons”: 12 said raw milk tasted better than pasteurized milk; 8 cited social/environmental concerns such as “supporting local farmers,” “it is better for the cows,” etc; 6 cited that they had allergies to pasteurized milk; two claimed it cured unspecified ills; and six cited individual reasons such as “I grew up on it” or “[I] don’t eat processed food.”

With regard to discomfort or symptoms after milk

**Table Results of Survey of Raw Milk Drinkers**

Question	Response No. (%)
I drink raw milk instead of pasteurized milk because it is (choose one): (N=153)	
a. Healthier	42 (27.5)
b. Easier to digest	2 (1.3)
c. Both a & b	86 (56.2)
d. Other reasons	23 (15.0)
Other (please specify) <sup>a</sup>	34 (22.2)
Prior to drinking raw milk, when I drank pasteurized milk, I would experience (choose all that apply): ( N=151)	
a. Bloating	44 (29.1)
b. Gas	47 (31.1)
c. Diarrhea	27 (17.9)
d. Cramping	26 (17.2)
e. No ill effects	73 (48.3)
f. I don't drink pasteurized milk	18 (11.9)
When I drink raw milk, I experience (choose all that apply): ( N=153)	
a. Bloating	1 (0.7)
b. Gas	2 (1.3)
c. Diarrhea	1 (0.7)
d. Cramping	1 (0.7)
e. No ill effects	151 (98.7)
Since drinking raw milk, when I drink pasteurized milk, I experience (choose all that apply): (N=150)	
a. Bloating	22 (14.7)
b. Gas	27 (18.0)
c. Diarrhea	14 (9.3)
d. Cramping	17 (11.3)
e. No ill effects	48 (32.0)
f. I don't drink pasteurized milk	70 (46.7)
I have been diagnosed as lactose intolerant by a medical professional: (N=150)	
a. Yes	5 (3.3)
b. No	145 (96.7)
I have been diagnosed as a lactose intolerant by a hydrogen breath test: (N=151)	
a. Yes	1 (0.7)
b. No	150 (99.3)
When I eat cheese, I experience (choose all that apply): (N=151)	
a. Bloating	13 (8.6)
b. Gas	17 (11.3)
c. Diarrhea	5 (3.3)
d. Cramping	9 (6.0)
e. No ill effects	121 (80.1)
f. I don't eat cheese	5 (3.3)
When I eat ice cream, I experience (choose all that apply): (N=149)	
a. Bloating	26 (17.4)
b. Gas	28 (18.8)
c. Diarrhea	19 (12.8)
d. Cramping	18 (12.1)
e. No ill effects	88 (59.1)
f. I don't eat ice cream	16 (10.7)

Table Results of Survey of Raw Milk Drinkers (cont.)

Question	Response No. (%)
When I first started drinking raw milk, there was a transition period during which I experienced (choose all that apply): (N=152)	
a. Bloating	3 (2.0)
b. Gas	7 (4.6)
c. Diarrhea	7 (4.6)
d. Cramping	4 (2.6)
e. No ill effects	137 (90.1)
The raw milk I drink comes from (choose best answer): (N=148)	
a. Jersey cows	50 (33.8)
b. Guernsey cows	7 (4.7)
c. Holstein cows	6 (4.1)
d. Other	7 (4.7)
e. Don't know	78 (52.7)
The raw milk I drink comes from cows that are (choose best answer): (N=152)	
a. Raised on grass	136 (89.5)
b. Raised on corn	0 (0.0)
c. Raised on both corn and grass	3 (2.0)
d. Certified organic	6 (3.9)
e. Don't know	7 (4.6)
I am: (N=151)	
a. Male	32 (21.2)
b. Female	119 (78.8)
I am: (N=152)	
a. 18-30 years old	19 (12.5)
b. 31-40 years old	46 (30.3)
c. 41-50 years old	40 (26.3)
d. 51-60 years old	28 (18.4)
e. Older than 61 years	19 (12.5)
I drink milk for my primary source of calcium (choose best answer): (N=151)	
a. Strongly agree	26 (17.2)
b. Agree	53 (35.1)
c. Neutral	49 (32.5)
d. Disagree	15 (9.9)
e. Strongly disagree	8 (5.3)
I eat yogurt with active cultures (choose best answer): (N=153)	
a. Once per day	56 (36.6)
b. Once per week	56 (36.6)
c. Once per month	33 (21.6)
d. Once per year	4 (2.6)
e. Never	4 (2.6)
I drink a glass of raw milk (choose best answer): (N=153)	
a. Several times per day	36 (23.5)
b. Once per day	77 (50.3)
c. Once per week	22 (14.4)
d. Once per month	9 (5.9)
e. Once per year	3 (2.0)
f. Never	6 (3.9)
*Although instructed to choose only one response, 11 respondents chose one of the letter selections, then added a comment under "Other (please specify)."	

consumption, 71 respondents reported no discomfort from drinking raw or pasteurized milk. Two reported discomfort from drinking raw and pasteurized milk, and one commented that he/she does not consume cow milk but instead drinks goat milk. Fifty-nine respondents claimed no discomfort after drinking raw milk but discomfort from drinking pasteurized milk. One reported no discomfort from drinking pasteurized milk but did report discomfort from drinking raw milk. Two responses were missing. Eighteen consumed raw milk without discomfort but reported they “do not drink pasteurized milk.” Considering the number of respondents who cited discomfort drinking milk, it was surprising that only 5 (3%) respondents were diagnosed as lactose intolerant and only 1 (0.7%) was confirmed lactose intolerant by means of an HBT. In terms of symptoms between before and after beginning to drink raw milk, responses included, “don’t drink pasteurized milk” (70); “do not have discomfort drinking pasteurized milk” (41); and “still get discomfort drinking pasteurized milk” (28). Twenty-six respondents reported no discomfort from drinking pasteurized milk, but nevertheless they do not drink pasteurized milk. Four reported no previous discomfort but did report discomfort since beginning to drink raw milk. Five respondents reported previously having trouble drinking pasteurized milk but no symptoms since drinking raw milk. Two respondents reported not drinking pasteurized milk but symptoms when they did drink pasteurized milk. Three respondents had missing data. There was no significant reduction in discomfort of the respondents between the before and after drinking raw milk periods.

## DISCUSSION

In the current study, survey results suggest that the motivation for raw milk consumption is complex. We hypothesized that one motivation for raw milk consumption was to avoid symptoms associated with lactose maldigestion. Yet almost half of the respondents indicated that they had no ill effects after drinking pasteurized milk. Despite the number of respondents indicating some gastrointestinal (GI) discomfort when having previously consumed pasteurized milk, only 5 (3%) respondents were diagnosed as lactose intolerant, and only 1 (0.7%) was confirmed lactose intolerant by means of an HBT. These findings suggest that the symptoms of lactose intolerance were mild enough to not warrant the respondents’ seeking a medical diagnosis or that the respondents self-diagnosed and sought alternatives to pasteurized milk. Diagnosing lactose maldigestion and the severity of the maldigestion would seem straightforward using the HBT. The HBT is considered the gold standard for diagnosing lactose maldigestion.<sup>7,12</sup> It is intriguing that a sizable percentage of those exhibiting lactose maldigestion symptoms have not been diagnosed by a medical professional as being lactose intolerant. It would be interesting to determine the HBT diagnosis of those who report GI discomfort. Some indicate that

what is self-diagnosed as lactose intolerance/maldigestion may be a misinterpretation of GI dysbiosis or irritable bowel syndrome.<sup>13</sup> It may also be a self-fulfilling diagnosis because those who consider themselves to be lactose maldigesters tend to avoid dairy, which causes a change in the gut microbiota, making the bacteria less adept at decomposing lactose. Others have found that those diagnosed as lactose maldigesters could ingest modest amounts of milk per day without incident and that symptoms associated with lactose maldigestion were misattributed.<sup>14-16</sup>

The underlying mechanism by which lactose in raw milk may be more readily digested, if in fact that is the case, is more difficult to determine. The predominant bacteria in raw milk are *Lactococcus lactis* (strains of which are used commercially as starter cultures in cheese making), but the bacteria are virtually eliminated when milk is pasteurized.<sup>17</sup> It is likely that these native bacteria account for the alleged enhanced digestibility of raw milk over pasteurized milk, but we found no report in the literature of a direct clinical comparison. In one study, yogurt with active bacterial colonies fed to maldigesters was more readily digested than pasteurized yogurt or milk with active cultures.<sup>10</sup> Yogurt has been found to have a greater buffering capacity than milk.<sup>9</sup> Therefore, yogurt maintains the stomach at a higher pH than milk, which protects the bacteria. In one study, heating yogurt and reintroducing live bacteria up to  $10^6$  bacteria/mL concentrations was not as effective as standard yogurt with  $10^8$  bacteria/mL in reducing  $H_2$  in lactose maldigesters.<sup>18</sup> Furthermore, certain strains of active bacteria appear to be more efficient than others at digesting lactose.<sup>19</sup> Exposing the intestinal microflora to lactose allows the lactose-fermenting non-hydrogen-producing organisms to thrive. The resulting colonic adaptation results in lactose being metabolized to short-chain fatty acids and lactate instead of hydrogen, which is the main component in flatus.<sup>20,21</sup> This colonic adaptation may confound the study results, which is why we included the question regarding discomfort from drinking pasteurized milk after the respondent had been consuming raw milk. Our results did not indicate any evidence of colonic adaptation, but our results may be skewed because most respondents, after drinking raw milk, reported never drinking pasteurized milk, so it is impossible to know how they would react to pasteurized milk consumption. Other investigators have suggested a placebo effect instead of colonic adaptation because clinical symptoms of maldigestion (eg, bloating, diarrhea) decreased in lactose-treated and control groups.<sup>22</sup> Yet objective analysis of  $H_2$  excretion decreased significantly in the lactose-exposed group compared with controls, suggesting some adaptation.<sup>22</sup> In our survey, 95% of the respondents reported eating yogurt with active cultures at least once a month. Our survey did not ask if the yogurt with active cultures consumption was similar before and after raw milk consumption, so it is unknown what role yogurt might

have in colonic adaptation in our survey group.

Our respondents reported greater ease of digestion for cheese than for ice cream. However, after the survey, we learned that some of the respondents made their own cheese and ice cream from raw milk. Therefore, it is unknown what percentage of responses was associated with pasteurized commercial cheese and ice cream compared with raw-milk cheese and ice cream. Ice cream is reportedly easier to digest than milk.<sup>10</sup>

When asked about drinking raw milk, almost 99% of respondents indicated no ill effects. This result suggests that, in the 20% to 30% who initially reported GI discomfort drinking pasteurized milk, the symptoms abated when consuming raw milk. Although these findings might argue the case that raw milk is more easily digested, it is unlikely that the result would apply to all who experience GI discomfort when consuming pasteurized milk because of a selection bias in our data set. It is unlikely that those who would experience GI discomfort from drinking raw milk would be part of a raw dairy–buying club. Thus, there is likely an overestimate of those lactose maldigesters who would benefit from raw milk.

That 99% of the respondents could drink raw milk without incident is high but consistent with the published finding that 82% of patients diagnosed as lactose intolerant after ingesting pasteurized milk were capable of ingesting raw milk without incident.<sup>1</sup> The patients in that survey were self-reporting their diagnosis by a healthcare professional, but the definition of “healthcare professional” was unclear.<sup>1</sup> Nevertheless, the information contained in that report is the best currently available for comparison.

Most respondents considered milk as their primary source of calcium. Calcium intake is important in reducing fracture risk and osteoporosis.<sup>23</sup> The current finding suggests that, at least among the group of survey respondents, milk is an important source of calcium. One might surmise that for those who are not able to digest milk easily, milk as a source of calcium may be eliminated from their consideration. In terms of osteoporosis prevention, it should be noted that calcium absorption from milk was not affected by lactose maldigestion status.<sup>24</sup> The reduction in calcium intake in patients with lactose maldigestion is associated with reduction in milk intake.<sup>11,25</sup> More than 75% of the respondents reported consuming at least one glass of milk per day. The size of the glass was not specified, so it is unknown what magnitude of nutrients would be available for ingestion on a daily basis.

Finally, the role of A1/A2  $\beta$ -casein variant in cow genetics and the role of husbandry on digestibility remain elusive. Almost 90% of the respondents reported that their milk came from grass-fed cows. The respondents were less sure about the cow breed from which their milk came. Although these results are consistent with expectations of the cows and husbandry that are associated with raw milk for human consumption, it is unknown how reliable the reporting of this

information is. More than half of the respondents readily admitted not knowing from which breed of cow their milk came.

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