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Milk Consumption Patterns among Persons with Type 1 Diabetes Mellitus from Mumbai city – an Exploratory Study

Research Article

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Abstract

Reports of epidemiological studies in the Western world, strongly suggest that consumption of A1 milk is associated with increased risk of Type 1 Diabetes Mellitus, Autism Spectrum Disorders, etc. However, very few studies in India have addressed this issue. Therefore, an exploratory study was undertaken to examine the milk consumption patterns of persons with T1DM attending clinics in Mumbai city and their awareness about A1 and A2 milk. Ninety six people with T1DM were approached, of which seventy five agreed to participate. The average age of participants was 22.4 years (3 - 52 years) (Median = 21 years). The mean age at diagnosis of type 1 diabetes was 9.5 years (6 months – 29 years) (Median = 9). Among the 75 participants, 64 consumed milk, but 11 did not consume milk. Almost half the participants (n = 30) had heard about A2 milk. Only ten participants (14.7%) had begun consuming A2 milk when it became commercially available, for reasons of their own or family members' health. Knowledge about A1/A2 milk and the possible role of A1 milk in the onset of diabetes was relatively poor and only twelve participants had some knowledge about the possible health implications.

Keywords: Milk; BCM7; Type 1 Diabetes mellitus, A1/ A2 milk

Abbreviations

T1DM -Type 1 Diabetes mellitus; BCM7 - β-casomorphin 7; SD - Standard deviation; NIN - National Institute of Nutrition; NOD mice - Non-obese diabetic mice; ASDs - Autism Spectrum Disorders; SIDS - Sudden Infant Death Syndrome; MPO - Myeloperoxidase activity; MCP-1 - Monocyte chemotactic protein; IL4 - Interleukin 4; IgE - Immunoglobulin E; IgG - Immunoglobulin G

Introduction

According to the 9th edition of the International Diabetes Federation Diabetes Atlas (2019) [1], one in six adults with diabetes is from India. As of 2019, India is home to the second largest number of children and adolescents with Type 1 diabetes mellitus (T1DM) globally, with 171,281 patients in the age group 0-19 years. Due to its large population, India adds15,900 children, the highest number of children with T1DM, per year in the age group of 0 to 14years [1]. Das (2015) reported a T1DM prevalence of 3.2 cases/ 100,000 children in Chennai [2], 10.2 cases/ 100,000 children in Karnal and17.93 cases/ 100,000 children in Karnataka. Dhingra and Kalra (2018) reported that in India the prevalence of T1DM is more than

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10/100,000 population [3], but in some urban pockets the prevalence is > 30/100,000 population. It is estimated that the increase in incidence is about 3 to 5 percent per year.

One of the risk factors identified in the multifactorial pathology of T1DM that is receiving attention since about two decades, is the consumption of A1 milk. The A1/A2 hypothesis states that exposure to the peptide β-casomorphin-7 (BCM-7), formed after the digestion of A1 milk, may act as an immunosuppressant, impair tolerance to dietary antigens in the gastrointestinal tract and thus contribute to the onset of T1DM [4,5]. This has led to growing concern about A1 milk in the world and in this country as well [6].

India is the largest producer of milk in the world and traditionally Indian cattle breeds produce A2 milk that does not lead to the formation of the BCM-7 peptide. However, in order to augment milk production, cross breeding of bovines with breeds such as Holstein was done [6]. At this time, the A1 allele entered in the genome, resulting in production of milk that would lead to the formation of BCM-7. We, in our laboratory analyzed milk produced by pure bred Gir cows as well as Holstein Frisian and Jersey cows crossbred with other indigenous breeds. We found that pure bred Gir cows produce A2A2 milk whereas Holstein Frisian and Jersey cows crossbred with other indigenous breeds produce A1A2, A1A1 as well as A2A2 milk (Unpublished Data).

Given that milk is widely recommended globally for its health benefits throughout the life cycle, particularly in India where it is consumed in almost every household, there is cause for concern, when health properties of A1 milk are questioned.

In this context, we undertook a survey to assess the milk consumption practices in persons with Type 1 diabetes and their knowledge regarding A2 milk.

Materials and Methods

Ethics Approval

The study was approved by the Intersystem Biomedica Ethics Committee (ISBEC) (Approval No. ISBEC/NR-30/KM-MN/2019) (July 22, 2019).

Sample Selection

Subjects were persons with T1DM attending two clinics that specialised in diabetes care and were located in a Western suburb in Mumbai city. Participants were recruited after obtaining informed consent.

The study was conducted between July 2019 and April 2020. Ninety six participants were contacted, among whom seventy five consented to participate in the study.

Data Collection

Information about age at diagnosis, medical history, family medical history was collected from the participants by a trained dietician using an interview schedule. Present age and age at diagnosis was calculated from date of birth (received from 74 out of 75 participants). Information regarding milk consumption patterns included current practice for consumption of milk and milk products, type and amount of milk consumed, frequency of milk consumed per day, presence of symptoms of lactose intolerance and knowledge about A1/A2 milk.

Data Analysis

Results were tabulated in MS Excel (version 10) and data was analysed using SPSS version 20. The 75 participants were categorized into two groups based on the type of milk consumed: Group 1consisted of those who consumed cow's milk or cow and buffalo milk but were not aware of the type of milk i.e. A1 or A2, and Group 2 included those who consumed A2 cow or buffalo milk. Milk non-consumers were placed in a third group, Group 3. One way Analysis for Variance was applied for statistical comparison.

Results

Profile of Participants

Among the 75 participants, 30 participants (40%) were males and 45 (60%) were females. Mean age of the participants was 22.4 years ± 11.4 years (Median = 21 years). Age at diagnosis varied from 0.5 years to 29 years, with the mean age at diagnosis being 9.5 years (Median = 9). Average duration of being diabetic was 13.0 years. The general profile of participants is given in (Table 1).

Milk Consumption

Sixty four of the 75 participants (85.3%) consumed milk. Among these 64, 36 participants (48%) were consuming cow milk or cow + buffalo milk (Group 1), and 28 participants (37.3%) reported that they were consuming A2 cow or buffalo milk (Group 2); of which, 11 consumed A2 cow's milk and 17 consumed buffalo milk. Eleven participants (14.7%) were not consuming milk at all (Group 3). A total of 19 different brands of milk were identified in our study group.

One-third of the participants (33.3%, n = 25) consumed milk twice per day, and one - fourth consumed milk once in a day (25.3%, n = 19). Average milk intake of participants per day was calculated by age group. The intake was compared to the amount recommended by the National Institute of Nutrition (2011) to be consumed as part of a balanced diet. In the age-groups of 1-3 years [7], 7-9 years and >18 years, on average about 80% of the recommended milk per day

Table 1: General Profile of Participants.

		Min - Max	Total
Number of participants		-	75
Age in years (Mean ± SD) (n = 74)		3 – 52	22.4 ± 11.4
Age at diagnosis in years (Mean ± SD) (n = 74)		0.5 – 29	9.5 ± 5.6
Duration of diabetes		0.5 months – 33 years	13.0 ± 9.5
Type of Family (number of participants):	Nuclear Joint Extended Single parent Live alone	-	42 30 1 1 1
Dietary Pattern (number of participants):	Vegetarian Non – vegetarian Ovo – vegetarian Vegan	-	24 40 10 1
Hours of sleep (self-reported) (Mean ± SD)		5.0 – 14.0	7.46 ± 1.36

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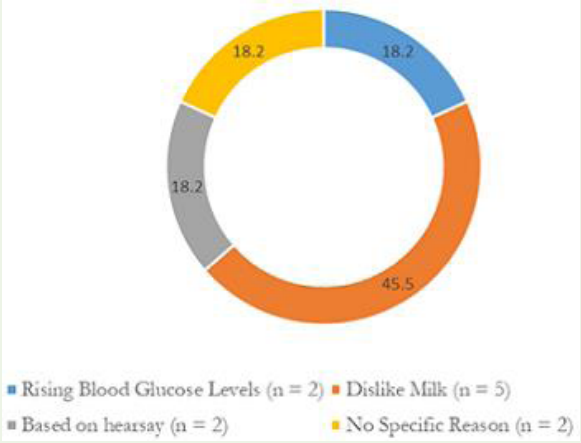

Figure 1: Participants reasons for discontinuation of milk consumption.

was consumed. In contrast, among the 4- to 6-year-old participants, only 50% of the recommended intake was met. Participants in the age groups 10-12 years (29.4%), 13-15 years (37%), 16-18 years (42%) and pregnant woman (25%) all had less than 50% of the recommended milk consumption (Table 2).

Eleven participants (14.7%) did not consume milk. Among these 11 participants, 10 had stopped consuming milk and/or milk products soon after they were diagnosed with diabetes. Only two (18.2%) participants stopped consuming milk because it caused their blood glucose levels to rise. Five participants had stopped consuming milk because they disliked it (45.5%). Two participants (18.2%) excluded milk and its products from their diet based on hear say information available online and two participants (18.2%) did not provide any reason for discontinuing milk consumption (Figure 1). All 11 participants took the decision on their own, without consulting their supervising diabetologist or dietician.

Consumption of milk products

Besides milk, participants were asked about consumption of milk products. The most commonly consumed dairy products were paneer and/or khoa (88%, n = 66), followed by curd and curd- based beverages (86.7%, n = 65) (Table 3). Flavoured milks and fresh cream were not commonly consumed (9.3%, n = 7 for each product).

Knowledge about A1/ A2 milk

Of the 75 participants, 30 (40%) were aware about A1 and A2 milk, whereas 45 (60%), were not. Of the 30 participants who were aware, only 2 participants (6.7%) knew about the scientific debate pertaining to A1/A2 milk. One-third of the participants (33.3%,n = 10) opined that A2 milk is beneficial for health, four (13.3%) were aware that it is obtained from Indian cow breeds, and two (6.7%) were aware that the topic was related to proteins. Ten participants (33.3%) did not know anything concerning A1/ A2 milk, and the remaining (n = 2, 6.7%) gave incorrect information about A1 and A2 milks figure 2.

Shift to A2 milk

Twenty participants (26.7%) reported that they had recently changed the milk that they used to habitually consume. Three participants had shifted to soy milk, four were using cows and buffalo milk both, and two were using cow's milk of a different brand. The remaining 11 (14.7%) participants had stopped using the milk they had used previously, although they did not know the type of milk they were using and switched to using either A2 cow's milk or buffalo milk.

Various reasons were given for switching to A2 milk/ buffalo milk (Figure 3). The reasons were:

- For health reasons (n = 1, 9.1%)
- Because another member of the family switched to A2 milk (Family Reasons) (n = 4)
- For better quality of milk (n = 2, 18.2%)
- Based on a newspaper article (n = 1, 9.1%)
- On the recommendation of a dietician (n = 1, 9.1%)
- To try A2 milk (n = 1, 9.1%), and
- To initiate A2 milk consumption (n = 1, 9.1%).

Discussion

One of the first studies to show a correlation between consumption of A1 containing milk in T1DM was reported by Elliot et al., (1999) [8]. Since this report, evidence comes largely from in vitro and animal studies. The diabetogenicity of bovine milk is based on observations and apparent incidence figures, and evidence regarding this association in humans comes largely from ecological studies [6].

Table 2: Amount of milk consumed per day as per age of participants.

Age Group	Milk consumed (mL/ day) Mean ± SD	Minimum - Maximum (mL)	Dietary Guidelines for balanced diet (per day) (NIN, 2011)	Gap in milk consumption (mL) Mean ± SD	F, *p*
1 - 3 year (n = 1)	400	400	500 ml	100	0.976
4 -6 year (n = 1)	250	250	500 ml	250	0.458
7 - 9 year (n = 6)	446 ± 527	100 - 1500	500 ml	54 ± 527	
10 – 12 year (n = 8)	166 ± 103	80 - 400	500 ml	334 ± 103	
13 – 15 year (n = 6)	216 ± 146	75 – 400	500 ml	284 ± 146	
16 – 18 year (n = 4)	263 ± 190	75 – 525	500 ml	238 ± 190	
>18 year (n = 37)	280 ± 170	75 – 750	300 ml	21 ± 170	
Pregnant Woman (n = 1)	125	-	500 ml	375	

*Milk consumption recommended for balanced diet calculated from portions where 1 portion = 100 ml

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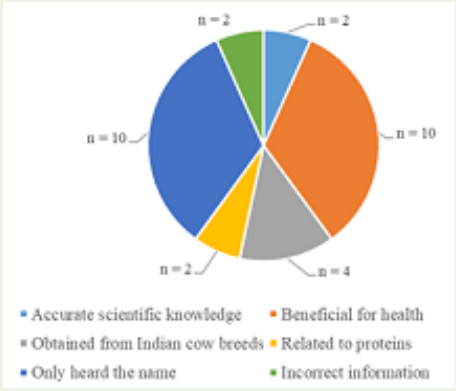

Figure 2: Knowledge of participants regarding A2 milk.

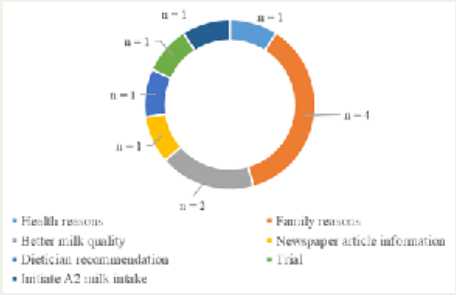

Figure 3: Participants' reasons for switching to A2 cow's/ buffalo milk.

Table 3: Consumption of Milk products.

Dairy Products	Number and Percentage of consumers
Tea and/or coffee	49 (65.3)
Khoa and/orpaneer	66 (88)
Cheese	59 (78.7)
Curd & curd beverages (lassi, buttermilk)	65 (86.7)
Milkshakes	20 (26.7)
Flavoured milk	7 (9.3)
Fresh cream	7 (9.3)
Ice cream	43 (57.3)
Milk with spices/ condiments (turmeric, cardamom, etc.)	24 (32)
Ghee	58 (77.3)
Butter	57 (76)
Other milk products	17 (22.7)

The Diabetes Autoimmunity Study in the Young (DAISY) (2014) [9], found that cow's milk increased the risk of autoimmunity in children at a low genetic risk for T1DM and there were higher chances of progression to T1DM [9].

Animal models have also been used to study this correlation. China and co-workers (2018) conducted an intergenerational study with adult NOD mice [10], where in they compared A1 or A2 β-casein supplemented diets. There was no difference observed in the incidence of diabetes in the first two generations. However, in the F3 generation, the incidence was doubled in the mice fed the A1 β-casein supplemented diet and in the F4 mice, they found subclinical insulitis and altered glucose handling was evident as early as 10 weeks of age in the A1 group. They concluded that possibly the adverse effects of dietary A1 β-casein on glucose homeostasis and development of type 1 diabetes may manifest in succeeding generations.

Epidemiological and animal studies have thus shown that consumption of A1 β-casein and other such variants with histidine at the 67th position could be potential risk factors in the onset of diabetes [8,10,11].

However, the evidence regarding this association is fairly equivocal. Savilahti & Saarinen (2009) earlier found no association between early exposure to cow's milk and development of T1DM [12]. A study conducted with a murine model showed that different casein hydrolysates did not significantly alter biochemical parameters in healthy and diabetic rats [13].

While the negative effects of A1 milk and BCM7 have received great attention, the possible benefits of this in terms of mucus secretion [14, 15], increased activity of superoxide dismutase and catalase [16], increased levels of prolactin and its analgesic role, the development of innate immunity, lymphocyte proliferation and cellular immunity have apparently been downplayed [17]. There are reports from animal studies that BCM-7 has a protective role against hyperglycaemia and free radical- mediated oxidative stress [18].

In contrast, variants of β-casein have also been implicated in diseases such as ischemic heart disease, ASDs, schizophrenia, SIDS, gastric discomfort, etc. [19, 20]. A study conducted to evaluate the inflammatory response of β-casein showed that A1A1 and A1A2 case in variants caused a significantly higher rise in myeloperoxidase activity (MPO), monocyte chemotactic protein (MCP-1) level, interleukin 4 (IL4), as well as IgE and IgG levels compared to A2A2 β-casein [21]. The paradoxical responses of various experiments with regard to the physiological implications of A1 β-casein consumption, therefore, warrant further investigation before deciding on whether A2 milk should be preferred over A1 milk.

The debate about A1 /A2 milk and several brands marketing A2 milk motivated us to determine whether individuals with T1DM associated it with milk consumption or whether they had changed their milk consumption practices; and their knowledge about A1/2 milk, after diagnosis.

In the present study, we found that none of the participants associated consumption of milk as a cause of T1DM. Another notable observation in this study was that some participants had chosen to consume A2 milk. It is noteworthy, that this was a self-made decision on the part of all the 11 participants. Only one participant made the change upon receiving the recommendation from a dietician, whereas the other 10 participants chose A2 milk without consulting their diabetologist and/or dietician.

We also found that knowledge of A1/A2 milk was quite poor. Among the 75 participants, only 30 participants were aware about A1 and A2 milks. Only two participants were aware about the details of the A1/A2 controversy, suggesting the level of knowledge among our participants was relatively poor. These findings show that there is still much to be understood about people's perception regarding milk and its role in diabetes mellitus, particularly in T1DM.

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Among the 75 participants, 64 consumed milk with the amounts varying from 75 mL to 1500 mL per day (273 ± 220 mL). On average, adults in urban India consume 120.7 g of milk and milk products, whereas mean consumption among rural adults is 117.9 g [22].

In a Nestle Nutrition workshop in 2011 [4], it was pointed out that there are several, infact there are 13 different variants of β-casein in dairy cattle; and A1, A2 and B, which are variants in dairy cattle are also present in human milk. The amino acid sequences of these β-casomorphins bear considerable similarity regardless of whether the source is bovine or human milk. In this workshop it was noted that epidemiological studies and animal models do not provide supportive evidence of association of these milk proteins even in breast milk and the development of T1DM. The European Food Safety Authority concluded that "a cause and effect relationship is not established between the dietary intake of BCM7 (beta-casomorphin-7), related peptides or their possible protein precursors and non-communicable diseases" [23].

Globally and locally within India, while the debate continues over the potential health implications of A1/A2 milk, the perception that A1 milk is harmful to human health, seems to be regarded seriously by some segments of the scientific community [5,6,14-17]. While the A1/A2 hypothesis is intriguing and if it is conclusively proven that A1 milk does increase the risk of T1DM and cardiovascular diseases, it will have important public health connotations. However, presently available data is not sufficient enough to be able to draw a conclusion about a cause-and-effect relationship. More studies in vivo and with animals; and generation of data with humans are required.

This study is a part of a larger study where we intend to explore the knowledge of A1/A2 milk and their health implications in multiple cohorts including bio-medical professionals. Our study can be considered preliminary, where none of our 75 participants indicates that majority of our participants did not associate milk consumption with negative implications for health. Our study had limitations in terms of lack of information whether the commercially available popular brands of cow's milk are either A1 or a mixture of A1 and A2 milk. Also, some brands did not clearly state whether the source of milk was cow or buffalo. Since the study was restricted to Mumbai city, it may be worthwhile to undertake a well-designed epidemiological study on a larger representative population to investigate the physiological effects of A1 milk or A2 milk or buffalo milk using available diagnostic techniques to determine whether people with diabetes have antibodies to the BCM peptide. This is particularly important considering the rising incidence of T1DM in India.

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