Dairy Intake in Association with Asthma Symptoms Among a Large Sample of Children and Adolescents: A Cross-Sectional Study

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Abstract

Dairy products may be linked to an increased risk of asthma, although there is little scientific evidence to back this up. The goal of this study was to look at the link between dairy consumption and asthma symptoms. This cross-sectional study was conducted on children and adolescents aged 6-8 and 13-14 living in central Iran. Dietary food consumption was assessed using a multiple-choice questionnaire. Logistic regression was used to obtain odds ratios for the association between milk, other dairy products, and total dairy consumption with asthma symptoms. In total, 7667 participants (3414 boys and 4253 girls) were included in the current study. Milk intake and total dairy consumption were not associated with the likelihood of wheezing, asthma confirmed by a doctor, current asthma, and asthma medication use. However, the analysis revealed that those who eat other dairy products on most days or every day might have a reduced likelihood of wheezing compared to those who do not eat or rarely eat other dairy products (OR: 0.65, 95% CI 0.44-0.94, P_{terend}=0.18). After adjusting for age, sex (OR: 0.58, 95% CI 0.39-0.84, P_{terend}=0.03), and additionally adjusting for watching TV and computer use (OR=0.58, 0.40-0.85, P_{terend}=0.02), and BMI (OR: 0.58, 95% CI 0.40-0.85, P_{terend}=0.02), individuals in the highest category of other dairy consumption had significantly lower odds of wheezing compared with those with the lowest intakes. In conclusion, the consumption of dairy products other than milk, including cheese and yogurt, might reduce the likelihood of wheezing in children and adolescents.

Introduction

Asthma is the most common chronic condition in children and adolescents (1), affecting about 6.6 million children in the United States (2). Exacerbations of asthma are a leading cause of disease morbidity, higher health-care expenses, and, in some individuals, a faster loss of lung function (3). Wheezing, coughing, shortness of breath, and chest tightness are some of the symptoms that might occur (4). In 1980, the prevalence of asthma was accounted to be about 3.5% among children. However, the number has grown to 9.5% in about thirty years (5). Adolescents have asthma prevalence and morbidity rates that are comparable to, if not higher than, those of young children (6). The disease is less common in white Americans (7.8%) compared to African Americans (11.9% in 2010) (5) and the highest prevalence rates are reported in developed countries like Australia (21%). In 27 papers that employed the International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire for their assessment, the prevalence rate of “asthma ever” among Iranian children ranged from 0.5–11.0% (self-reported tool for ascertainment of the disease) (4).

The causes of asthma are not fully understood. However, several risk factors, including microbiome and viral infections, smoking (7), vitamin D status, chemical exposure, air pollution (8), pollen (9), stress, genetic factors (10), and dietary changes (11) are proposed to be associated with the development of the disease. The association between dietary components like nutrients, foods, and food groups like vitamin D3 (12), antioxidants (13), soy isoflavones (14), fish oil (15), and dairy products and asthma has been examined by several investigations (8, 16). Although dairy products are high in micronutrients, fatty acids, and probiotics, it is thought that they may raise the incidence of asthma and allergies in children (17). Dairy products have been linked to asthma flare-ups, although there is little scientific evidence to back up this theory (18). The epidemiological research on the link between dairy consumption and asthma has been mixed. Several studies in children have found a strong link between dairy consumption and asthma, wheezing, eczema, and rhinitis (19, 20), whereas a null association has been found in studies in adults (21–23) as well as in other studies in children (24–27). For instance, a study in Greece, found that consumption of farm milk at age 5 is associated with a lower prevalence of

atopy at age 11–19 (28). It's also been suggested that daily ingestion of milk fat-containing products could help young children with asthma and wheezing. A case-control study published in 2015 found a link between frequent dairy consumption and the risk of developing asthma in children (29). A link between ricotta and low-fat cheese intake and “doctor-diagnosed asthma” has also been discovered (21). However, a double-blind, placebo controlled, cross-over study could not confirm that dairy products might induce bronchoconstriction or changes in asthma symptoms in adults (18). In contrast, the consumption of full fat milk and butter from early childhood was reported to be inversely associated with the onset of allergic asthma (30). According to previous studies, more than half of people with asthma change their eating habits, with dairy products being the most typically avoided food (21).

As previous investigations have led to inconsistent results and limited data from large-scale studies, particularly from the Middle-East, is available, the present study aimed to investigate the association between dietary milk and other dairy products consumption and asthma and its symptoms in a large sample of children and adolescents living in central Iran.

Subjects And Methods

Participants

The current cross-sectional study was part of the Global Asthma Network (GAN), which took place in Yazd, central Iran, in early 2020. The GAN is a cross-sectional, multi-center, multi-country epidemiological study that builds on and enhances the ISAAC Phase three methodology (31). According to the GAN recommendation, at least 3,000 samples are required to estimate a good prevalence of asthma (32). In the present study, students from 48 and 36 high and elementary schools (state and private) were randomly selected from two educational districts using a cluster sampling design, respectively. Moreover, non-Iranian students were excluded from the study. All the subjects aged 13-14 and parents of 6-7 years were invited to fill out online electronic questionnaires on asthma and its symptoms and risk factors, which were designed and placed in the virtual education groups of schools. The information was collected using paper questionnaires for a group of participants aged 6-8 years. Due to the school closures during the COVID-19 pandemic, the rest of the 6-8year old students were provided with the electronic questionnaires. Out of 7214 and 3026 adolescents, and children, 5141 and 2526 completed the questionnaire, with response rates of 71.3% and 83.5%, respectively, and then demographic data that seemed unacceptable was reviewed by telephone and corrected if necessary. At the beginning of the study, due to schools' closure during the outbreak of COVID-19, an electronic questionnaire was designed and placed in the virtual education groups of schools.

The ethics committee of Shahid Sadoughi University (SSU) of Medical Sciences in Yazd, Iran, approved the GAN study on Iranian youngsters (IR.SSU.REC.1398.244). The ethics committee also gave its approval for the current study. The Yazd Education administration then granted permission to conduct the study at elementary and guidance schools. Parents gave their informed consent as well. The consent form was included at the start of the internet questionnaires so that kids and their parents may feel entirely comfortable participating in the research.

Asthma and its symptoms confirmation

The GAN questionnaire, derived from the ISAAC questionnaire (29), includes questions about the symptoms of allergic diseases and related risk factors. In this study, we used some questions about asthma symptoms, "use of

asthma medication" and "asthma confirmed by a doctor", as well as the amount of dairy consumed in the diet last year. According to the protocol of this study, current asthma was defined as a history of confirmed asthma by a doctor and having had wheezing and/or use of asthma medication in the past 12 months. Once the questionnaire was translated into Persian, the reliability of the translated version was confirmed by a study conducted on 100 selected subjects using Cronbach's alpha. The alpha coefficient for asthma symptoms was estimated to be 0.862, thus exhibiting appropriate internal consistency. Finally, the questionnaire was translated back into English and sent to the GAN principals in order to be approved.

Assessment of dietary intake

In this study, the dietary intake of children's food groups in the last 12 months was assessed using one of the multiple choice questions in the GAN questionnaire (33). The frequency response section had three options (never or occasionally/once or twice a week most or all days of the week). Milk, other dairy products, and total dairy consumption were assessed. The frequency of total dairy intake was assessed by summing dietary milk (including flavored milk), cheese, and yoghurt consumption.

Assessment of other variables: The data on participants' height, weight, ethnicity (Kord/Turk/Persian/Lor/Arab/Balooch), watching television and computer use (2-4 hours/5-8 hours/9-14 hours a day) were obtained using a self-reported online GAN questionnaire. The body mass index (BMI) was calculated by using the following formula: weight (kg) divided by height squared (m^2).

Statistical methods. STATA version 14 was used for all analyses (State Crop., College Station, TX). To compare continuous and categorical variables between individuals with and without "asthma confirmed by a doctor" and "usage of asthma medication," we used independent samples of student t tests and chi-square testing. Multivariable logistic regression analysis was used in crude and multivariable controlled models to investigate the relationship between dairy intake and the probabilities of asthma confirmed by a doctor, current asthma, usage of asthma medication, and wheezing in the last 12 months. In the first model, adjustments were made for age and sex. Additional adjustments were made for watching TV and computer use in the second model. In the last model (third model), an additional adjustment for BMI was made. In all models, the lowest level of dairy intake (never or only occasionally) was considered as the reference category. P-value< 0.05 was considered as statistically significant.

Results

The current study included 7667 participants in total (3414 boys and 4253 girls). According to Table 1, boys had a considerably higher frequency of doctor-diagnosed asthma than girls. Compared to healthy people, asthmatics were older ($P < 0.001$) and had a higher prevalence of wheezing in the previous 12 months ($P < 0.001$). Furthermore, the prevalence of medication prescribed for asthma was higher in male compared to female participants. Subjects with medication were older ($P = 0.05$) and experienced more wheezing in the past 12 months ($P < 0.001$) than subjects without medication. The participants' ethnicity was also significantly different between the two groups ($P= 0.003$).

Table 1
General characteristics of the subjects according to asthma

Variables	Asthma confirmed by a doctor		p-value	Use of asthma medication		p-value
	Without (n=7343)	With (n=324)		Without (n=7476)	With (n=191)	
Sex						
Male	3226 (43.93)	188 (58.02)	<0.001	3296 (44.09)	118 (61.7)	<0.001
Female	4117 (56.07)	136 (41.98)		4180 (55.9)	73 (38.2)	
Age (years)	10.9±3.37	11.7±2.94	<0.001	10.9±3.36	11.3±3.16	0.05
BMI ($kg/m^{2)}$	18.9±10.4	19.1±4.18	0.35	18.97±10.3	18.73±3.97	0.37
Ethnicity			0.13			0.003
Kord	38 (0.52)	5 (1.54)		38 (0.51)	5 (2.62)	
Turk	73 (0.99)	2 (0.62)		74 (0.99)	1 (0.52)	
Persian	7064 (96.2)	311 (95.9)		7192 (96.2)	183 (95.8)	
Lor	62 (0.84)	4 (1.2)		64 (0.86)	2 (1.05)	
Arab	55 (0.75)	1 (0.31)		56 (0.75)	0 (0.0)	
Balooch	51 (0.69)	1 (0.31)		52 (0.70)	0 (0.0)	
Watching television and computer use			0.38			0.29
2-4 hours	3945 (53.7)	163 (50.3)		4016 (53.7)	92 (48.1)	
5-8 hours	2463 (33.5)	103 (34.8)		2506 (33.5)	70 (36.6)	
9-14 hours	935 (12.7)	48 (14.8)		954 (12.7)	29 (15.1)	
Wheezing (in the past 12 months)						
Yes	553 (7.5)	56 (17.2)	<0.001	518 (6.9)	91 (47.6)	<0.001
No	6790 (92.4)	268 (82.7)		6958 (93.0)	100 (52.3)	

Variables	Asthma confirmed by a doctor		p-value	Use of asthma medication		p-value
	Without (n=7343)	With (n=324)		Without (n=7476)	With (n=191)	
Milk intake						
Never	1282 (17.4)	51 (15.7)	0.71	1300 (17.3)	33 (17.2)	0.21
Weekly	3854 (52.4)	175 (54.0)		3939 (52.6)	90 (47.1)	
Every day	2207 (7343)	98 (30.2)		2237 (29.9)	68 (35.6)	
Other dairy intake						
Never	286 (3.8)	10 (3.09)	0.15	287 (3.8)	9 (4.7)	0.16
Weekly	2273 (30.9)	86 (26.5)		2312 (30.9)	47 (24.6)	
Every day	4784 (65.1)	228 (70.3)		4877 (65.2)	135 (70.6)	
Total Dairy intake						
Never	178 (2.4)	7 (2.1)	0.21	178 (2.3)	7 (3.6)	0.19
Weekly	2061 (28.0)	77 (23.7)		2094 (28.0)	44 (23.0)	
Every day	5104 (69.5)	240 (74.0)		5204 (69.6)	140 (73.3)	

Values are mean (SD) or percentages

[a]χ^2 Test for ordinal qualitative variables and t-test for continuous variables

Table 2. The association between dairy intake and likelihood of asthma confirmed by a doctor

	Never or only occasionally	Once or twice per week	Most or all days	P trend
	0R (95% CI)	0R (95% CI)	0R (95% CI)	
Milk				
No. with/without asthma	57/1276	168/3861	99/2206	
Crude	1.00	0.97 (0.71-1.32)	1.00 (0.72-1.40)	0.93
Model 1	1.00	0.95 (0.69-1.29)	0.98 (0.70-1.37)	0.99
Model 2	1.00	0.95 (0.70-1.29)	0.98 (0.70-1.37)	0.99
Model 3	1.00	0.95 (0.70-1.30)	0.99 (0.70-1.38)	0.98
Other dairy				
No. with/without asthma	8/288	99/2260	217/4795	
Crude	1.00	1.57 (0.75-3.27)	1.62 (0.79-3.33)	0.32
Model 1	1.00	1.51 (0.72-3.14)	1.45 (0.71-2.98)	0.70
Model 2	1.00	1.51 (0.72-3.14)	1.46 (0.71-2.99)	0.70
Model 3	1.00	1.51 (0.72-3.14)	1.46 (0.71-2.99)	0.69
Total dairy				
No. with/without asthma	6/179	87/2051	231/5113	
Crude	1.00	1.26 (0.54-2.93)	1.34 (0.59-3.07)	0.44
Model 1	1.00	1.19 (0.51-2.76)	1.18 (0.52-2.71)	0.84
Model 2	1.00	1.18 (0.51-2.76)	1.18 (0.51-2.71)	0.85
Model 3	1.00	1.18 (0.50-2.75)	1.18 (0.51-2.70)	0.84

Model 1: adjusted for age and sex

Model 2: further adjusted for watch TV & computer use

Model 3: additionally adjustment for BMI

Tables 2, 3, and 4 show the multivariable-adjusted odds ratios and 95% confidence intervals for asthma confirmed by a doctor, current asthma, and use of asthma medication in the past 12 months for the intake categories of dietary milk, other dairy, and total dairy consumption. According to the findings, there is no link between dairy consumption and doctor-diagnosed asthma, current asthma, or asthma medication use.

Table 3
The association between dairy intake and likelihood of current asthma

	Never or only occasionally	Once or twice per week	Most or all days	P trend
	OR (95% CI)	OR (95% CI)	OR (95% CI)	
Milk				
No. with/without current asthma	10/1172	28/3578	18/2040	
Crude	1.00	0.91(0.44-1.89)	1.03(0.47-2.24)	0.86
Model 1	1.00	0.93(0.45-1.93)	0.98(0.45-2.15)	0.98
Model 2	1.00	0.93(0.45-1.93)	0.98(0.45-2.15)	0.98
Model 3	1.00	0.93(0.45-1.93)	0.99(0.45-2.15)	0.98
Other dairy				
No. with/without asthma	3/257	20/2096	33/4437	
Crude	1.00	0.81(0.24-2.76)	0.63(0.19-2.09)	0.28
Model 1	1.00	0.81(0.24-2.77)	0.70(0.21-2.32)	0.47
Model 2	1.00	0.81(0.24-2.77)	0.70(0.21-2.32)	0.47
Model 3	1.00	0.81(0.24-2.77)	0.70(0.21-2.32)	0.47
Total dairy				
No. with/without asthma	3/163	16/1895	37/4732	
Crude	1.00	0.45(0.13-1.59)	0.42(0.12-1.39)	0.34
Model 1	1.00	0.47(0.13-1.65)	0.47(0.14-1.57)	0.52
Model 2	1.00	0.47(0.13-1.65)	0.47(0.14-1.57)	0.52
Model 3	1.00	0.47(0.13-1.65)	0.47(0.14-1.57)	0.52

Model 1: adjusted for age and sex

Model 2: further adjusted for watch TV & computer use

Model 3: additionally adjustment for BMI

Table 4
The association between dairy intake and use of asthma medication

	Never or only occasionally	Once or twice per week	Most or all days	P trend
	OR (95% CI)	OR (95% CI)	OR (95% CI)	
Milk				
No. with/without use of asthma medication	33/1300	90/3939	68/2237	
Crude	1.00	0.90 (0.60-1.34)	1.19 (0.78-1.82)	0.24
Model 1	1.00	0.87 (0.58-1.30)	1.12 (0.73-1.71)	0.38
Model 2	1.00	0.87 (0.58-1.30)	1.12 (0.73-1.71)	0.38
Model 3	1.00	0.87 (0.58-1.31)	1.12 (0.73-1.72)	0.37
Other dairy products				
No. with/without use of asthma medication	9/287	47/2312	135/4877	
Crude	1.00	0.64 (0.31-1.33)	0.88 (0.44-1.75)	0.26
Model 1	1.00	0.60 (0.29-1.25)	0.78 (0.39-1.56)	0.46
Model 2	1.00	0.61 (0.29-1.26)	0.79 (0.39-1.57)	0.47
Model 3	1.00	0.60 (0.29-1.25)	0.78 (0.39-1.56)	0.49
Total dairy				
No. with/without use of asthma medication	7/178	44/2094	140/520	
Crude	1.00	0.53 (0.23-1.20)	0.68 (0.31-1.48)	0.52
Model 1	1.00	0.49 (0.22-1.12)	0.60 (0.27-1.31)	0.83
Model 2	1.00	0.49 (0.21-1.12)	0.59 (0.27-1.30)	0.85
Model 3	1.00	0.50 (0.22-1.13)	0.59 (0.27-1.30)	0.87

	Never or only occasionally	Once or twice per week	Most or all days	P trend
Model 1: adjusted for age and sex				
Model 2: further adjusted for watch TV & computer use				
Model 3: additionally adjustment for BMI				

Table 5 shows the multivariable-adjusted odds ratios and 95% confidence intervals for wheezing in the previous 12 months by dairy consumption category. The likelihood of wheezing was not linked to milk intake or total dairy consumption. However, the analysis revealed that those who eat other dairy products (including cheese, yogurt, and other products) most days or every day might have a reduced likelihood of wheezing compared to those who do not eat or rarely eat other dairy products (OR: 0.65, 95% CI 0.44-0.94, P_{terend}=0.18). In model I, after controlling for age and sex, individuals in the highest category of other dairy consumption had a significantly lower odds of wheezing compared with those in the lowest category (OR: 0.58, 95% CI 0.39-0.84, P_{terend}=0.03) and this association remained significant after adjusting for watching TV and computer use in model 2 (OR= 0.58, 0.40-0.85, P_{terend}=0.02). Additional BMI adjustment in the previous model revealed that the relationship between "other dairy" consumption and wheezing is independent of obesity, with people in the top category of dairy consumption having a lower risk of wheezing than those in the bottom (OR: 0.58, 95% CI 0.40-0.85, P_{terend}=0.02).

Table 5
The association between dairy intake and likelihood of wheezing in the past 12 months

	Never or only occasionally	Once or twice per week	Most or all days	P trend
	OR (95% CI)	OR (95% CI)	OR (95% CI)	
Milk				
No. with/without wheezing	114/1219	311/3718	184/2121	
Crude	1.00	0.89 (0.71-1.11)	0.92 (0.72-1.18)	0.65
Model 1	1.00	0.87 (0.69-1.09)	0.90 (0.70-1.15)	0.54
Model 2	1.00	0.88 (0.70-1.10)	0.91 (0.71-1.17)	0.60
Model 3	1.00	0.88 (0.70-1.10)	0.91 (0.71-1.17)	0.61
Other dairy products				
No. with/without wheezing	34/262	184/2175	391/4621	
Crude	1.00	0.65 (0.44-0.96)	0.65 (0.44-0.94)	0.18
Model 1	1.00	0.62 (0.42-0.91)	0.58 (0.39-0.84)	**0.03**
Model 2	1.00	0.63 (0.42-0.93)	0.58 (0.40-0.85)	**0.02**
Model 3	1.00	0.63 (0.42-0.93)	0.58 (0.40-0.85)	**0.02**
Total dairy				
No. with/without wheezing	19/166	172/1966	418/4926	
Crude	1.00	0.76 (0.46-1.25)	0.74 (0.45-1.20)	0.37
Model 1	1.00	0.71 (0.43-1.18)	0.65 (0.40-106)	0.09
Model 2	1.00	0.70 (0.42-1.16)	0.63 (0.38-1.03)	0.07
Model 3	1.00	0.70 (0.42-1.16)	0.63 (0.38-1.03)	0.07

	Never or only occasionally	Once or twice per week	Most or all days	P trend
Model 1: adjusted for age and sex				
Model 2: further adjusted for watch TV & computer use				
Model 3: additionally adjustment for BMI				

Discussion

According to this study, higher consumption of dairy products other than milk (such as cheese or yogurt), but not just milk or total dairy consumption, was linked to a lower risk of wheezing in the previous 12 months, but no link was found between dairy consumption and asthma confirmed by a doctor or use of asthma medication. In a large sample of Middle-Eastern children and adolescents, the current study could investigate the connection between dairy consumption and asthma symptoms.

Our findings are consistent with those of a cross-sectional study of 1601 participants conducted in Melbourne, which indicated a negative relationship between dairy product consumption and asthma (21). PIAMA birth cohort research, which included 2978 children, found that frequent use of milk fat-containing items is linked to a lower risk of asthma symptoms (8). Low levels of vitamin A and milk consumption were linked to an increased risk of airway blockage among heavy smokers, according to data from the national health and examination survey I (NHANES I) in the United States (34). In contrast to the findings of the current study, Malaeb et al. found that consuming less milk on a regular basis reduced the current asthma risk (35). Another study of 1014 students (5–14 years old) discovered a link between dietary variables and allergen exposure at school, with the connections between allergen exposure and respiratory symptoms being stronger among those who consumed less fresh milk and milk fat and more margarine (20). Higher maternal intake of total dairy products, cheese, yogurt, and calcium during pregnancy may reduce the risk of infantile eczema in the previous 12 months, physician-diagnosed asthma, physician-diagnosed atopic eczema, and physician-diagnosed atopic eczema, according to Miyake et al. in a pre-birth cohort study in Japan (36). In a cross-sectional study, Hijazi et al. found that decreased milk consumption is linked to a higher prevalence of asthma symptoms and allergy symptoms (19). According to the findings of a study conducted by Hallit et al., eating dairy products (even a few times a week) had an inversely significant influence on asthma compared to never eating them (37). Tabak et al., on the other hand, found no apparent link between dairy products and asthma (25). Milk and dairy products are high in saturated fat, which has been linked to a lower incidence of allergy disorders and asthma (35). Butter and whole milk consumption may be beneficial for asthma and allergy symptoms. However, margarine consumption was found to be detrimental to asthma and allergy symptoms (38). The beneficial effect of milk and butter may be due to the fatty acid makeup of milk (38) and the fact that lactose digestion differs from that of other carbohydrates, and it may serve as a conditional prebiotic (39). Their prebiotic activity is probably related to the stimulation of the growth of beneficial bacteria in the intestines, which may modulate immune responses and thus protect humans from asthma and allergies (40). Milk proteins, including-lactalbumin,-lactoglobulin, and immunoglobulins, as well as whey proteins such as serum albumin, lactoferrin, and lactoperoxidase, as well as various enzymes and cytokines found in dairy products, are thought to have a part in this protective effect (41).

Many researchers have looked at the medicinal and preventative effects of yogurt and the lactic acid bacteria that are widely utilized in yogurt production (42). The link between cytokine imbalance and asthma symptoms is

thought to be significant. A shift away from a TH1 interferon gamma (IFN-γ) pattern toward a TH2 (IL-4, IL-5, and IL-13) profile is seen in Atopic illness immunological responses. Incomplete IFN-γ production, according to these findings, predisposes to the development of allergy disorders and asthma (43). Long-term ingestion of substantial amounts of yogurt (450 g/d) has been found in human studies to boost the production of IFN-γ by lymphocytes, separated T cells. Interferon gamma is a lymphokine that activates macrophages. Oral ingestion of Lactobacillus casei and other probiotic strains (44), for example, has been shown to reduce immunoglobulin E (IgE) production. These findings suggest eating yogurt could help to reduce IgE-mediated diseases, including asthma (42). Conjugated linoleic acid is one of the other probable pathways discussed in the papers (CLA). This fatty acid, which is said to occur naturally in dairy fats, is a diverse set of positional and geometric isomers of linoleic acid with over 25 isomers. These compounds have a wide range of biological features that could help asthma sufferers, including impacts on energy management, lipid metabolism, inflammation, and immunological function. CLA's metabolic benefits, which include fat loss and adipokine regulation, may be beneficial for respiratory mechanics and systemic inflammation, which may apply to asthmatic airway inflammation (45).

The current study includes various flaws that should be taken into account when evaluating the results. The current study relied solely on self-reported data, with questions about milk and other dairy products included in the questionnaire. Furthermore, although the associations were adjusted for several possible confounding variables, we had no data on some other variables, including energy intake, physical activity, and other variables. Therefore, residual confounding might be a limitation of the current study. As each dairy product intake was not asked in the questionnaire, we were unable to check the association for each dairy product. In cross-sectional studies, the dependent and independent variables were gathered at the same time; therefore, no causal association can be inferred from their results. Therefore, future prospective studies are highly recommended.

Conclusion

In conclusion, the current investigation was unable to establish a link between dairy consumption and doctor-diagnosed asthma or asthma medication use. However, it was shown that dairy products other than milk, such as cheese and yogurt, may lessen the risk of wheezing in children and adolescents. These findings will need to be confirmed in prospective cohort studies.

Declarations

Ethical Approval and Consent to participate

This Research involving human participants, human material, or human data, was performed in accordance with the Declaration of Helsinki and was approved by Shahid Sadoughi University (SSU) of Medical Sciences ethics committee (IR.SSU.REC.1398.244). written informed consent was obtained from a parent or guardian for participants under 16 years old.

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Authors' contribution

Mona Jamalvandi and Bahareh Sasanfar participated in the analysis and drafted the initial version of the manuscript. Marjan Jafari helped with data collection. Nasrin Behniafard and Zahra Nafei contributed to the conception and design. All authors reviewed the final version of the manuscript. Nasrin Behniafard, Zahra Nafei and Amin Salehi-Abargouei supervised the study.

Conflict of interest

There is no conflict of interest in this study to declare.

Consent for Publication

There is no personal information regarding any patients in our article.

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Availability of Supporting Data

The datasets used and/or analyzed during the current study available from the corresponding author on reasonable request.

References

1. de Benedictis D, Bush A. Asthma in adolescence: Is there any news? Pediatric pulmonology. 2017;52(1):129–38.
2. Guilbert TW, Bacharier LB, Fitzpatrick AM. Severe asthma in children. The Journal of Allergy and Clinical Immunology: In Practice. 2014;2(5):489–500.
3. Castillo JR, Peters SP, Busse WW. Asthma exacerbations: pathogenesis, prevention, and treatment. The Journal of Allergy and Clinical Immunology: In Practice. 2017;5(4):918–27.
4. Mehravar F, Rafiee S, Bazrafshan B, Khodadost M. Prevalence of asthma symptoms in Golestan schoolchildren aged 6–7 and 13–14 years in Northeast Iran. Frontiers of Medicine. 2016;10(3):345–50.
5. Alwarith J, Kahleova H, Crosby L, Brooks A, Brandon L, Levin SM, et al. The role of nutrition in asthma prevention and treatment. Nutrition Reviews. 2020.
6. Ghozikali MG, Ansarin K, Naddafi K, Nodehi RN, Yaghmaeian K, Hassanvand MS, et al. Prevalence of asthma and associated factors among male late adolescents in Tabriz, Iran. Environmental Science and Pollution Research. 2018;25(3):2184–93.
7. Brigham EP, West NE, editors. Diagnosis of asthma: diagnostic testing. International forum of allergy & rhinology; 2015: Wiley Online Library.
8. Wijga A, Smit H, Kerkhof M, De Jongste J, Gerritsen J, Neijens H, et al. Association of consumption of products containing milk fat with reduced asthma risk in pre-school children: the PIAMA birth cohort study.

Thorax. 2003;58(7):567–72.

9. Taylor PE, Jacobson KW, House JM, Glovsky MM. Links between pollen, atopy and the asthma epidemic. International archives of allergy and immunology. 2007;144(2):162–70.
10. Kabesch M, Tost J, editors. Recent findings in the genetics and epigenetics of asthma and allergy. Seminars in immunopathology; 2020: Springer.
11. Mims JW, editor Asthma: definitions and pathophysiology. International forum of allergy & rhinology; 2015: Wiley Online Library.
12. Forno E, Bacharier LB, Phipatanakul W, Guilbert TW, Cabana MD, Ross K, et al. Effect of vitamin D3 supplementation on severe asthma exacerbations in children with asthma and low vitamin D levels: the VDKA randomized clinical trial. Jama. 2020;324(8):752–60.
13. Wood LG, Garg ML, Smart JM, Scott HA, Barker D, Gibson PG. Manipulating antioxidant intake in asthma: a randomized controlled trial. The American journal of clinical nutrition. 2012;96(3):534–43.
14. Smith LJ, Kalhan R, Wise RA, Sugar EA, Lima JJ, Irvin CG, et al. Effect of a soy isoflavone supplement on lung function and clinical outcomes in patients with poorly controlled asthma: a randomized clinical trial. Jama. 2015;313(20):2033–43.
15. Lang JE, Mougey EB, Hossain MJ, Livingston F, Balagopal PB, Langdon S, et al. Fish oil supplementation in overweight/obese patients with uncontrolled asthma. A randomized trial. Annals of the American Thoracic Society. 2019;16(5):554–62.
16. Litonjua AA. Dietary factors and the development of asthma. Immunology and allergy clinics of North America. 2008;28(3):603–29.
17. Maslova E, Halldorsson TI, Strøm M, Olsen SF. Low-fat yoghurt intake in pregnancy associated with increased child asthma and allergic rhinitis risk: a prospective cohort study. Journal of nutritional science. 2012;1.
18. Woods RK, Weiner JM, Abramson M, Thien F, Walters EH. Do dairy products induce bronchoconstriction in adults with asthma? Journal of allergy and clinical immunology. 1998;101(1):45–50.
19. Hijazi N, Abalkhail B, Seaton A. Diet and childhood asthma in a society in transition: a study in urban and rural Saudi Arabia. Thorax. 2000;55(9):775–9.
20. Kim J-L, Elfman L, Mi Y, Johansson M, Smedje G, Norbäck D. Current asthma and respiratory symptoms among pupils in relation to dietary factors and allergens in the school environment. Indoor air. 2005;15(3):170–82.
21. Woods RK, Walters EH, Raven JM, Wolfe R, Ireland PD, Thien FC, et al. Food and nutrient intakes and asthma risk in young adults. The American journal of clinical nutrition. 2003;78(3):414–21.
22. Nagel G, Linseisen J. Dietary intake of fatty acids, antioxidants and selected food groups and asthma in adults. European journal of clinical nutrition. 2005;59(1):8–15.
23. Hong SJ, Lee MS, Lee SY, Ahn KM, Oh JW, Kim KE, et al. High body mass index and dietary pattern are associated with childhood asthma. Pediatric pulmonology. 2006;41(12):1118–24.
24. Miyake Y, Tanaka K, Okubo H, Sasaki S, Arakawa M. Dairy food, calcium and vitamin D intake and prevalence of allergic disorders in pregnant Japanese women. The International journal of tuberculosis and lung disease. 2012;16(2):255–61.
25. Tabak C, Wijga AH, de Meer G, Janssen NA, Brunekreef B, Smit HA. Diet and asthma in Dutch school children (ISAAC-2). Thorax. 2006;61(12):1048–53.

26. Tsai H-J, Tsai AC. The association of diet with respiratory symptoms and asthma in schoolchildren in Taipei, Taiwan. Journal of Asthma. 2007;44(8):599–603.
27. Fussman C, Todem D, Forster J, Arshad H, Urbanek R, Karmaus W. Cow's milk exposure and asthma in a newborn cohort: repeated ascertainment indicates reverse causation. Journal of Asthma. 2007;44(2):99–105.
28. Barnes M, Cullinan P, Athanasaki P, MacNeill S, Hole A, Harris J, et al. Crete: does farming explain urban and rural differences in atopy? Clinical & Experimental Allergy. 2001;31(12):1822–8.
29. Han Y-Y, Forno E, Brehm JM, Acosta-Pérez E, Alvarez M, Colón-Semidey A, et al. Diet, interleukin-17, and childhood asthma in Puerto Ricans. Annals of Allergy, Asthma & Immunology. 2015;115(4):288–93. e1.
30. Jaudszus A, Mainz JG, Pittag S, Dornaus S, Dopfer C, Roth A, et al. Effects of a dietary intervention with conjugated linoleic acid on immunological and metabolic parameters in children and adolescents with allergic asthma–a placebo-controlled pilot trial. Lipids in health and disease. 2016;15(1):21.
31. Ellwood P, Ellwood E, Rutter C, Perez-Fernandez V, Morales E, García-Marcos L, et al. Global Asthma Network Phase I surveillance: geographical coverage and response rates. Journal of Clinical Medicine. 2020;9(11):3688.
32. Asher M, Keil U, Anderson H, Beasley R, Crane J, Martinez F, et al. International Study of Asthma and Allergies in Childhood (ISAAC): rationale and methods. European respiratory journal. 1995;8(3):483–91.
33. Behniafard N, Nafei Z, Mirzaei M, Karimi M, Vakili M. Prevalence and Severity of Adolescent Asthma in Yazd, Iran: Based on the 2020 Global Asthma Network (GAN) Survey. Iranian Journal of Allergy, Asthma, and Immunology. 2021;20(1):24–32.
34. Fogarty A, Britton J, Hodge L, Salome C, Peat J, Haby M, et al. Erratum: The role of diet in the aetiology of asthma (Clinical and Experimental Allergy (2000) 30:(615-627)). Clinical and Experimental Allergy. 2000:1334.
35. Malaeb D, Hallit S, Sacre H, Malaeb B, Hallit R, Salameh P. Diet and asthma in Lebanese schoolchildren: A cross-sectional study. Pediatric pulmonology. 2019;54(6):688–97.
36. Miyake Y, Tanaka K, Okubo H, Sasaki S, Arakawa M. Maternal consumption of dairy products, calcium, and vitamin D during pregnancy and infantile allergic disorders. Annals of Allergy, Asthma & Immunology. 2014;113(1):82–7.
37. Hallit S, Raherison C, Abou Abdallah R, Hallit R, Salameh P. Correlation of types of food and asthma diagnosis in childhood: A case–control study. Journal of Asthma. 2018;55(9):966–74.
38. Tricon S, Willers S, Smit H, Burney P, Devereux G, Frew A, et al. Nutrition and allergic disease. Clinical & experimental allergy reviews. 2006;6(5):117–88.
39. Hettinga KA. Lactose in the dairy production chain. Lactose: Elsevier; 2019. p. 231–66.
40. Brick T, Hettinga K, Kirchner B, Pfaffl MW, Ege MJ. The beneficial effect of farm milk consumption on asthma, allergies, and infections: from meta-analysis of evidence to clinical trial. The Journal of Allergy and Clinical Immunology: In Practice. 2020;8(3):878–89. e3.
41. Brick T, Ege M, Boeren S, Böck A, Von Mutius E, Vervoort J, et al. Effect of processing intensity on immunologically active bovine milk serum proteins. Nutrients. 2017;9(9):963.
42. Meydani SN, Ha W-K. Immunologic effects of yogurt. The American journal of clinical nutrition. 2000;71(4):861–72.
43. Busse WW, Rosenwasser LJ. Mechanisms of asthma. Journal of allergy and clinical immunology. 2003;111(3):S799-S804.

44. Hill D, Sugrue I, Tobin C, Hill C, Stanton C, Ross R. The Lactobacillus casei group: history and health related applications. Front Microbiol 9: 2107. 2018.
45. MacRedmond R, Dorscheid DR. Conjugated linoleic acid (CLA): is it time to supplement asthma therapy? Pulmonary pharmacology & therapeutics. 2011;24(5):540–8.