

The protective effect of milk consumption on milk allergy in children and adults in Fez-Meknes region of Morocco

Milk allergy in
children and
adults

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Received 18 March 2018
Revised 20 October 2018
Accepted 24 October 2018

Abstract

Purpose – The purpose of this study is to compare the evolution of self-reported milk allergy in children and adults within the population of Fez-Meknes region, as well as to investigate the consumption of milk and its correlation to milk allergy.

Design/methodology/approach – It is a cross-sectional study conducted in Fez-Meknes region between April 2014 and March 2015 basing on a questionnaire completed by 3,068 children and 1,281 adults.

Findings – The results showed that food allergy was more reported among children (29.4 per cent) than adults (16.9 per cent). Milk allergy was reported by 5.3 per cent of children and 4.2 per cent of adults. Children reported mostly cutaneous manifestations (64.8 per cent) while adults reported mostly gastrointestinal manifestations (68.5 per cent). The consumption of milk showed a protective effect against the development of milk allergy ($p < 0.001$).

Originality/value – The consumption of milk was associated significantly with a low rate of milk allergy, especially in adults. However, the pasteurization of milk seemed to be correlated to increase milk sensitivity.

Keywords Milk allergy, Milk consumption, Cross sectional study, Children, Adults

Paper type Research paper

Introduction

Adverse reactions to food become a major health anxiety in most countries during the last few decades (Björnsson *et al.*, 1996; Asero *et al.*, 2007). Food allergy is the consequence of maladaptive immune responses to common and otherwise innocuous food antigens (Vassallo and Camargo, 2010). The most common allergenic foods are cow's milk, hen's egg, peanuts, nuts, gluten containing cereals, sesame, soybeans, mustard, fish, crustaceans and shellfish (Pereira *et al.*, 2005; Venter *et al.*, 2006; Sicherer and Leung, 2011; Bousfiha and Aarab, 2012; Sampson *et al.*, 2012; Ouahidi *et al.*, 2017; Mejrhit *et al.*, 2017).

A meta-analysis of Rona *et al.* (2007) found that the incidence of self-reported food allergies ranges between 3 per cent and 35 per cent, as well as it is more common among children than adults (Venter *et al.*, 2008; Kim *et al.*, 2008).

This work was supported by grants of the Moroccan National Center for Scientific and techniques Research (CNRST) to Ouarda AZDAD. The authors would like to thank the Local authorities of Educational Ministry of Fez-Meknes region and all participants in this work for their help.

Conflict of interest: The authors report no conflicts of interest.



In Morocco, food allergy was reported by 28 per cent of schoolchildren from Fez-Meknes region (Azdad *et al.*, 2016), while it was about 45 per cent in atopic children (Ghadi *et al.*, 2007). Recently, in a cross-sectional study in the Fes-Meknes region, food allergy was estimated at 11.5 per cent in the general population (Azdad *et al.*, 2017). Milk allergy is one of the most reported food allergies, especially in children. Generally, it resolves before adolescence and only minority of milk allergic patients still allergic and symptomatic in adulthood (Saarinen *et al.*, 2005; Skripak *et al.*, 2007; Santos *et al.*, 2010).

In Morocco, milk allergy was reported by 6.9 per cent of schoolchildren of Fez-Meknes region (Azdad *et al.*, 2016), while in a prospective study including 160 atopic children in Marrakech, milk allergy was estimated at 2 per cent (Ghadi *et al.*, 2007).

Therefore, the aim of the present study is to compare self-reported milk allergy (SRMA) in children and adults in the population of Fez-Meknes region of Morocco, as well as to examine the association of milk consumption to SRMA.

Methods

Population characteristics

A cross-sectional survey study was conducted in Fez-Meknes region, Morocco, between April 2014 and March 2015. The survey was executed by distribution of a questionnaire in different schools targeting children population (12-19 years old), and in a random population from Fez-Meknes region targeting adult population (20-60 years old). The children population was approached through public and private schools after discussions with the Fez Regional Education Authorities and Head Directors. All schools consented to participate in the study. The schools included in the study were middle and high schools. The survey was conducted with approval of the Faculty of Medicine/Pharmacy and the University Hospital Center of Fez Ethics Committee.

Questionnaire

The reported prevalence of food allergy was established by using a questionnaire that was completed by the subjects. The distribution and collection of information on food allergy were done by contact direct with all participants. All collected questionnaires were verified according to our inclusion criteria. The principal inclusion criterion was the absence of any complicated health problems of the participants. The questionnaire contained questions about personal data (sex, age and city) and questions about the occurrence of any adverse reaction to foods. The foods selected included foods from plant origin (cereals, peanut, almond, sesame, white bean, haricot, strawberry and apple) and from animal origin (milk, fish, meat, chicken and eggs). The participants reporting adverse reactions to milk provided additional information concerning the nature of consumed milk and dairy products causing sensitivity, as well as the type of manifestations suffering from after milk consumption. The manifestations were classified as gastrointestinal symptoms (nausea, vomiting, abdominal pain and diarrhea), respiratory symptoms (coughing, asthma/wheezing) and cutaneous symptoms (urticaria, exacerbation of eczema, angioedema, rash) according to affected organs. Finally, questions about the medical treatments and family history concerning milk allergy were joined to the questionnaire. That data, in addition to the detailed description of symptoms by the research group, were important to avoid any possible confusion between milk allergy and milk hypersensitivity/lactose intolerance.

Statistical analysis

Statistical analysis was based on Chi-square test to compare proportions with confidence intervals set at 95 per cent taking $p < 0.05$ as the limit of significant values. All statistical

analyses were performed using Epi Info™ version 7.2.0.1 logical. Associated factors were identified by odds ratio (OR), with confidence intervals set at 95 per cent (95 per cent CI).

Results

Self-reported food allergy

A total of 3,068 children (age: 12 years to 19 years) and 1,282 adults (age: 20 years to 60 years) were included in this study. The self-reported food allergy (SRFA) was 29.4 per cent ($N = 903$) in children and 16.9 per cent ($N = 217$) in adults with a significant difference (OR, 2.04; 95 per cent CI, 1.7-2.4; $p < 0.0001$). Rates of reported food allergy according to sex showed that girls reported allergy more than boys (32.4 per cent vs 26.5 per cent) (OR, 0.75; 95 per cent CI, 0.6-0.8; $p < 0.001$). However, regarding adults, no statistical significant difference was observed between men and women (17.5 per cent vs 16.4 per cent) (OR, 1.08; 95 per cent CI, 0.8-1.4; $p = 0.6$).

Regarding population age, we remarked that the rate of reported food allergy did not increase with age. A prevalence of 33 per cent was reported by children aged 12 to 15 years, and just 14 per cent was reported by adults aged 40 to 60 years.

Basing on food origin, results showed that foods of animal origin were more reported than foods of plant origin in both children and adults: (36.7 per cent vs 29.4 per cent) and (17.3 per cent vs 5.3 per cent), respectively (Table I). The most foods implicated in food allergy from animal origin were eggs (10.1 per cent and 2.9 per cent), milk (5.3 per cent and 4.2 per cent) and fish (9.8 per cent and 9.4 per cent) for both children and adults, respectively. The rates of reported adverse reactions to these foods were significantly different between children and adults ($p < 0.001$).

Self-reported milk allergy

Milk allergy was reported by 5.3 per cent ($N = 162$) of children, and 4.2 per cent ($N = 54$) of adults. This finding showed that Milk allergy did not increase with age ($p = 0.1$). As regards gender, milk allergy was more reported by girls than boys (6.4 per cent vs 4.3 per cent) ($p = 0.009$) in children population, while in adult population it was more reported by men than women (5.1 per cent vs 3.3 per cent) ($p = 0.09$). The typical clinical manifestations indicated by children reporting milk allergy were cutaneous and respiratory symptoms with rates of 64.8 per cent and 24.7 per cent, respectively. Whereas, adults declared mostly gastrointestinal (68.5 per cent), and cutaneous manifestations (25.9 per cent) (Table II).

In this study, we surveyed allergy to milk of different species, and we remarked that cow milk is the most implicated in milk allergy than other milk species. Children reported allergy to milk of different species higher than adults, except for cow milk. This latter was more

Food origin	Age range (year)							
	12-15		15-19		20-40		40-60	
	$(N = 1,762)$		$(N = 1,306)$		$(N = 991)$		$(N = 291)$	
	N	(%)	N	(%)	N	(%)	N	(%)
Animal origin	535	30.3	358	27.7	173	17.4	49	16.8
Plant origin	354	20.1	202	15.5	52	5.2	16	5.5

Notes: N , %: number, percentage of person reporting food allergy in each age range. Food of animal origin: milk, fish, meat, chicken, and eggs; Food of plant origin: cereals, peanut, almond, sesame, white bean, haricot, strawberry, and apple

Table I.
Self-reported food
allergy according to
its origin and age
range

NFS

Demographic characteristics	Children N (%) N = 3,068	<i>p</i> -value	Adults N (%) N = 1,282	<i>p</i> -value
Overall	162 (5.3)		54 (4.2)	0.1
<i>Sex</i>				
Male	65 (4.3)	0.009	33 (5.1)	0.09
Female	97 (6.4)		21 (3.3)	
<i>Clinical manifestations</i>				
Digestive manifestations	34 (21)		37 (68.5)	<0.001
Cutaneous manifestations	105 (64.8)		14 (25.9)	<0.001
Respiratory manifestations	40 (24.7)		3 (5.6)	<0.001

Table II.
SRMA and clinical
manifestations

Notes: Children N (%): number (percentage) of children reporting milk allergy; Adults N (%): number (percentage) of adults reporting milk allergy; *p*-value corresponds to differences in the prevalence of Milk Allergy between children and adults; X^2 test: any value of $p < 0.05$ was considered statistically significant

reported by adults than children (90.7 per cent vs 65.4 per cent; $p = 0.6$) (Table III). In addition, we examined sensitivity to different dairy products. We found that both raw and pasteurized milk were the most reported in milk allergy for the both studied populations with an elevated level in adults. While regarding the sensitivity to butter and cheese, they were frequently reported by children (33.3 per cent and 22.8 per cent; $p = 0.05$) than adults (22.2 per cent and 20.4 per cent; $p = 0.3$), respectively (Table IV).

Regarding milk consumption, the results showed that both adults and children consumed cow milk nearly at the same pattern (94.7 per cent vs 92 per cent). Similarly, both populations preferred consumption of pasteurized milk at rates of 90.2 per cent for adults and 82.8 per cent for children. In the adult population, raw milk was highly consumed by women (36 per cent) than men (27 per cent), whereas in children population it was highly consumed by boys (18 per cent) than girls (11 per cent).

Correlation between milk consumption and milk allergy

The correlation between consumption of milk and milk allergy showed that among children non-consuming milk ($N = 134$), 7.4 per cent ($N = 10$) reported sensitivity to milk. This percentage was higher than the rate stated among the children consuming milk ($N = 2824$) which was 5.2 per cent ($N = 154$) ($p = 0.3$). Likewise, adults consuming milk reported sensitivity to milk less than the non-consuming ones (3.3 per cent vs 21.5 per cent) ($p < 0.001$). For milk species, the self-reported hypersensitivity to cow milk by children and

Milk allergy	Children (NT = 162) N (%)	Adults (NT = 54) N (%)	OR (95% CI)	<i>p</i> -value
<i>Cow milk</i>	106 (65.4)	49 (90.7)	0.9 (0.6-1.2)	0.6
<i>Goat milk</i>	51 (31.5)	8 (14.8)	2.6 (1.2-5.6)	0.01
<i>Camel milk</i>	26 (16)	4 (7.4)	2.7 (0.9-7.8)	0.08
<i>Sheep milk</i>	12 (7.4)	1 (1.9)	5.0 (0.6-38.7)	0.1

Table III.
Self-reported allergy
to milk of different
species in both
children and adults

Notes: N_T: number total of person reporting milk allergy; N: number of person reporting allergy to each milk specie; OR (95% CI): odds ratio, confidence intervals set at 95%; *p*-value corresponds to difference in the prevalence of SRMA for each milk specie between children ($N = 3068$) and adults ($N = 1282$); X^2 test: any value of $p < 0.05$ was considered statistically significant

adults no consuming cow milk was higher than the rate reported by the consuming ones (7.3 per cent vs 3.2 per cent) and (2.9 per cent vs 19.1 per cent), respectively ($p < 0.001$).

Regarding the nature of consumed milk, we remarked that there was not any difference in reported sensitivity to raw milk between the children consuming raw milk and the non-consuming ones (2.7 per cent vs 2.6 per cent). Nevertheless, in adults, the rate of persons reporting sensitivity to raw milk was prominent within the non-consuming than the consuming ones (6.1 per cent vs 0.6 per cent) ($p < 0.001$). Moreover, the self-reported sensitivity to pasteurized milk was highly stated by children non-consuming pasteurized milk than others (2.4 per cent vs 1.6 per cent) ($p = 0.2$). However, in the adult population, the consumption of pasteurized milk seemed to be correlated with high sensitivity ($p < 0.001$) (Table V).

We concluded that a significant correlation existed between the consumption of raw milk and the reduction of milk sensitivity, particularly in adults. Regarding children, although the correlation does not reach any significance, there was an evident difference between children reporting sensitivity to milk with its consumption and the children reporting sensitivity without its consumption, suggesting that consumption of raw milk may be protective against milk allergy.

Multiple allergies

Multiple allergies (Milk + other food) were more frequent than single allergy (milk solely) in children (66 per cent vs 33.9 per cent) as well as in adults (55.5 per cent vs 44.4 per cent) (Table VI). Regarding the chi-square test, we noticed that the difference was significant between children and adults in reporting multiple allergies ($p < 0.05$) while there was no statistically significant difference regarding single allergy ($p = 0.2$). Regarding reported allergy to milk of different milk species, it was frequently because of cow milk than the other milk species in both studied populations. Furthermore, cow milk was generally reported as a single cause of milk allergy than being associated with any milk of other species. No significant difference was observed between children and adults concerning single milk allergy (cow milk solely) and multiple milk allergies (cow milk + milk of another specie) ($p \geq 0.3$).

Discussion

We conducted a cross-sectional study in Fez-Meknes region to compare SRMA between children and adults in the population of Fez-Meknes region of Morocco, then to examine the milk consumption levels and its correlation to SRMA.

Milk allergy	Children (NT =162) N (%)	Adults (NT =54) N (%)	OR (95% CI)	<i>p</i> -value
Raw milk	82 (50.6)	38 (70.4)	0.8 (0.6-1.3)	0.6
Pasteurized milk	55 (34)	22 (40.7)	1.0 (0.6-1.7)	0.9
Yogurt	26 (16)	15 (27.8)	0.7 (0.3-1.3)	0.4
Beverage	17 (10.5)	14 (25.9)	0.5 (0.2-1.0)	0.08
Butter	54 (33.3)	12 (22.2)	1.8 (1.0-3.5)	0.05
Cheese	37 (22.8)	11 (20.4)	1.4 (0.7-2.7)	0.3

Notes: N_T: number total of person reporting milk allergy; N: number of person reporting allergy to each dairy product; OR (95% CI): odds ratio, confidence intervals set at 95%; *p*-value corresponds to difference in the prevalence of SRMA to each dairy product between children (N = 3068) and adults (N = 1282); χ^2 test: any value of $p < 0.05$ was considered statistically significant

Table IV.
Self-reported allergy
to dairy products
according to age

Milk consumption	Children (Ch)			Adults (A)		
	Milk allergy (%)	OR (95% CI)	<i>p</i> -value	Milk allergy (%)	OR (95% CI)	<i>p</i> -value
<i>Milk Yes</i> ; <i>NCh</i> = 2934 ; <i>NA</i> = 1217 <i>No</i> ; <i>NCh</i> = 134 ; <i>NA</i> = 65	152 (5.2)	10 (7.4)	0.6 (0.3 – 1.3)	36 (3.3)	14 (21.5)	0.1 (0.06 – 0.24)
<i>Cow milk Yes</i> ; <i>NCh</i> = 2824 ; <i>NA</i> = 1214 <i>No</i> ; <i>NCh</i> = 244 ; <i>NA</i> = 68	91 (3.2)	18 (7.3)	0.4 (0.2 – 0.7)	36 (2.9)	13 (19.1)	0.1 (0.06 – 0.25)
<i>Raw milk Yes</i> ; <i>NCh</i> = 857 ; <i>NA</i> = 771 <i>No</i> ; <i>NCh</i> = 2211 ; <i>NA</i> = 511	23 (2.7)	59 (2.6)	1 (0.6 – 1.6)	5 (0.6)	33 (6.4)	0.09 (0.03 – 0.24)
<i>Pasteurized milk Yes</i> ; <i>NCh</i> = 2540 ; <i>NA</i> = 1157 <i>No</i> ; <i>NCh</i> = 528 ; <i>NA</i> = 125	42 (1.6)	13 (2.4)	0.6 (0.3 – 1.2)	9 (0.7)	13 (0.1)	0.06 (0.02 – 0.16)

Notes: OR (95% CI): odds ratio, confidence intervals set at 95%; *NCh*: number of children; *NA*: number of adults; *p*-value corresponds to difference in the prevalence of SRMA between persons who consumed milk and those who did not, in both children and adults; χ^2 test: any value of *p* < 0.05 was considered statistically significant

Our results showed that SRFA was more pronounced in children than adults (29.4 per cent *vs* 16.4 per cent). Regarding children, this result is in line with previous studies indicating that 27.7 per cent of African children reported food allergy (Cheikh *et al.*, 2013). Other countries also reported similar prevalence such as Iran (Varasteh *et al.*, 2009) and Estonia (Sandin *et al.*, 2005). However, this rate was higher than other Mediterranean countries where SRFA varied from 5.7 per cent to 12.4 per cent (Obeng *et al.*, 2011; Venter *et al.*, 2006; Orhan *et al.*, 2009; Rance *et al.*, 2005; Pereira *et al.*, 2005; Soller *et al.*, 2012). In addition, based on Skin Prick Test, 20.3 per cent of schoolchildren in Niger showed positive reaction to foods (Adelakun and Arinola, 2016).

While in adults, the result of SRFA was lower than data reported in some African countries (Achinewu, 1983; Lunet *et al.*, 2005) and some European countries (Björnsson *et al.*, 1996; Schäfer *et al.*, 2001; Osterballe *et al.*, 2009) based on a questionnaire survey. Using IgE analysis, values of food allergy in many European countries were close to our results varying from 7.7 per cent to 24 per cent with an average of 16.2 per cent (Burney *et al.*, 2010). However, in a population of Korean adults suspected of having food allergy, the rate of food sensitivity was 54.5 per cent (Kim *et al.*, 2016).

The difference in SRFA between children and adults was found in previous studies (Williams *et al.*, 1999; Sicherer *et al.*, 2004; Alvarado and Pérez, 2006; Rona *et al.*, 2007; Sackesen *et al.*, 2011; Nwaru *et al.*, 2014; Mejrhit *et al.*, 2018), indicating that children are more sensitive than adults.

By our results, we showed that SRFA was significantly higher in girls than boys in children population were while in adults there was a slight difference. Previous studies indicated that SRFA was frequently reported by female sex than male sex (Altman and Chiamonte, 1996; Schäfer *et al.*, 2001; Sicherer *et al.*, 2004; Lunet *et al.*, 2005; Alvarado and Pérez, 2006).

As regards food origin, our results showed that both studied populations (children and adults) reported adverse reactions to foods of animal origin more than plant origin. A systematic review and a meta-analysis performed before, including data from 33 publications, studying allergy prevalence to plant and animal foods, indicated that allergy to plants was generally lower than that of animal foods (Osterballe *et al.*, 2005; Rona *et al.*, 2007; Zuidmeer *et al.*, 2008).

Our findings showed that the SRMA was slightly more pronounced among children than adults (5.3 per cent *vs* 3.4 per cent), and cow's milk was the most involved both in children and in adults. Results of children were almost in accordance with the reported percentage in Spain (4.7 per cent) (Venter *et al.*, 2006) and in the USA (4.8 per cent) (Salo *et al.*, 2014). However, it was less than the rate reported in other countries such Turkey (10.1 per cent) (Orhan *et al.*, 2009), Saudi Arabia (13 per cent) (GadElRab, 1999) and France (11.9 per cent) (Rance *et al.*, 2005). Moreover, in atopic populations, data showed higher values; Egypt (10.2 per cent) (World

	Children (NT = 162)		Adults (NT = 54)	
	Single allergy N (%)	Multiple allergies N (%)	Single allergy N (%)	Multiple allergies N (%)
<i>Milk</i>	55 (33.9)	107 (66)	24 (44.4)	30 (55.5)
<i>Cow milk</i>	92 (79.3)	24 (20.6)	45 (88.2)	6 (11.7)
<i>Goat milk</i>	21 (41.2)	30 (5.8)	2 (25)	6 (75)
<i>Camel milk</i>	9 (34.6)	17 (65.4)	0 (0)	4 (100)

Notes: NT: number total of person reporting milk allergy; N: number of person reporting allergy to each milk specie within the population reporting milk allergy

Table VI.
Single and multiple
milk allergies in
children and adults

Allergy Organization, 2010), Iran (6.3 per cent) (Farjadian *et al.*, 2012) and Mexico (15.1 per cent) (Robles-Vargas *et al.*, 2013). Although, basing on clinical investigations such as prick test and oral challenge, the rates of cow's milk allergy seemed to decrease; Egypt (2 per cent) (Hossny *et al.*, 2011), South Africa (1.9 per cent) (Levin *et al.*, 2011) and Turkey (2.7 per cent) (Güngör *et al.*, 2015), except in North African and Sub Saharan African children (8.2 per cent) (Cheikh *et al.*, 2013). Regarding adults, our results were in accordance with rates reported by adult populations of Portugal (3.8 per cent) (Falcao *et al.*, 2004) and France (3 per cent) (Kanny *et al.*, 2001), but less than the rate reported by adult population in Greece (5 per cent) (Kalogeromitros *et al.*, 2013). Nevertheless, this percentage did not exceed 2 per cent in Germany and the USA (Schäfer *et al.*, 2001; Vierk *et al.*, 2007).

This high prevalence of SRMA among children compared to adults was observed by previous studies. Rona *et al.* (2007) in the European meta-analysis indicated that SRMA varied from 6-7 per cent in children compared to 1-2 per cent in adults. Many other works confirmed this conclusion (Crittenden and Bennett, 2005; Ho *et al.*, 2012; Luyt *et al.*, 2014; Strinnholm *et al.*, 2014; Winberg *et al.*, 2014; Nwaru *et al.*, 2014) indicating that children were more sensitive than adults.

Milk allergy was more reported by male sex than female sex in the adult population (5.1 per cent vs 3.3 per cent). Conversely, in children population, the SRMA was highly reported by girls than boys (6.4 per cent vs 4.3 per cent). This latter finding was in line with a recent study in Sweden (Winberg *et al.*, 2016).

In our studied population, the proportions of cow's milk consumption were significant in both children and adults, particularly pasteurized milk. However, the intake of milk and dairy derivatives remains low in Morocco, at an annual average of 38 kg per capita far below the internationally recommended 90 kg (MAMF, 2007). Furthermore, we observed that milk consumption was inversely correlated to SRMA. Indeed, the rate of persons reporting milk allergy was higher within the population non-consuming milk than the consuming population. This could be explained either by a previous milk hypersensitivity leading to avoid milk consumption or by the low of milk consumption leading to the emergence of milk hypersensitivity. This second point seems to be more probable since it was confirmed by previous observations showing that cow's milk contains many components that lead to protection against atopy and allergies (Agostoni and Turck, 2011; Van Neerven *et al.*, 2012). As well, several epidemiologic studies have identified that the consumption of untreated bovine milk can reduce the risk of allergy (Ege *et al.*, 2007; Waser *et al.*, 2007; Braun-Fahrlander and Von Mutius, 2011; Riedler *et al.*, 2001; Loss *et al.*, 2011). Similarly, previous studies reported the protective effect of drinking raw milk against current asthma, atopy and allergy (Woods *et al.*, 2003; Perkin and Strachan, 2006; Douwes *et al.*, 2009; Sozańska *et al.*, 2013).

Comparing rates of SRMA in developed and underdeveloped countries and its correlation to milk consumption, we remarked that SRMA was lower in developed countries than in developing and underdeveloped countries, e.g. in USA (2 per cent) (Vierk *et al.*, 2007), Australia (2.4 per cent) (Woods *et al.*, 2002), Germany (1.8 per cent) (Schäfer *et al.*, 2001) and Sewed (1 per cent) (Björnsson *et al.*, 1996) where milk consumption exceeds 150 kg per capita per year, according to data from the Food and Agriculture Organization of the United Nations (FAO). Regarding low consuming milk countries, we observed that SRMA varied from 5 to 8 per cent in African countries (Westritschnig *et al.*, 2003; Adelakun and Arinola, 2016; Azdad *et al.*, 2016), and from 3 to 9.5 per cent in Latin America (Avila *et al.*, 2001; Naspitz *et al.*, 2004; Martínez *et al.*, 2005; Marrugo *et al.*, 2008), where milk consumption is less than 40 kg of milk per capita per year.

On the other hand, we found that the consumption of pasteurized milk is correlated to a high prevalence of SRMA, especially in adults. Indeed, it has been suggested that homogenization

and pasteurization of milk may affect the allergenic or anti-allergenic properties of milk proteins, fat, vitamin content, and microbial composition (Perkin, 2007; Michalski, 2007; Roth-Walter *et al.*, 2008; Pfefflerle *et al.*, 2010). Previous studies showed that pasteurization of milk may increase the allergenicity of its proteins component. Bu *et al.* (2009) showed that IgE-binding to α -lactalbumin and β -lactoglobulin increased significantly after pasteurization at temperatures between 50 and 90°C, compared to non-heated milk. These findings are backed up by epidemiological studies showing a lower prevalence of milk allergy upon ingestion of raw milk compared to consumption of commercially available milk products (Waser *et al.*, 2007; Braun-Fahrlander and Von Mutius, 2011; Riedler *et al.*, 2001; Loss *et al.*, 2011). It is noteworthy to mention that, in Morocco, the intake of pasteurized milk is regularly correlated to modern lifestyle and within rich families. Therefore, it was hypothesized that high living standards and hygienic conditions are correlated with an increased risk for the development of allergic diseases (Björkstén *et al.*, 2001; Heinrich *et al.*, 2002). This is commonly referred to the “hygiene hypothesis” which suggests that a lack of early childhood exposure to infectious agents, and symbiotic microorganisms increases susceptibility to allergic diseases by suppressing the natural development of the immune system (Bäckhed *et al.*, 2015; Thompson *et al.*, 2015; Azad *et al.*, 2013).

Regarding clinical signs, cutaneous and respiratory signs were the most symptoms reported by children suffering milk allergy with percentages of 64.8 per cent and 24.7 per cent, respectively. While, regarding adults, they presented typically gastrointestinal and cutaneous manifestations with 68.5 per cent and 25.9 per cent, respectively. It is known that, as in children, in adult and adolescent patients suffering food allergy, symptoms usually involve one or more organ systems, such as the skin, the respiratory tract, the gastrointestinal tract, or the cardiovascular system (Schäfer *et al.*, 2001; Alvarado and Pérez, 2006; Ho *et al.*, 2012; Azdad *et al.*, 2016; Ouahidi *et al.*, 2017; Mejrhit *et al.*, 2018). Kaczmarek *et al.* (2013) reported that symptoms elicited in (2-14 years) patients suffering cow's milk allergy were mostly cutaneous (77.2 per cent), followed by gastrointestinal, and respiratory symptoms (less than 34.2 per cent). While in an Algerian study, the most noticeable symptoms were gastrointestinal (42.5 per cent), then cutaneous symptoms (20 per cent) (Boughellout and Zidoune, 2010). In adults, Ballmer-Weber, 2015 reported that symptoms of the gastrointestinal tract were commonly accompanied by symptoms from other organ systems (Ballmer-Weber, 2015). Similarly, Potter *et al.* (2004) found that gastrointestinal disorders are frequently diagnosed in the adult population suffering food hypersensitivity.

The obtained results provide worthwhile information on the reported milk allergy among the children and adults of a Moroccan population as well as the relationship between milk consumption and milk allergy. Our results showed that the consumption of milk was greater within adults than children, which is attractive to our national authorities to encourage the population, especially children to consume more milk and dairy products in the target to reach the internationally recommended level of milk intake which could lead to rising milk tolerance within our population. Moreover, we observed that the consumption of raw milk correlated with the reduction of allergy more than the consumption of pasteurized milk. This should encourage our authorities to launch a responsible discussion about the commercialization and consumption of raw milk.

Conclusion

In conclusion, our results showed that the SRFA in the Moroccan population was more frequent in children than adults, and it was frequently related to food of animal origin. Similarly, SRMA was more pronounced among children than adults, especially among girls.

Clinical manifestations were mostly presented by cutaneous and respiratory symptoms in children while by gastrointestinal symptoms in adults. We noted that milk intake was significantly associated with a decrease in SRMA in both populations revealing its protective effect. Yet, the pasteurization of milk was correlated to an increase in milk sensitivity.

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