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María Teresa Solis-Soto[1,2]*, Armando Patiño[3], Dennis Nowak[4] and Katja Radon[4]

[1]Universidad Mayor, Real y Pontificia de San Francisco Xavier de Chuquisaca, Sucre, Bolivia
[2]Center for International Health, Ludwig-Maximilians-University, Munich
[3]Departmental Service of Health (SEDES) - Chuquisaca
[4]Institute for Occupational, Social and Environmental Medicine, Occupational and Environmental Epidemiology & Net Teaching Unit, University Hospital Munich (LMU), Munich

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***Corresponding author:** Solis-Soto María Teresa, Universidad Mayor, Real y Pontificia de San Francisco Xavier de Chuquisaca Sucre, Bolivia, Tel: 591-4-6461080; E-mail: maritesolissoto@gmail.com

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Research Article

Diet and Current Asthma Symptoms in School-Aged Children from Oropeza Province -Chuquisaca, Bolivia

Abstract

Background: Several studies have linked dietary intake and asthma symptoms, nevertheless the results are still inconclusive and data from developing country are scarce.

Objective: To assess the association of Food patterns and current asthma symptoms in school-aged children from rural and urban areas of Oropeza Province – Bolivia.

Methods: A total of 1655 children attending the fifth elementary grade were invited to participate in a cross-sectional study in rural and urban areas of Oropeza province. Current Asthma symptoms were defined following the International Study of Asthma and Allergies in Childhood (ISSAC) recommendation (written and video questionnaire). Food patterns were defined using the ISAAC environmental questionnaire. The Mediterranean diet (MD) score was calculated based on this information. Crude and adjusted logistic regression models were calculated including age, sex and place of living.

Results: The age range was between 9 – 15 years (Median 11), and 47.9% were male. Current asthma symptoms were reported in a 17% considering the written questionnaire (WQ) and in a 6% considering the video questionnaire (VQ). Higher consumption of nuts [(p=0.01, aOR= 1.6(1.1-2.2)], corn [(p=0.03, aOR= 1.5(1.0-2.2)] and fast food [(p=0.06, aOR= 1.4(1.0-2.0)] showed positive association with current asthma symptoms. Greater adherence to the MD was associated with lower risk of asthma symptoms.

Conclusion: Promotion of healthy food patterns in children is needed in order to avoid the rapid increase of non-communicable diseases in this region.

Introduction

Asthma is one of the most common chronic diseases in the world [1,2]. Several studies have shown that the prevalence of asthma increases as communities adopt western lifestyles and become urbanized. Since the percentage of urbanization is increasing, it is estimated that there may be an additional 100 million persons with asthma around the world by 2025 [1].

Among the lifestyle factors under discussion to be related with asthma are obesity, physical inactivity, exposure to air pollution and dietary habits. Some characteristics of more urbanized diets which have been related which asthma and atopic diseases includes a decrease in the consumption of saturated fats as butter, but an increase in the consumption of ω-6 (omega-6) polyunsaturated fat (present in vegetable oils). In the same way, diets patterns with poor consumption of oily fish or derived fish oil products with high content of ω-3 (omega-3) polyunsaturated fatty acids might be related with this kind of diseases [3]. Additionally, several studies have found that increased consumption of foods rich in antioxidants (including fruit and vegetables), vitamin C, vitamin E, selenium and carotenoids could have a positive effect in asthma prevention [3].

The International Study of Asthma and Allergies in Childhood (ISAAC), in consistency with other studies [4-7], reported lower prevalence of asthma and allergies symptoms in Mediterranean countries [8]. It suggest a potential protective effect of the Mediterranean diet (MD) for asthma and allergies. In general MD is characterized high consumption of fruit, fish, vegetables, legumes, pasta, cereals and grains and at the same time a moderate consumption of milk and low consumption of fast food and meat products [9].

The relationship between diet and asthma is still unclear and inconclusive [4, 10-12]. The evidence is even more limited considering developing countries. The present study therefore

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investigated the association between diet and current asthma symptoms in children from Oropeza Province in Chuquisaca – Bolivia.

Methodology

Study Design

A cross-sectional study was conducted in rural and urban areas in the north western part of Chuquisaca, Bolivia (Oropeza Province) from July to December 2011. ISAAC recommendations to assess asthma symptoms were implemented [13].

Study subjects

Methodology of this study has been reported previously [14,15]. A number of 43 educational establishments were selected randomly and invited to participate from a total of 185 schools listed in the Regional Education Service (SEDUCA - Chuquisaca). Due to access difficulties schools with less than 20 students were excluded before selection. A total of 36 schools agreed to participate, from them 10 schools where located in rural areas. In a second step, all students in the fifth grade of elementary school were invited to participate in each of the sampled schools (2584 children). ISAAC project recommendations were considered for sample size estimation. It considered 1% of significance level and 80% of statistical power [13]. A total of 2340 parents and children (91%) accepted to participate. In this study, complete data analysis was performed including 1655 children (70.7% of the total). A total of 685 questionnaires were excluded because incomplete data in questions exploring food consumption or asthma symptoms.

Study Instruments and variable definition

The International Study of Asthma and Allergies in Childhood (ISAAC) proposed an standardized methodology to assess asthma and allergic symptoms in children in order to make the results comparable across countries and over time. ISAAC developed two approaches to explore asthma symptoms prevalence, it is through the standardized written and video questionnaire (AVQ 3.0) [13], both of them were used in this study.

The validated *Spanish version of the ISAAC Written Questionnaire* (WQ) explore lifetime (ever), current asthma symptoms (considering 12 months prevalence) and also severity of asthma, rhinitis and eczema symptoms [16]. For this analysis the question: ''Have you had wheezing or whistling in the chest during the last 12 months?'' was used to define current asthma symptoms. Additionally *The ISAAC Video Questionnaire AVQ3.0 (VQ)* [17] was implemented following ISAAC recommendations. The VQ comprised five video sequences of young people suffering asthmatic symptoms in different situations. In this analysis a positive answer to the first scene of the video questionnaire (moderate wheezing at rest) during the last 12 months was used to define current asthma symptoms. Have been reported a high level of agreement between the first scene of the VQ and the question selected from the WQ to assess current wheezing [17-19].

The ISAAC environmental questionnaire (EQ) was implemented to explore average frequency of food consumption in the last 12 months[13]. It asks, in 3 point Likert scale (never/occasionally, 1-2 times, and 3/more times), for consumption per week of 16 food groups. Considering this information Mediterranean Diet (MD) score was computed considering consumption of 11 food groups as other studies recommend [5].

Foods considered in favor of MD received a higher score, while higher consumption. It included: fruit, fish, vegetables, legumes, cereals, pasta, rice, and potatoes. These foods received a score of 0 for never or occasionally, score of 1 for a frequency reported of 1 or 2 times per week and score of 2 for a frequency reported of 3 times per week.

Foods considered against MD included meat, milk, and fast food. It received lower score, while higher consumption. It means 2 for never or occasionally, score of 1 for a frequency reported of 1 or 2 times per week and score of 0 for a frequency reported of 3 times per week.

Considering these values, MD score is the result of a sum of all foods considered (minimum 0 and maximum 22). It means that while higher the score, greater the adherence to MD.

On the other hand, some variables were taken into consideration as potential confounders:

- Exercise: It was explored asking frequency per week of vigorous physical activity.
- Sedentary conduct: It was explored through two questions. Fist one explored hours per day watching television, and the second one asked hours per playing videogames. In both questions a cut-off of 3 hours/day were used.

Body Mass Index (BMI) was calculated taking into consideration World Health Organization instructions [20]. For this we used WHO AnthroPlus software for children (5 to 19 years)and the following categories were used [21]:

Normal weight: It included children up to +1 Standard Deviation (SD) according to WHO definition. In this group also were included 14 children with ≤ – 1 SD (thin).

Overweight: This group included children between > 1 and ≤+2 SDs

Obesity: This category included children with > +2 SDs.

Ethical considerations

This study was revised and had the ethical approved of the National Research Ethics Committee working in the University of San Andres in La Paz – Bolivia. Additionally the study protocol was approved by Regional Education Service (SEDUCA- Chuquisaca). Parents or legal guardians of the children received information about the study objectives at least a week before the planned visit to the educational establishment. At the same time the written informed consent form was required. Voluntary participation from children was respected in all steps of research.

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Statistical analysis

EpiInfo V. 3.5.3 for Windows was used for double-entry of data. After that congruence checking was performed in order to avoid possible mistakes. For statistical analysis, data was exported to SPSS v.17.

For descriptive analysis, absolute and relative frequencies were reported. In order to assess potential selection bias, children included and excluded in the analysis were compared using chi-squared test ($\chi 2$ test). Median value and range were reported for MD score.

In order to assess the association of food groups consumption per week (1 - 2 times/ and 3 or more times versus never/occasionally) and MD current asthma symptoms, crude and adjusted odds ratios and 95% confidence intervals were computed considering WQ and VQ. The adjusted models considered variables with statistically significance in the bivariate analysis (P value less than 0.05) and reported as confounders in the literature [22]. It included age (three groups: ≤ 10, 11 and ≥12 years), children residence (urban or rural), and sex.

Results

In order to explore potential selection bias, a first comparison was done between children excluded from the analysis (685), and those included. Excluded children were older and reported watch less hours of television ($\chi 2$=0.08) (Table 1).

Forty eight per cent of children included in the analysis (complete data) were male and reported a median age of 11 considering a range from 9 to 15 years. Current asthma symptoms (last 12 months), showed a prevalence of 17% considering the WQ and 6% considering the VQ. Regarding nutritional status, about 35% of the children were classified with overweight or obese.

Score of the MD reported a median of 13 points, with a range from 3 to 22) (Table 1). The foods with the highest consumption per week (3 or more times) were cereals, fruits, vegetables, rice, and potatoes (Table 2).

Considering current asthma definition by the WQ and VQ, a higher risk for current asthma symptoms was reported for corn and fast food consumption. In the other hand a tendency as protective factor was found for fruit, vegetables, cereal, rice, butter and milk consumption (Table 2). Inconsistency in the logistic regression models were found for margarine, pasta and nuts consumption. Not all the results reached statistically significance. The results for MD score suggest that a greater the adherence to the MD lower the risk for current asthma symptoms. The results were stronger considering the VQ (Table 3).

Discussion

The present study suggests a protective role of MD for current asthma symptoms (last 12 months) in children attending rural and urban schools of the central part of Bolivia.

Table 1: Comparison between children included and excluded (N=2340)

		Included[1] (n=1655)	Excluded[2] (n=685)	p-value[3]
Sex	Female	862 (52.1)	355 (52.0)	0.94
	Male	791 (47.9)	328 (48.0)	
Age	≤ 10 years	737 (44.7)	260 (38.5)	0.02
	11 years	669 (40.6)	306 (45.3)	
	≥ 12 years	243 (14.7)	110 (16.3)	
Place of living	Rural	420 (25.4)	193 (28.3)	0.16
	Urban	1235 (74.6)	492 (71.8)	
Asthma symptoms (12 months prevalence)	Written Questionnaire[4]	281 (17.0)	133 (19.7)	0.12
	Video Questionnaire[5]	105 (6.3)	43 (6.7)	0.78
Body mass index	Normal weight	1071 (65.0)	452 (67.2)	0.39
	Overweight	451 (27.4)	180 (26.7)	
	Obesity	125 (7.6)	41 (6.1)	
Intense exercise	Never/ Occasionally	278 (16.9)	129 (19.6)	0.28
	1-2 times per week	845 (51.4)	321 (48.7)	
	≥ 3 times per week	520 (31.6)	209 (31.7)	
Time watching television	≤ 2 hours per week	1024 (63.1)	438 (67.1)	0.08
	>3 hours per week	598 (36.9)	215 (32.9)	
Time playing video games	≤ 2 hours per day	1309 (87.7)	514 (86.0)	0.27
	>3 hours per day	183 (12.3)	84 (14.0)	
Mediterranean Diet Score	**Median (range)**	13 (3-22)	-	-

[1] All the food questions are completed
[2] One or more food questions are missing
[3]Chi square Test
[4]Positive answer to the question: "Have you had wheezing or whistling in the chest during the last 12 months?"in the written questionnaire.
[5]Positive answer to the first scene of the video questionnaire: Moderate wheezing at rest

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Table 2: Association between the frequency of food groups intake and current asthma symptoms during last year (Unadjusted and Adjusted Odds Ratios and 95% Confidence Intervals). Comparison group: never or occasionally (N=1655).

	Frequency of intake			Asthma symptoms: Written questionnaire				Asthma symptoms: Video questionnaire			
Food	Never/occasionally	1-2/week	3+/week	Crude OR (95% CI) p-value		aOR[1] (95% CI) p-value		Crude OR (95% CI) p-value		aOR[1] (95% CI) p-value	
				Frequency of intake[2]		Frequency of intake[2]		Frequency of intake[2]		Frequency of intake[2]	
	% (n)	% (n)	% (n)	1-2/week	3+/week	1-2/week	3+/week	1-2/week	3+/week	1-2/week	3+/week
Meat	11.4 (189)	52.4 (868)	36.1 (598)	1.16 (0.8-1.8) p=0.45	1.08 (0.7-1.7) p=0.69	1.19 (0.8-1.8) p=0.42	1.11 (0.7-1.8) p=0.65	0.73 (0.4-1.4) p=0.47	1.00 (0.5-1.9) p=0.83	0.76 (0.4-1.4) p=0.39	1.00 (0.5-2.0) p=0.89
Fish	48.6 (804)	41.0 (679)	10.4 (172)	0.97 (0.7-1.3) p=0.87	1.28 (0.8-1.9) p=0.18	0.98 (0.7-1.3) p=0.90	1.37 (0.9-2.1) p=0.13	0.94 (0.6-1.4) p=0.96	0.76 (0.4-1.6) p=0.78	0.94 (0.6-1.4) p=0.45	0.75 (0.4-1.6) p=0.78
Fruit	6.7 (111)	30.6 (506)	62.7 (1038)	0.63 (0.4-1.0) p=0.10	0.76 (0.5-1.2) p=0.39	0.71 (0.4-1.2) p=0.20	0.84 (0.5-1.4) p=0.50	0.55 (0.3-1.1) p=0.16	0.54 (0.3-1.0) p=0.08	0.55 (0.3-1.1) p=0.11	0.53 (0.3-1.0) p=0.06
Vegetables	9.4 (156)	31.4 (519)	59.2 (980)	0.98 (0.6-1.5) p=0.94	0.83 (0.5-1.3) p=0.42	1.01 (0.6-1.6) p=0.97	0.85 (0.5-1.3) p=0.47	0.91 (0.4-1.8) p=0.98	0.76 (0.5-1.7) p=0.97	0.90 (0.4-1.9) p=0.79	0.94 (0.5-1.9) p=87
Pulses	33.5 (555)	44.9 (743)	21.6 (357)	1.10 (0.8-1.5) p=0.54	1.27 (0.9-1.8) p=0.17	1.08 (0.8-1.5) p=0.60	1.22 (0.9-1.7) p=0.27	0.99 (0.6-1.5) p=0.94	0.83 (0.5-1.5) p=0.59	1.01 (0.6-1.6) p=0.98	0.91 (0.5-1.6) p=0.74
Cereal	12.4 (205)	27.7 (458)	59.9 (992)	0.74 (0.5-1.1) p=0.20	0.85 (0.6-1.2) p=0.42	0.76 (0.5-1.2) p=0.21	0.87 (0.6-1.3) p=0.47	0.66 (0.3-1.3) p=0.30	0.84 (0.5-1.5) p=0.73	0.69 (0.4-1.4) p=0.28	0.86 (0.5-1.5) p=0.61
Pasta	15.2 (251)	43.5 (720)	41.3 (684)	0.98 (0.7-1.4) p=0.91	1.14 (0.8-1.7) p=0.44	1.01 (0.7-1.6) p=0.81	1.18 (0.8-1.7) p=0.41	0.49 (0.3-0.9) p=0.02	0.77 (0.5-1.3) p=0.41	0.51 (0.3-0.9) p=0.02	0.85 (0.5-1.5) p=0.56
Rice	6.9 (114)	36.8 (609)	56.3 (932)	0.86 (0.5-1.5) p=0.81	0.99 (0.6-1.6) p=0.76	0.94 (0.5-1.6) p=0.82	1.07 (0.3-1.8) p=0.80	0.56 (0.3-1.1) p=0.20	0.66 (0.3-1.3) p=0.37	0.58 (0.3-1.2) p=0.58	0.73 (0.4-1.5) p=0.73
Butter	41.8 (692)	41.2 (670)	16.3 (265)	0.95 (0.7-1.2) p=0.56	0.80 (0.5-1.2) p=0.28	0.93 (0.7-1.2) p=0.61	0.83 (0.6-1.2) p=0.34	0.80 (0.5-1.2) p=0.35	0.70 (0.4-1.3) p=0.28	0.81 (0.5-1.3) p=0.34	0.68 (0.4-1.3) p=0.22
Margarine	58.1 (921)	28.9 (458)	13.1 (207)	1.05 (0.8-1.4) p=0.80	1.48 (1.0-2.1) p=0.05	1.07 (0.8-1.5) p=0.66	1.45 (1.0-2.1) p=0.05	0.85 (0.5-1.3) p=0.51	0.52 (0.2-1.1) p=0.09	0.83 (0.5-1.3) p=0.42	0.52 (0.2-1.1) p=0.09
Nuts	32.2 (523)	45.7 (742)	22.0 (357)	1.16 (0.9-1.6) p=0.37	1.59 (1.1-2.3) p=<0.01	1.12 (0.8-1.5) p=0.46	1.58 (1.1-2.2) p=0.01	0.94 (0.6-1.5) p=0.91	0.91 (0.5-1.6) p=0.84	0.99 (0.6-1.6) p=0.96	1.00 (0.6-1.7) p=0.98
Potatoes	6.0 (99)	23.2 (384)	70.8 (1172)	0.84 (0.5-1.5) p=0.76	0.91 (0.5-1.5) p=0.97	0.94 (0.5-1.7) p=0.85	1.00 (0.6-2.1) p=0.98	1.29 (0.6-3.0) p=0.37	0.78 (0.3-1.7) p=0.83	1.45 (0.6-3.6) p=0.42	0.91 (0.4-2.2) p=0.84
Milk	12.6 (209)	46.5 (770)	40.8 (676)	0.79 (0.5-1.2) p=0.33	0.92 (0.6-1.4) p=0.77	0.82 (0.5-1.2) p=0.33	0.96 (0.6-1.4) p=0.85	0.96 (0.5-1.7) p=0.93	0.78 (0.4-1.4) p=0.56	1.11 (0.6-2.1) p=0.76	0.83 (0.4-1.6) p=0.58
Eggs	11.4 (186)	53.7 (874)	34.8 (567)	0.90 (0.6-1.4) p=0.77	1.14 (0.7-1.8) p=0.50	1.97 (0.6-1.5) p=0.88	1.16 (0.7-1.8) p=0.52	0.74 (0.4-1.3) p=0.46	0.73 (0.4-1.4) p=0.46	0.78 (0.4-1.4) p=0.42	0.82 (0.4-1.6) p=0.55
Corn	30.8 (493)	46.4 (742)	22.8 (364)	1.19 (0.9-1.6) p=0.24	1.60 (1.1-2.3) p=0.04	1.18 (0.9-1.6) p=0.31	1.50 (1.0-2.2) p=0.03	0.85 (0.5-1.3) p=0.59	0.95 (0.6-1.6) p=0.95	0.91 (0.6-1.5) p=0.71	1.10 (0.6-1.9) p=0.73
Fast food	23.0 (380)	47.4 (784)	29.7 (491)	1.00 (0.7-1.4) p=0.77	1.35 (1.0-1.9) p=0.05	1.07 (0.8-1.5) p=0.70	1.40 (1.0-2.0) p=0.06	0.78 (0.5-1.3) p=0.41	1.01 (0.6-1.7) p=0.87	0.79 (0.5-1.3) p=0.35	1.03 (0.6-1.7) p=0.92

Abbreviations: aOR: adjusted odds ratio; CI: confidence interval.
[1]Adjusted for sex, age, place of living; [2]Reference category: Never/Occasionally

In the other hand, although the association is weak, high consumption of corn, nuts and fast food seems to increase the risk for asthma symptoms.

Although the ISAAC standardized environmental questionnaire (EQ) has been reported as validated instrument to report current diet considering different cultural contexts

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Table 3: Association between different risk factors under study and current asthma symptoms during the past 12 months (unadjusted and adjusted Odds Ratios with 95% Confidence Intervals) (N=1655).

		Current asthma symptoms Written questionnaire				Current asthma symptoms Video questionnaire			
Variables		**Crude OR (95%CI)**	**p-value**	**a OR (95%CI)**	**p-value**	**Crude OR (95%CI)**	**p-value**	**a OR (95%CI)**	**p-value**
Sex	Female	1		1		1		1	
	Male	0.99 (0.8-1.3)	0.94	0.98 (0.8-1.3)	0.97	0.87 (0.6-1.3)	0.51	0.91 (0.6-1.4)	0.68
Age	≤ 10 years	1		1		1		1	
	11 years	1.20 (0.9-1.6)	0.14	1.14 (0.9-1.5)	0.30	0.56 (0.4-0.9)	<0.01	0.62 (0.4-1.0)	0.03
	≥ 12 years	0.96 (0.6-1.4)	0.93	0.86 (0.6-1.3)	0.52	0.76 (0.4-1.4)	0.35	0.86 (0.5-1.6)	0.60
Place of living	Rural	1		1		1		1	
	Urban	0.68 (0.5-0.9)	<0.01	0.69 (0.5-0.9)	<0.01	2.32 (1.3-4.1)	<0.01	2.24 (1.3-4.0)	<0.01
Body mass index	Normal weight	1		-		1		-	
	Overweight	0.95 (0.7-1.3)	0.61	-		0.95 (0.6-1.5)	0.72	-	
	Obesity	1.12 (0.7-1.8)	0.75	-		1.45 (0.7-2.8)	0.28	-	
Intense exercise	Never/ Occasionally	1		-		1		-	
	1-2 times per week	0.90 (0.6-1.3)	0.56	-		0.68 (0.4-1.1)	0.15	-	
	≥ 3 times per week	0.83 (0.6-1.2)	0.33	-		0.73 (0.4-1.3)	0.26	-	
Time watching television	≤ 2 hours per week	1		-		1		-	
	>3 hours per week	1.05 (0.8-1.4)	0.62	-		1.07 (0.7-1.6)	0.73	-	
Time playing video games	≤ 2 hours per day	1		-		1		-	
	>3 hours per day	1.41 (0.9-2.0)	0.09	-		1.40 (0.8-2.5)	0.24	-	
Mediterranean diet score	Quartile 1	1		1		1		1	
	Quartile 2	0.98 (0.7-1.4)	0.98	0.99 (0.7-1.4)	0.97	0.57 (0.3-1.0)	0.04	0.56 (0.3-0.9)	0.04
	Quartile 3	0.71 (0.5-1.0)	0.09	0.72 (0.5-1.1)	0.15	0.73 (0.4-1.3)	0.31	0.70 (0.4-1.2)	0.25
	Quartile 4	0.84 (0.6-1.2)	0.45	0.84 (0.6-1.2)	0.49	0.63 (0.4-1.1)	0.05	0.59 (0.3-1.0)	0.05

Abbreviations: aOR: adjusted odds ratio; CI: confidence interval.

[23], it doesn´t explore eating patterns in greater depth including quantity of food, preparation of meals according geographical area, culture and season [24]. In this sense olive oil is a considerable ingredient of MD, unfortunately it is not reported separately in the ISAAC Environmental Questionnaire. Nevertheless, measurement of olive oil consumption in Bolivia would be difficult given the low consumption of this food in the Bolivian diet. Several studies agree on the potential role of exposures to risk or protective factors on asthma during an early stage of life [25]. Unfortunately, it was not possible to explore these aspects in our study, due to the potential memory bias and lack of knowledge about this by children.

It is important to take into consideration that this study included children from different age group than the one recommended by ISAAC [13]. We decided include children attending the 5th grade of elementary schools (median age 11) because higher courses (children aged 13-14) reported high drop-out percentage especially in public and rural schools [26], affecting in this way the generalizability of our result to the rest of Chuquisaca, and Bolivia. During pilot study we assured that children in this grade were able to understand and complete the questionnaire in a proper way. On the other hand the use of parental questionnaire for children aged 6-7 years as recommended by ISAAC was not considered because a high adult illiteracy especially in rural areas in Bolivia [27].

Some study strengths are related to the representativeness achieved by a high participation (91%). This percentage is quite similar to previous studies using the ISAAC approach in Latin America countries [28].

In order to explore diet, we considered two types of analysis: first, we analyzed individual foods (16 groups) groups and second, we analyzed MD as diet pattern. The second approach, has been reported as a good option in some epidemiological studies [5, 29], but also because as being a summary measure (score), allows us to improve statistical power [6].

In the present study, all associations between diet and asthma were analyzed according to *a priori* hypotheses; therefore tests for multiple comparisons were not used. Has been reported that multiple testing could be problematic in genetic, prognostic, confirmatory studies, and when the study is of exploratory nature [30].

Previous studies have mainly used the WQ to evaluate the effect of diet on current asthma symptoms. Although the VQ report is not so extended, it has been suggested as very sensitive instrument considering cultural, language or educational differences [18, 31]. Is for this reason that we decided include VQ for asthma symptoms definition. In Bolivia, considerable sociocultural and educational differences have been reported,

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especially between urban and rural areas. The large difference found for current asthma symptoms between WQ (17%) and VQ (6%) could be explained by the lack of knowledge, especially in rural areas) of the written terms causing over reporting of symptoms as has been previously suggested [14, 32]. But, on the other hand the video scene could explore presence of more severe asthma symptoms in comparison with WQ [19, 33]. This argument could explain the differences in our models, although the results do not show consistency in all the cases.

Several studies have reported a positive correlation between high consumption of fast food and asthma symptoms [23]. Although we found a weak correlation, and only considering WQ, it has been hypothesized that this kind of food affects the modulation of immune responses, therefore could trigger asthma [3, 34]. Less evidence had been published explaining the role of corn on asthma. It should be explored in more detail, because corn is an essential component on the diet of most Latin American countries and preparation process might present important differences in each area.

Our result showed a tendency as protective role of high consumption of cereal, butter, milk, rice, vegetables and fruit on asthma symptoms. It is consistent with previous studies and explained because their important content of vitamins and antioxidants [22, 23].

Correlation between pasta, margarine and nuts with current asthma symptoms were inconsistent might be by chance. Margarine reported the highest percentage of missing values (11%), for that we could assume that children had difficulties filling this question and also it could be possible that they did not recognize properly the difference between butter and margarine. Although, a potential protective role of nuts on asthma symptoms was suggested [35], our results don´t support that. In Bolivia, as in other countries, it is very common that more ingredients (sugar or salt) are added to nuts, so it could be consumed as snack. In this sense some studies have reported salty snacks as potential risk factor for asthma [36].

Evaluation of individual food groups does not take into consideration the combined effects of meals and the potential interaction between them, for that reason some studies are looking for dietary patterns instead of individual foods [3, 6]. Considering that MD was assessed by several studies supported by the idea that this diet has a positive effect on host resistance due the high consumption of antioxidants decreasing in that way asthma symptomatology [3, 37]. Additionally MD is characterized by high consumption of foods rich in ω-3 PUFAs and less consumption of foods rich in ω-6, in this way synthesis of prostaglandin E2 (PGE2) is inhibited reducing susceptibility to allergic diseases [3]. As expected, children in our study reported less adherence to MD compared to other groups in Mediterranean countries as Spain [38]. Unlike these countries, our population reported low consumption of fish. It is considered one of the main components of this diet and is one of the main sources of ω-3 PUFAs. Bolivian typical food is characterized by high content of seasoner, salt, animal fat and lower consumption of olive oil.

Current findings suggest that the presence of asthma symptoms depends on a complex interaction between genetic and environmental factors. For Latin American countries, where an important variability in asthma burden among and within countries have been reported, environmental factor, including diet, are an important points under discussion [39]. Although there are few studies reporting asthma symptoms in Bolivia, it also showed a considerable variation. A previous study in Santa Cruz including children 13-14 years, reported a prevalence of Asthma of 13.5% using the written questionnaire [40]. Santa Cruz, located in the west part of Bolivia, is one of the cities with the greatest agricultural production in the country; at the same time is also the city with the highest economic growth and more accelerated modernization. These contrasts are also reflected in the diet, with a more accentuated combination between typical and imported than in Chuquisaca.

Considering our results, it is important to explore some social, economic and cultural factors that influence food patterns. Some studies reported an association between unhealthy food consumption in children and low socioeconomic status [41]. In the same way, higher prevalence of asthma symptoms was found in countries with high rates of parasitic infections, stress and violence, and limited access to asthma treatment [39].

Overall, our study found a weak association between Mediterranean Diet current asthma symptoms (last 12 months), suggesting a protective role of MD. The results assessing individual foods groups did not show significant and consistent associations. Considering the evidence and the cultural and social context of Bolivia, it is not possible suggest MD as public recommendation; However it is needed to stress in the importance of National campaigns promoting healthy dietary habits addressed to children to prevent an accelerated increase of some preventable non-communicable diseases in Bolivia.

Authors' contributions

MTSS took part in the study design, field work, statistical analysis and manuscript preparation. KR participated in study design and coordination and manuscript preparation. MTSS, AP, DN and KR, critically reviewed the manuscript, and agreed on the final manuscript.

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