

The influence of socio-demographic factors on patterns of thyme and thyme products consumption: the case of a Mediterranean country

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Abstract

Thyme intake assessment is gaining significance because thyme is becoming a global staple food and its use has been on the rise. In our study, a food frequency questionnaire (FFQ) was developed to assess thyme intake in Lebanon. Out of the total 1555 adult participants, 1523 persons (97.9%) consumed at least one thyme product among the 14 assessed thyme-containing products. The mean consumption of thyme products was estimated to be 425.5 g/day, providing an estimated 31.4 g/day of thyme. Thyme pie had the highest mean intake (72.5 g/day) and represented the highest thyme contribution (10.4 g/day) among all thyme products, while crackers with thyme had the lowest mean intake (3.7 g/day) and the lowest thyme contribution (0.2 g/day). The mean consumption values for thyme products were significantly different between participants of different genders, age categories, socio-economic and demographic levels. This study highlighted the importance of a food frequency questionnaire as a tool for data collection about the consumption patterns.

Keywords: thyme; food frequency questionnaire; dietary intake; herbs.

Practical Application: Our study can be a useful approach for estimating thyme products intake, since it is based on assessing both the quantity and frequency of thyme products consumption. This is needed for investigating dietary intake of thyme products and health outcomes relationships, such as estimating the risk assessment of chemicals and food contaminants that could be consumed through thyme products.

1 Introduction

Herbs and spices are widely used ingredients in food preparation. They are becoming a global trend and their use has been on the rise in the last century (Alejandro et al., 2011; Carraro et al., 2012; Vallverdú-Queralt et al., 2015; Szűcs et al., 2018; Sedlacek-Bassani et al., 2020). Lebanese thyme gained significant importance, increased demand and is exported mainly to the Gulf countries as well as the United States, Australia, and Germany (Ghanem, 2018; Hamade, 2016).

Thyme is the most frequently used herb and it is a part of several recipes in different cuisines including European, Mediterranean, American and others (Kapadia, 2021). It could be used in two forms, either fresh or dried (Kapadia, 2021) and added to several recipes, such as pita bread sandwiches, pizza, pasta, salads, pies (known as manakeesh), crunchy bread sticks (known as Kaak), dressings, and ready-to eat meals. Furthermore, it could be mixed with other ingredients to develop a very commonly used thyme mixture consisting of dried thyme, sesame seeds, sumac, and olive oil (Culture of Arab Food, 2017).

Thyme has many beneficial effects on human health. It can be considered as a table salt substitute, and thus decrease the risk of cardiovascular diseases and help hypertension patients

limit their salt consumption and therefore maintain their blood pressure level (Gajewska et al., 2020).

Thyme has a high vitamin content, such as vitamin E (antioxidant), folate, riboflavin, biotin, as well as other minerals like iron, potassium, calcium and zinc (Dauqan & Abdullah, 2017). It also contains several active chemical compounds, such as carvacrol that, in addition to its antimicrobial properties, was found to help in preventing obesity and diabetes in mouse models (Dauqan & Abdullah, 2017). However, thyme is not a realistic source of the aforementioned nutrients as it is consumed as part of a mixture of other ingredients, such as sesame, nuts and sumac.

Thyme and its mixing ingredients can be exposed to biological and chemical contaminants, causing a threat to human health. These contaminants may be introduced to food through multiple pathways; such as environmental pollution (e.g. heavy metals) and poor agricultural practices (pesticide residues and mycotoxins) (Hassan & Ramaswamy, 2011; Hassan et al., 2012; Arnich et al., 2012).

Therefore, assessment of thyme products consumption is of considerable importance to assess both the health benefits

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and risks of exposure to contaminants through their dietary intake. This can be accomplished by the mean of data collection at the individual level targeting the portion size consumed of a specific food item containing thyme as well as the consumption frequency, without neglecting the added quantity of thyme (Siruguri & Bhat, 2015).

Simple and complex techniques were used to assess the dietary intake. The simple techniques include food records, 24-hour recall, diet histories and food frequency questionnaire (FFQ), while the complex techniques are biochemical tests considering nutrient intakes in blood and urine (Moghames et al., 2015). FFQ is a method used for epidemiological studies in order to assess long-term food consumption pattern of a particular item within a defined population. A single administration is capable of capturing the variability and availability of food when using FFQ (Saravia et al., 2018). Moreover, FFQ can rank individuals according to their usual intake (Saravia et al., 2018).

FFQ, 24-hour recall, diet records and diet histories examine the relationship between diet and disease, but FFQ can additionally identify the dose-response relationship. However, all previously discussed methods are susceptible to biases such as memory and recall biases (Food and Agriculture Organization, 2018; Fagúndez et al., 2015).

Methods of quantification present a wide range of challenges; thus, accurate measurements and knowledge of frequency of consumption are crucial to assess food intake in order to prevent measurement errors (Saravia et al., 2018). Previous studies used food frequency questionnaire to assess various dietary intakes including herbs and spices. These were conducted in Asian countries such as Southern India (Siruguri & Bhat, 2015), Sri Lanka (Jayawardena et al., 2012), Japan (Sunami et al., 2016), Middle East countries such as Jordan (Tayyem et al., 2020) and European countries including Austria, Germany, Hungary, Ireland, Latvia, Slovakia, the Netherlands (Szűcs et al., 2018), Norway (Carlsen et al., 2010), France (Gazan et al., 2017), and Belgium (Tollosa et al., 2017).

In Lebanon, recently, Hassan et al. (2022) and Karam et al. (2021) assessed the safety of thyme products marketed in the country in terms of microorganisms and mycotoxins, respectively. In addition, several studies used FFQ to assess food consumption patterns of different food groups for adults in Beirut (Nasreddine et al., 2006), to estimate intake of vitamins A, C, and E in rural and urban areas all over the country (Zalaket et al., 2019) and to evaluate eating habits among Lebanese University students in Beirut (Yahia et al., 2008). However, no studies in Lebanon were done so far to estimate thyme consumption, especially, that this product is becoming trendy and staple worldwide

Therefore, the key objectives of this study were to (i) assess the frequency and average of thyme products consumption in Lebanon, (ii) identify the most consumed thyme products, (iii) assess the effect of socio-demographic and economic factors on thyme consumption.

2 Materials and methods

2.1 Sample characteristics

A cross-sectional survey was carried out on a convenient sample of adults living in Lebanon. The sample size calculation

was performed using Epi Info™ based on a 50% prevalence of thyme consumption and a precision (d) of 2.5% yielding a target number of sample size equal to 1541 participants taking into consideration that the total Lebanese population was equal to 3.8 million (Yaacoub & Badre, 2012). This number was proportionally distributed and stratified into the 5 administrative regions (Yaacoub & Badre, 2012): Beirut, Mount Lebanon and Beirut suburbs, North, South and Bekaa (Table 1). We have exceeded this target number by additional 16 questionnaires to have a total of 1555 participants. If the participant had children (aged below 18 years old), additional consumption data was filled by any of the parents on their behalf.

2.2 Food consumption and dietary assessment method

Food consumption data were obtained using a semi-quantitative Food Frequency Questionnaire (FFQ) to estimate food intake between April 2018 and January 2019. All study procedures were approved by the Institutional Review Board at our university. The questionnaire was based on that of Moghames et al. (2015) and was piloted with 50 participants before the beginning of data collection. The study participants were interviewed face to face by a trained dietitian for around 7 to 12 min.

This questionnaire consisted of closed-ended questions divided in three parts: The first part addressed questions related to personal data, weight (kg) and indicators of socio-economic level, such as area of residence, educational and income levels.

The second part was a table that consisted of a list of 14 thyme-containing products that are commonly used by Lebanese population. These items were selected through market screening. The English, traditional names, thyme content/contribution and photos of the thyme products are shown in Table 2. The thyme content of each product was estimated through traditional recipe formulations extracted from local cookbooks or by weighing the added thyme using a digital high precision ($\pm 0.01g$) balance (Gerbertini Europe 500 machine, Italy). The frequency of consumption ranging from daily, weekly, monthly, less than 1 month and never eaten as well as the standard portion size consumed were collected. Furthermore, any exceptional or increased consumption and sources of products were also considered. The participants who never consumed a thyme product were considered as non-consumers.

The third part provided tool for helping participants to accurately report the source and quantity of thyme products intake by suggesting brands, bakeries and standard reference

Table 1. Distribution of sample habitants in different administrative regions (Yaacoub & Badre, 2012).

Administrative Regions	Percentage of habitants (%)	Number of sample population (habitants)
Beirut	9	139
Mount Lebanon + Beirut suburbs	41	632
North	20	308
Bekaa	12	185
South	18	277
Total	100	1541

Table 2. Thyme products assessed in the food frequency questionnaire.


















English name	Traditional name	Abbreviations	Thyme contribution % (w/w)	Photo
Thyme pie	Manoushe zaatar	TP	14.3 (10.4)	
Cheese and thyme pie	Manooshe cheese and zaatar	CTP	5.6 (3.1)	
Fresh thyme salad	Fresh zaatar salad	FTS	3.5 (2.4)	 
Thyme regular mix sandwich	Zaatar regular sandwich	TRS	31.0 (5.2)	
Thyme mix with nuts and seeds sandwich	Zaatar mix with nuts, seeds... sandwich	TNS	34.5 (3.9)	
Pizza and pasta with thyme sauces	Pizza and pasta with zaatar sauces	PP	1.2 (0.3)	 
Bread sticks with thyme (crunchy)	Kaak with zaatar (crunchy)	BS	11.6 (0.6)	
Sesame thick bread with thyme (soft)	Kaak with zaatar (soft)	SB	6.8 (0.9)	
Crackers with thyme	Crackers with zaatar	CT	6.7 (0.2)	
Toast/Bread with thyme	Toast/bread with zaatar	TB	3.4 (0.2)	
Thyme croissant	Croissant zaatar	TC	9.4 (0.9)	
Traditional molded aged cheese with thyme Traditional strained yogurt balls with thyme	Chanklish Labneh mkaazaleh	TCY	1.1 (0.2)	 

Table 2. Continued...

English name	Traditional name	Abbreviations	Thyme contribution % (w/w)	Photo
Homemade or catering recipes with thyme	Homemade or catering recipes with zaatar	HMC	7.7 (4.8)	
Tea thyme	Zaatar tea	TT	1.7 (0.9)	

portion size for each food item using photographs and local household units such as plate, bowl, spoons of different size (tablespoon, teaspoon) and teacups.

Thyme products intake was expressed as daily consumption in grams (g/day) taking into account the frequency of consumption and the estimated portion sizes.

This study was approved by the Institutional Ethical Review Board at our university and each participant signed a consent form before filling the FFQ.

2.3 Statistical analysis

Statistical analyses were performed using the Statistical Package for Social Sciences (IBM SPSS statistics version 20) software. The analyses were stratified by age and gender whenever appropriate. T-test was performed to compare mean consumption values between genders (men and women), and ANOVA to compare demographic, socioeconomic characteristics, and age groups. The results were expressed as means \pm SD (standard deviation) and frequency (%). Differences were considered statistically significant at $p < 0.05$.

3 Results and discussion

3.1 Socio-demographic characteristics

Among the total number of interviewed participants ($n = 1555$), 1523 adults (97.9%) were consumers of thyme products (Table 3). Average age was 35 years and average weight was 72 kg. More than half of the participants (56.8%) were females as similarly reflected in other work where Females were the biggest proportion of the Lebanese population (Nasreddine et al., 2006; Yaacoub & Badre, 2012).

Participants were recruited according to the percentage of habitants in the five main residence areas in Lebanon and the majority of the participants were located in urban (64.7%) areas (Tables 1-3). Most of the participants had a bachelor degree (45.9%), followed by technical/high school (24.6%), elementary (13.8%) and then postgraduate (15.7%). As for the income, more than 75% of the participants earned more than 1000\$ per month (1\$ was equivalent to 1515 LBP).

Table 3. Socio-demographic characteristics of participants.

Variable	Total participants Thyme consumers	
	Mean ¹ (SD ²)	
Age	35.3 (15.6)	35.4 (15.7)
Weight	72.3 (15.3)	72.4 (15.3)
	Frequency (%)	
Number of participants	1555 (100)	1523 (97.9)
Gender		
Male	672 (43.2)	661 (43.4)
Female	883 (56.8)	862 (56.6)
Area of residence		
Mount Lebanon	634 (40.8)	628 (41.3)
North	317 (20.4)	296 (19.4)
Beirut	139 (8.9)	137 (9.0)
South	277 (17.8)	274 (18.0)
Bekaa	188 (12.1)	188 (12.3)
Urban	1004 (64.7)	993 (65.2)
Rural	551 (35.3)	530 (34.8)
Education level		
Elementary school	215 (13.8)	214 (14.0)
Technical/high school	381 (24.6)	376 (24.7)
Bachelor	716 (45.9)	696 (45.7)
Master/Doctorate/Post doctorate	243 (15.7)	237 (15.6)
Household income (US \$³ per month)		
≤ 499	77 (5.0)	77 (5.1)
500-999	263 (16.9)	259 (17.0)
1000-1999	426 (27.4)	422 (27.7)
2000-2999	376 (24.2)	361 (23.7)
≥ 3000	413 (26.5)	404 (26.5)

¹Mean consumption values are expressed in years old for age and kg for weight; ²SD: Standard deviation; ³Each 1 US\$ is equivalent to 1515 Lebanese Pounds (LBP).

3.2 Frequency of consumption

Thyme regular mix sandwich, thyme pie and fresh thyme salad were observed to have the highest daily frequency of consumption among thyme products (9.1, 3.3, and 5.2%, respectively). Same order of 25.3, 34.9 and 19.7% was noted on weekly basis (Table 4). In addition, on a monthly basis, thyme pie was the highest consumed thyme product (36.1%), followed by

Table 4. Frequency of thyme products consumption by the participants.

Thyme product	Frequency of Consumption % (n)				
	Never	< 1/month	Monthly	Weekly	Daily
TP	14.7 (229)	11.0 (171)	36.1 (562)	34.9 (541)	3.3 (52)
CTP	52.7 (821)	11.3 (176)	22.8 (354)	12.6 (195)	0.6 (9)
FTS	42.4 (659)	8.6 (133)	24.1 (376)	19.7 (306)	5.2 (81)
TRS	33.8 (525)	8.0 (124)	23.8 (371)	25.3 (393)	9.1 (142)
TNS	69.5 (1081)	6.0 (94)	13.2 (206)	9.2 (143)	2.1 (31)
PP	46.9 (730)	8.0 (124)	33.8 (527)	10.8 (167)	0.5 (7)
BS	58.5 (910)	10.2 (159)	19.2 (299)	9.0 (139)	3.1 (48)
SB	52.4 (815)	14.9 (231)	25.9 (403)	6.5 (101)	0.3 (5)
CT	69.0 (1074)	8.0 (125)	13.7 (212)	8.2 (127)	1.1 (17)
TB	76.8 (1196)	6.3 (98)	11.1 (173)	4.4 (66)	1.4 (22)
TC	51.0 (794)	14.6 (228)	26.4 (409)	7.7 (120)	0.3 (4)
TCY	55.2 (858)	9.1 (142)	21.5 (333)	12.7 (199)	1.5 (23)
HMC	69.8 (1087)	7.3 (114)	13.1 (203)	8.3 (129)	1.5 (22)
TT	82.2 (1278)	5.6 (87)	5.3 (83)	4.7 (73)	2.2 (34)

TP: Thyme pie, CTP: Cheese and thyme pie, FTS: Fresh Thyme salad, TRS: Thyme regular mix sandwich, TNS: Thyme mix with nuts and seeds sandwich, PP: Pizza/Pasta with thyme sauces, BS: Bread sticks with thyme, SB: Sesame thick bread with thyme, CT: Crackers with thyme, TB: Toast/Bread with thyme, TC: Thyme croissant, TCY: Traditional strained yogurt balls with thyme, HMC: Homemade or catering recipes with thyme, TT: Tea thyme.

pizza and pasta with thyme sauces (33.8%) and thyme croissant (26.4%). However, the lowest frequencies of less than once per month and never, were observed for sesame thick bread (14.9%) and tea thyme (82.2%), respectively (Table 4).

In a study done in North-East Lebanon, thyme herbs were among the most consumed herbs with a frequency of 5 times per week (Jeambey et al., 2009). In United Arab Emirates and Kuwait, a culture-specific FFQ showed that cereals were an important food category with a frequency of consumption of 4.8 times and 5.3 times per day, respectively. Our study findings list several cereal-based products such as thyme pie, cheese and thyme pie, crackers, pizza and pasta, as being the most frequently consumed, making them an important category in Lebanese and Arab populations' diet.

On the international level, thyme and oregano are typically used in worldwide cuisines due to their popularity. Oregano was the most consumed herb in Austria with a frequency of 63%, while the thyme was the second most consumed herb in Ireland (47.8%) (Szűcs et al., 2018).

3.3 Quantity of thyme products intake

Percentage of consumers, mean consumption values, and thyme contribution for each of the 14 thyme products during routine and increased consumption are shown in Table 5. The majority of the participants (85.3%) consumed thyme pie, followed by thyme regular mix sandwich (66.2%), while tea thyme had the lowest percentage of consumption (17.9%). Thyme pie had the highest mean intake (72.5 g/day) and represented the highest thyme contribution (10.4 g/day) among all thyme products, while crackers with thyme had the lowest mean intake (3.7 g/day) and the lowest thyme contribution (0.2 g/day) (Table 5).

Thyme pie is a traditional Lebanese product that many people would have for breakfast. It is also a perfect appetizer when

served in small sized dough. The high consumption observed can be related to its affordable price and availability on the go in all Lebanese bakeries. On another note, tea thyme was the least consumed due to the popularity of other types of herbal teas such as green and black tea.

Several factors changed and increased significantly the mean consumption of all thyme products except pizza and pasta with thyme sauces (Table 5). Such factors were cultivation season (12.3%), lent meals (10.5%), school snacks (3.6%), picnic meals (1.2%), weight loss diet (5.1%) and sickness remedies (2.0%). This is in line with study findings in North-East Lebanon, where thyme herbs were among the mostly consumed in the winter season as compared to other seasons (Jeambey et al., 2009). Sickness factor can also increase the consumption of herbal teas for medicinal purposes to treat flu and intestinal discomfort for example (Söukand et al., 2013).

3.4 Number of thyme products consumed

Eight point seven % to 13.6% of the participants consumed 3 to 7 thyme products, followed by 7.0 to 9.6% who consumed 8 to 9 thyme products. The lowest consumption percentages of 0 to 3 thyme products were almost similar to that of 10 to 14 thyme items, which ranged between 0.5 to 5.3% (Figure 1).

Lebanese population consumed thyme products in its different forms since thyme can be used in different ways and forms. A study done by Jeambey et al. (2009), reported that participants had an increased consumption of several herbs, including thyme, since it could be used either fresh such as in salads, or when it is ground and mixed with sesame seeds, sumac, salt and olive oil (Jeambey et al., 2009).

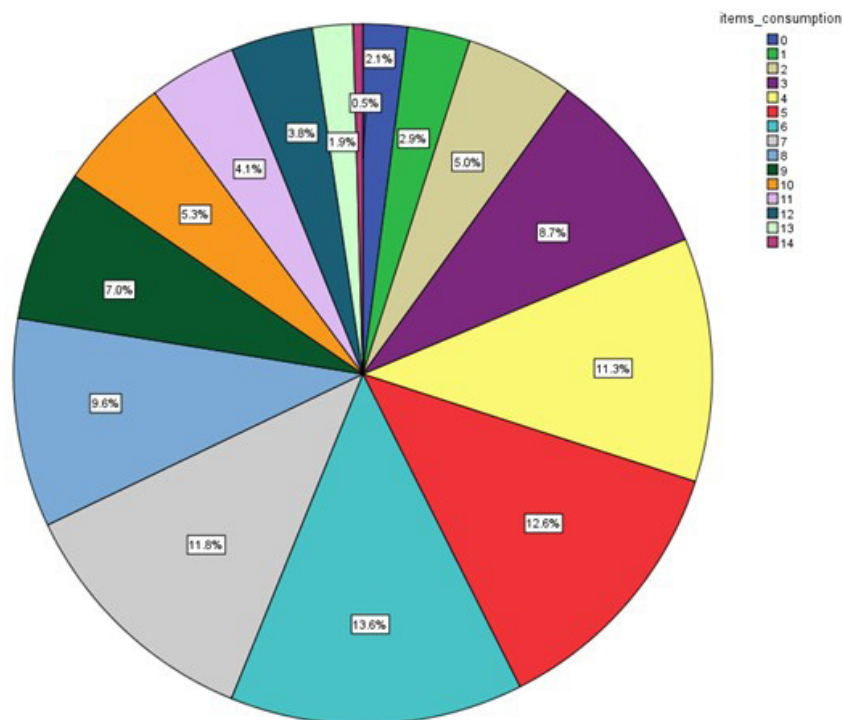
3.5 Age and gender

Mean consumption values by age and gender are shown in Table 6. Consumption of thyme pie, fresh thyme salad, thyme

Table 5. Percentage of consumers, mean consumption values (g/day) and thyme contribution (g/day) for each thyme product during routine and increased consumption.

Thyme products	Routine consumption		Thyme contribution	Increased consumption		p value	
	Consumers % (n)	Mean ¹ ± SD ²		Consumers % (n)	Mean ± SD		Thyme contribution
TP	85.3 (1323)	72.5 ± 109.4	10.4	10.1 (154)	141.9 ± 119.8	20.3	< 0.001*
CTP	47.2 (733)	55.2 ± 85.4	3.1	3.2 (48)	167.3 ± 198.5	9.4	< 0.001*
FTS	57.6 (892)	68.2 ± 115.4	2.4	11.2 (171)	115.8 ± 101.2	4.1	< 0.001*
TRS	66.2 (1027)	16.8 ± 24.2	5.2	6.2 (95)	34.0 ± 29.7	10.5	< 0.001*
TNS	30.5 (472)	11.2 ± 18.2	3.9	2.7 (41)	29.2 ± 20.4	10.1	< 0.001*
PP	53.1 (821)	27.3 ± 37.4	0.3	3.8 (58)	28.8 ± 160.1	0.3	0.275
BS	41.5 (641)	5.0 ± 11.1	0.6	3.7 (57)	13.4 ± 14.2	1.5	< 0.001*
SB	47.6 (737)	13.9 ± 28.5	0.9	2.9 (44)	40.8 ± 80.7	2.7	< 0.001*
CT	30.9 (477)	3.7 ± 6.0	0.2	3.2 (48)	7.7 ± 9.5	0.5	< 0.001*
TB	23.1 (357)	6.6 ± 15.2	0.2	1.2 (18)	9.8 ± 7.0	0.3	< 0.001*
TC	49.0 (760)	9.6 ± 19.0	0.9	1.8 (28)	23.0 ± 27.7	2.2	< 0.001*
TCY	44.8 (693)	20.9 ± 47.8	0.2	3.0 (45)	38.8 ± 39.5	0.4	< 0.001*
HMC	30.1 (463)	61.9 ± 123.3	4.8	1.6 (25)	122.2 ± 102.6	9.4	< 0.001*
TT	17.9 (265)	52.7 ± 78.7	0.9	4.7 (72)	119.0 ± 78.9	2	0.001*

*p < 0.05 is considered significantly different for routine and increased consumption; ¹Mean consumption and thyme contribution values are expressed in grams per day; ²SD: Standard deviation. TP: Thyme pie, CTP: Cheese and thyme pie, FTS: Fresh Thyme salad, TRS: Thyme regular mix sandwich, TNS: Thyme mix with nuts and seeds sandwich, PP: Pizza/Pasta with thyme sauces, BS: Bread sticks with thyme, SB: Sesame thick bread with thyme, CT: Crackers with thyme, TB: Toast/Bread with thyme, TC: Thyme croissant, TCY: Traditional strained yogurt balls with thyme, HMC: Homemade or catering recipes with thyme, TT: Tea thyme.

**Figure 1.** Number of thyme products consumed by the participants (n = 1555).

regular mix sandwich, crackers with thyme and traditional molded aged cheese with thyme/ traditional strained yogurt balls with thyme (TCY) significantly differed between age groups ($p < 0.05$). The highest consumption among participants aged more than 60 years old was for fresh thyme salad (106.6 g/day), thyme regular mix sandwich (21.7 g/day), and TCY (27.0 g/day).

The lowest consumption was for those aged between 18-24 years old for fresh thyme salad (47.7 g/day) and thyme regular mix sandwich (12.7 g/day), whereas, group aged between 35 and 44 years represented the lowest consumption for TCY (14.5 g/day) (Table 6). Opposite trend was observed for crackers with thyme where the highest consumption was among the participants

Table 6. Mean consumption (g/day) of thyme products by different age groups and gender (n = 1523).

	Consumption of each food item (g/day)								
	Adults Age (years)					p value	Gender		
	18-24	25-34	35-44	45-59	> 60		Male	Female	p value
Mean ¹ ± SD ²	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD		Mean ± SD	Mean ± SD		
TP	64.3 ± 99.9^a	76.4 ± 135.6 ^{ab}	89.5 ± 131.0^{abc}	72.5 ± 84.0^{bcd}	69.9 ± 86.6^{abc,d}	0.008*	97.5 ± 133.8	53.3 ± 81.4	< 0.001*
CTP	63.1 ± 95.4	47.6 ± 86.0	52.3 ± 79.8	50.6 ± 67.3	55.6 ± 71.2	0.366	66.6 ± 91.6	45.0 ± 78.0	0.001*
FTS	47.7 ± 89.6^a	58.1 ± 118.1^{ab}	67.3 ± 87.3^{bc}	81.1 ± 125.5^{bc}	106.6 ± 153.0^d	< 0.001*	70.1 ± 108.5	66.8 ± 120.5	0.824
TRS	12.7 ± 20.0^d	18.2 ± 27.4^{ab}	15.8 ± 21.1^a	20.5 ± 26.2^c	21.7 ± 27.2^{ab,c}	< 0.001*	19.0 ± 26.0	15.4 ± 22.8	0.023*
TNS	8.9 ± 14.9	11.0 ± 15.7	12.9 ± 20.2	11.4 ± 22.1	16.1 ± 20.8	0.076	13.7 ± 21.8	9.5 ± 15.0	0.013*
PP	28.0 ± 42.0	29.7 ± 37.6	23.3 ± 23.1	23.1 ± 23.6	35.0 ± 57.2	0.639	31.2 ± 42.7	24.6 ± 33.1	0.017*
BS	4.87 ± 8.02	4.8 ± 9.1	7.1 ± 21.9	4.3 ± 7.2	5.1 ± 11.6	0.413	4.7 ± 8.1	5.2 ± 12.6	0.137
SB	16.5 ± 38.9	11.0 ± 13.6	9.4 ± 12.1	16.4 ± 30.9	11.4 ± 13.31	0.173	14.0 ± 20.5	13.8 ± 33.3	0.245
CT	4.4 ± 6.6^{bcd}	2.7 ± 3.3 ^{abcd}	3.4 ± 5.2 ^{ab}	3.5 ± 7.5^a	2.5 ± 3.3 ^{abc}	0.048*	4.0 ± 6.8	3.5 ± 5.6	0.768
TB	8.5 ± 19.8	5.0 ± 13.1	3.7 ± 10.5	7.0 ± 13.7	6.6 ± 9.0	0.36	5.5 ± 13.4	7.2 ± 16.2	0.067
TC	11.6 ± 25.7	9.2 ± 13.7	10.0 ± 18.4	7.5 ± 10.2	5.8 ± 6.9	0.285	13.3 ± 25.3	6.7 ± 11.1	< 0.001*
TCY	20.2 ± 37.8^{ab}	28.4 ± 85.2 ^{abc}	14.5 ± 22.2^a	16.2 ± 22.5^{bcd}	27.4 ± 45.9^{cd}	0.012*	24.3 ± 41.4	18.2 ± 52.2	0.196
HMC	41.4 ± 74.1	68.0 ± 127.0	68.2 ± 157.1	73.1 ± 126.4	71.5 ± 154.6	0.064	68.0 ± 141.7	57.8 ± 109.5	0.292
TT	49.32 ± 75.58	51.03 ± 74.41	37.80 ± 66.94	53.87 ± 73.22	70.37 ± 104.28	0.491	47.6 ± 75.0	56.4 ± 81.4	0.678

*p < 0.05 is considered significant; ¹Mean consumption values are expressed in grams per day; ²SD: Standard deviation. Columns with superscripts **without** a common symbol differ, p < 0.05.

aged 18-24 years (4.4 g/day) and the lowest consumption among participants aged more than 60 years (2.5 g/day). On the other hand, participants aged between 35 and 44 years had the highest mean consumption of thyme pie (89.5 g/day), whereas, the lowest consumption of thyme pie was among participants aged between 18-24 years (64.3 g/day) (Table 6).

Our study showed that older persons consumed healthier thyme products (fresh thyme salad, thyme sandwiches) compared to the younger age groups (thyme pie, crackers). A healthy dietary pattern/food choice among old populations (45-54 years old) was similarly observed in a total diet study for the urban population living in Beirut, Lebanon (Nasreddine et al., 2006). Also, a high consumption of herbs and spices was observed among persons aged between 50 and 60 years in Poland since they could this way substitute table salt and consequently regulate blood pressure (Assimiti, 2020; Gajewska et al., 2020). Furthermore, a fast-food/dessert dietary pattern was mainly observed among young age groups in Lebanon similar to our findings (Naja et al., 2013).

Consumption of thyme pie, cheese and thyme pie, thyme regular mix sandwich, thyme mix with nuts sandwich, pizza and pasta with thyme, thyme croissant significantly differed between gender groups (p < 0.05) with a higher consumption among male participants (Table 7). This significant difference was related to larger portion sizes and quantities consumed among males as compared to females. In addition, the listed thyme products belong to high caloric groups yielding between 450 and 750 kcal per portion size (Mahan & Raymond, 2017). This can be related to the higher focus of women on the caloric value of food, weight loss and healthy eating, as compared to males (Crane et al., 2017; Bärebring et al., 2020; Overcash & Reicks, 2021). Similar results were reported by Nasreddine et al. (2006), who found that males in Lebanon reported higher mean energy intake than females. Also in Lebanon, another study conducted by Yahia et al. (2008) reported that being overweight is more common among males than in females (37.5 vs. 13.6%, respectively). On the other

hand, Dehghan et al. (2005) reported that females in UAE had higher BMI values than males highlighting the different dietary patterns among countries.

3.6 Geographical location

Consumption of thyme pie (56.1 g/day), cheese and thyme pie (43.4 g/day), thyme mix with nuts sandwich (7.4 g/day), pizza and pasta with thyme sauces (23.4 g/day), thyme croissant (6.9 g/day), toast/bread with thyme (5.5 g/day), homemade or catering recipes with thyme (40.4 g/day), tea thyme (38.2 g/day) significantly differed between areas of residence with the lowest consumption among participants located in Mount Lebanon. Thyme pie (108.5 g/day), cheese and thyme pie (76.4 g/day), thyme croissant (16.6 g/day) and toast/bread with thyme (12.1 g/day) had the highest consumption among participants living in South. In addition, homemade or catering recipes with thyme (163.5 g/day) and tea thyme (104.0 g/day) had the highest consumption among participants living in North, while thyme mix with nuts sandwich (26.4 g/day) had the highest consumption among participants living in Bekaa and pizza/pasta sauces with thyme (34.9 g/day) among participants living in Beirut (Table 7).

In addition, the consumption of thyme regular mix sandwich, and traditional molded aged cheese with thyme/traditional strained yogurt balls with thyme significantly differed between areas of residence (p < 0.05); with the lowest consumption among participants located in Beirut (11.4 g/day, and 15.7 g/day, respectively) and the highest consumption was among participants living in North and Bekaa (23.6 g/day, and 33.0 g/day, respectively). Furthermore, sesame thick bread with thyme had the highest consumption among participants living in Beirut (25.2 g/day) and the lowest consumption in Bekaa (9.7 g/day). Finally, fresh thyme herbs had the highest consumption in Bekaa (103.3 g/day) and the lowest in North (55.7 g/day) (Table 7). The observed differences in dietary habits

Table 7. Mean consumption (g/day) of thyme products by area of residence for consumers (n = 1523).

Thyme product	Mount Lebanon	North	Beirut	South	Bekaa	p value	Urban	Rural	p value
	Mean ¹ ± SD ²	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD		Mean ± SD	Mean ± SD	
TP	56.1 ± 83.5 ^a	74.2 ± 97.9 ^{b,c}	68.0 ± 88.2 ^{a,b}	108.5 ± 163.9 ^d	73.5 ± 103.5 ^{b,c,d}	< 0.001*	66.6 ± 98.9	83.6 ± 126.4	0.013*
CTP	43.4 ± 56.6 ^a	58.2 ± 125.1 ^{a,b}	69.9 ± 102.1 ^{b,c,d}	76.4 ± 106.7 ^d	54.8 ± 90.0 ^{a,b,c}	< 0.001*	54.7 ± 81.7	56.7 ± 93.7	0.51
FTS	57.8 ± 109.7 ^a	55.7 ± 69.5 ^{a,b}	64.6 ± 86.0 ^{a,b,c}	84.6 ± 148.2 ^{b,c}	103.3 ± 138.6 ^c	< 0.001*	57.9 ± 96.4	88.9 ± 144.5	0.001*
TRS	14.3 ± 23.5 ^a	23.6 ± 26.5 ^b	11.4 ± 16.6 ^a	17.9 ± 23.9 ^c	21.3 ± 27.1 ^b	< 0.001*	15.5 ± 24.5	19.9 ± 23.3	0.483
TNS	7.4 ± 13.7 ^a	11.3 ± 15.4 ^{b,c}	8.7 ± 15.9 ^{a,b}	11.3 ± 18.1 ^{a,b,c}	26.4 ± 26.0 ^d	< 0.001*	8.9 ± 17.0	17.6 ± 19.9	< 0.001*
PP	23.4 ± 30.8 ^a	34.9 ± 51.1 ^{b,c,d}	36.5 ± 44.5 ^{a,b,c,d}	25.5 ± 33.1 ^{a,b}	28.9 ± 38.0 ^{a,b,c}	0.033*	24.8 ± 33.9	33.8 ± 44.8	0.007*
BS	3.8 ± 6.8 ^a	4.3 ± 7.9 ^{a,b,c}	3.1 ± 3.6 ^{a,b}	6.2 ± 11.3 ^{a,b,c}	13.5 ± 26.5	< 0.001*	4.0 ± 8.2	7.2 ± 15.3	0.005*
SB	12.2 ± 24.3 ^{a,b}	14.9 ± 35.8 ^a	25.2 ± 53.9 ^d	13.7 ± 15.4 ^{c,d}	9.7 ± 9.8 ^{a,b,c}	0.003*	12.9 ± 28.6	16.5 ± 28.2	0.183
CT	3.1 ± 5.9	4.4 ± 6.7	4.4 ± 7.6	4.2 ± 5.1	3.6 ± 3.9	0.321	3.6 ± 6.2	3.8 ± 5.7	0.801
TB	5.5 ± 15.8 ^a	6.3 ± 11.4 ^{a,b}	4.9 ± 7.7 ^{a,b,c,d}	12.1 ± 18.5 ^{c,d}	9.2 ± 13.7 ^{a,b,c}	< 0.001*	6.4 ± 16.8	6.9 ± 9.8	0.619
TC	6.9 ± 10.4 ^a	10.5 ± 17.3 ^{a,b,c}	7.7 ± 9.6 ^{a,b}	16.6 ± 34.2 ^e	10.2 ± 18.3 ^{b,d,e}	< 0.001*	9.1 ± 19.4	10.9 ± 18.1	0.271
TCY	16.6 ± 37.0 ^{a,b}	24.8 ± 41.5 ^{a,c,d}	15.7 ± 27.5 ^{a,b,c}	17.1 ± 30.2 ^a	33.0 ± 83.6 ^d	< 0.001*	18.1 ± 33.4	26.1 ± 66.5	0.075
HMC	40.4 ± 77.3 ^a	163.5 ± 241.4 ^{b,c,d}	52.0 ± 69.2 ^{b,c}	46.9 ± 78.4 ^{a,b}	114.3 ± 187.1 ^d	< 0.001*	43.8 ± 79.4	108.1 ± 187.5	< 0.001*
TT	38.2 ± 62.9 ^a	104.0 ± 108.0 ^{b,c,d}	80.7 ± 91.8 ^{b,c,d}	77.4 ± 89.0 ^{b,c}	44.0 ± 81.3 ^{a,b}	0.002*	52.9 ± 80.7	52.4 ± 75.4	0.616

¹Mean consumption values are expressed in grams per day; ²SD: Standard deviation; *P < 0.05 is considered significant. Columns with superscripts **without** a common symbol differ, p < 0.05. TP: Thyme pie, CTP: Cheese and thyme pie, FTS: Fresh Thyme salad, TRS: Thyme regular mix sandwich, TNS: Thyme mix with nuts and seeds sandwich, PP: Pizza/Pasta with thyme sauces, BS: Bread sticks with thyme, SB: Sesame thick bread with thyme, CT: Crackers with thyme, TB: Toast/Bread with thyme, TC: Thyme croissant, TCY: Traditional strained yogurt balls with thyme, HMC: Homemade or catering recipes with thyme, TT: Tea thyme.

between different areas were similarly reported by Anzid et al. (2009). Also, it was reported that different areas represented multiple variations in food preparation recipes (Food and Agriculture Organization, 2007).

Consumption of thyme pie, fresh thyme salad, thyme mix with nuts sandwich, pizza and pasta with thyme, bread sticks with thyme and homemade/catering recipes with thyme significantly differed between areas of residence ($p < 0.05$) with a higher consumption among participants living in rural than urban areas (Table 7).

The lower consumption of several traditional thyme products in urban areas can be due to the wider availability of food channels that offer a variety of food choices over the classic ones (Kosaka et al., 2018). Similar results were reported by a report released by the Food and Agriculture Organization (2007) in Lebanon, which found that participants living in urban areas replaced traditional dishes by a westernized diet consisting of fast foods and ready to eat meals.

In Iran, a semi-quantitative FFQ showed that urban women had significantly higher score for western pattern than rural areas (Rezazadeh et al., 2017). In Morocco, a high consumption of spices, condiments and herbal teas was observed among participants living in rural areas due to its traditional value and meaning.

3.7 Socio-economic status (educational levels and household incomes)

Mean consumption values among consumers with different educational levels and monthly household incomes are shown in Tables 8 and 9.

Consumption of thyme pie, cheese and thyme pie, fresh thyme salad, thyme regular mix sandwich, sesame thick bread with thyme, and thyme croissant significantly differed between different educational levels ($p < 0.05$) with the highest consumption

among participants of elementary level (104.8 g/day, 89.4 g/day, 89.9 g/day, 22.4 g/day, 19.3 g/day, 12.9 g/day, respectively). The lowest consumption was among postgraduate participants for thyme pie (54.8 g/day), cheese and thyme pie (28.6 g/day), thyme croissant (6.5 g/day) and among participants with technical background for fresh thyme salad and sesame thick bread with thyme (10.7 g/day). As for homemade or catering recipes with thyme, the highest consumption was among participants of postgraduate level (81.3 g/day) and the lowest among participants with elementary level (50.7 g/day) (Table 8).

Consumption of thyme pie, cheese and thyme pie, fresh thyme salad, thyme mix with nuts and seeds sandwich, sesame bread sticks with thyme, thyme croissant, tea thyme significantly differed between participants of different household incomes ($p < 0.05$) with a higher consumption among participants that earned < 1000\$ per month (90.1 g/day, 43.4 g/day, 53.5 g/day, 14.4 g/day, 9.3 g/day, 7.9 g/day, 13.4 g/day) as compared to those with higher incomes (Table 10). As for crackers with thyme, participants who earned more than 1000\$ per month consumed higher mean intakes (1.2 g/day).

Table 9 Mean consumption of thyme products by consumers with different household incomes (\$) (n = 1523).

Participants with low socio-economic status had higher mean intake for several thyme products than the ones with higher status because thyme is considered a traditional food item, available at affordable/cheap prices and has a long shelf life when it is in its dry form (United Nations Development Programme, 2018). In addition, those participants were less selective for the healthy version of some thyme products and consumed more ready-to-eat or junk items (such as pies, croissant, and thick bread). Similar results were reported by Naja et al. (2013) in Lebanon, who found that eating habits are related to the socioeconomic status of individuals since their

Table 8. Mean consumption (g/day) of thyme products by consumers with different educational levels (n = 1523).

Thyme products	Elementary school	Technical/high school	Bachelor	Postgraduate	p-value
	Mean ¹ ± SD ²	Mean ± SD	Mean ± SD	Mean ± SD	
TP	104.8 ± 134.0 ^b	80.4 ± 131.8 ^c	63.6 ± 95.5 ^a	54.8 ± 66.6 ^a	< 0.001*
CTP	89.4 ± 120.2 ^b	54.6 ± 62.6 ^{a,b}	52.8 ± 89.8 ^a	28.6 ± 36.5 ^c	< 0.001*
FTS	89.9 ± 128.0 ^c	60.6 ± 101.0 ^{a,b}	62.5 ± 120.2 ^a	73.1 ± 103.6 ^{a,b}	0.001*
TRS	22.4 ± 30.9 ^c	15.8 ± 22.4 ^{a,b}	14.8 ± 21.5 ^a	19.3 ± 26.4 ^{a,b,c}	0.009*
TNS	16.7 ± 22.5	9.8 ± 12.6	10.7 ± 19.4	9.9 ± 17.3	0.131
PP	30.9 ± 45.4	21.3 ± 23.9	29.8 ± 40.8	25.8 ± 35.8	0.108
BS	3.4 ± 6.5	5.1 ± 8.8	4.7 ± 8.3	7.6 ± 22.1	0.672
SB	19.3 ± 37.6 ^c	10.7 ± 12.3 ^{a,b}	13.8 ± 26.1 ^{b,c}	14.2 ± 42.7 ^a	0.008*
CT	2.4 ± 3.6	4.0 ± 5.6	3.7 ± 5.6	3.8 ± 5.1	0.143
TB	7.3 ± 16.0	4.2 ± 5.9	6.8 ± 14.5	8.9 ± 24.8	0.464
TC	12.9 ± 21.2 ^c	9.2 ± 25.8 ^{a,b}	9.9 ± 16.2 ^{b,c}	6.5 ± 9.9 ^a	0.005*
TCY	25.0 ± 42.1	18.4 ± 33.5	22.7 ± 61.8	16.3 ± 24.0	0.443
HMC	50.7 ± 86.2 ^{b,c}	51.2 ± 131.0 ^a	63.4 ± 126.9 ^{a,b}	81.3 ± 128.5 ^c	0.001*
TT	47.6 ± 86.0	46.3 ± 71.2	53.1 ± 77.4	74.3 ± 87.9	0.378

*p < 0.05 is considered significant; ¹Mean consumption values are expressed in grams per day; ²SD: Standard deviation. Columns with superscripts **without** a common symbol differ, p < 0.05. TP: Thyme pie, CTP: Cheese and thyme pie, FTS: Fresh Thyme salad, TRS: thyme regular mix sandwich, TNS: Thyme mix with nuts and seeds sandwich, PP: Pizza/Pasta with thyme sauces, BS: Bread sticks with thyme, SB: Sesame thick bread with thyme, CT: Crackers with thyme, TB: Toast/Bread with thyme, TC: Thyme croissant, TCY: Traditional strained yogurt balls with thyme, HMC: Homemade or catering recipes with thyme, TT: Tea thyme.

food choices are based on financial constraints and obstacles. In Europe, a study done by Biesbroek et al. (2018) showed that people with low socioeconomic status had a high mean score to consume a traditional diet, while participants with high socioeconomic status tend to have high mean scores for prudent diet (includes fish, nuts, fruits, vegetables, low fat dairies). In the US, a study done by Kell et al. (2015) showed that people with low socioeconomic status had limited food item choices due to purchasing difficulties (Kell et al., 2015).

3.8 Children consumption

Interviewed parents provided information about thyme products consumption of 143 children (less than 18 years old) with an average age of 8 years old and average weight of 33 kg (Table 10).

Thyme pie was the most consumed (80.4%, n = 115) and tea thyme was the least consumed product (8.4%, n = 12). Cheese and thyme pie had the highest mean consumption value of 85.2 g/day with thyme contribution of 4.8g/day, followed by thyme pie (77.6 g/day) that had the highest thyme contribution of 11.1 g/day. Whereas crackers with thyme represented the lowest mean consumption (2.8 g/day), as well as the lowest thyme contribution (0.2 g/day). Our results showed that children had similar trend in consumption as their parents with higher amount of cheese and thyme pie intake. Similarly, local cheese was the most consumed food item among children and adolescents in South America (Saravia et al., 2018). In addition, Lebanese consumers refer to thyme products as memory enhancing and they are embedded in our culture that school students consume thyme in order to perform better at school.

Several thyme products are convenient meals for schools (shelf-stable), afternoon snacks or even as a diner. Children choices are affected by their parents so it could be important

Table 9. Mean consumption of thyme products by consumers with different household incomes (\$) (n = 1523).

Thyme products	< 1000\$ ¹	≥ 1000\$	p value
	Mean ² ± SD ³	Mean ± SD	
TP	90.1 ± 149.9	53.7 ± 85.7	< 0.001*
CTP	43.4 ± 92.9	21.2 ± 53.5	< 0.001*
FTS	53.5 ± 120.2	35.1 ± 84.5	0.009*
TRS	14.4 ± 24.3	10.2 ± 20.2	0.004*
TNS	4.1 ± 11.7	3.2 ± 11.2	0.06
PP	14.1 ± 30.1	14.5 ± 30.5	0.8
BS	2.0 ± 6.0	2.1 ± 7.9	0.731
SB	9.3 ± 26.4	5.8 ± 18.9	0.023*
CT	0.8 ± 2.8	1.2 ± 4.0	0.011*
TB	1.4 ± 6.8	1.5 ± 8.1	0.693
TC	7.9 ± 24.4	3.8 ± 9.3	0.003*
TCY	10.4 ± 25.7	9.0 ± 35.4	0.472
HMC	16.7 ± 50.2	18.9 ± 78.1	0.238
TT	13.4 ± 47.3	7.7 ± 35.0	0.040*

*p < 0.05 is considered significant; ¹Each 1\$ is equivalent to 1500 LBP; ²Mean consumption values are expressed in grams per day; ³SD: Standard deviation. Columns with superscripts **without** a common symbol differ, p < 0.05. TP: Thyme pie, CTP: Cheese and thyme pie, FTS: Fresh Thyme salad, TRS: thyme regular mix sandwich, TNS: Thyme mix with nuts and seeds sandwich, PP: Pizza/Pasta with thyme sauces, BS: Bread sticks with thyme, SB: Sesame thick bread with thyme, CT: Crackers with thyme, TB: Toast/Bread with thyme, TC: Thyme croissant, TCY: Traditional strained yogurt balls with thyme, HMC: Homemade or catering recipes with thyme, TT: Tea thyme.

that parents favor a healthy nutritional education for their children (Isacco et al., 2010). Moreover, In New Zealand, a cross-sectional survey showed that children were influenced by the diet of their parents especially those aged between 9 and 12 years since they consumed most of their meals at home (Davison et al., 2017). In Europe, children's dietary patterns

Table 10. Characteristics of children participants, % of consumers and mean consumption (g/day) of thyme products (n = 143).

	Minimum	Maximum	Mean ¹ ± SD ²
Age	1.5	17	8.5 ± 5.0
Weight (Kg)	11	60	32.6 ± 14.5
Consumption (g/day)			
Thyme Products	% consumers (n)	Mean ± SD	Thyme contribution per food item (g/day)
TP	80.4 (115)	77.6 ± 92.3	11.1
CTP	31.5 (45)	85.2 ± 132.4	4.8
FTS	32.9 (47)	60.0 ± 80.4	2.1
TRS	62.2 (89)	18.1 ± 18.9	5.6
TNS	21.0 (30)	15.1 ± 13.3	5.2
PP	46.9 (67)	35.6 ± 60.0	0.4
BS	43.4 (62)	3.4 ± 6.7	0.4
SB	48.3 (69)	19.1 ± 33.5	1.3
CT	27.3 (39)	2.8 ± 6.4	0.2
TB	16.1 (23)	5.6 ± 6.0	0.2
TC	39.2 (56)	9.9 ± 20.3	0.9
TCY	31.5 (45)	24.0 ± 47.4	0.3
			1.8
HMC	14.7 (21)	64.7 ± 81.3	1.1
TT	8.4 (12)	43.4 ± 70.4	0.4

¹Mean consumption values are expressed in grams per day; ²SD: Standard deviation. TP: Thyme pie, CTP: Cheese and thyme pie, FTS: Fresh Thyme salad, TRS: Thyme regular mix sandwich, TNS: Thyme mix with nuts and seeds sandwich, PP: Pizza/Pasta with thyme sauces, BS: Bread sticks with thyme, SB: Sesame thick bread with thyme, CT: Crackers with thyme, TB: Toast/Bread with thyme, TC: Thyme croissant, TCY: Traditional strained yogurt balls with thyme, HMC: Homemade or catering recipes with thyme, TT: Tea thyme.

were in alliance with their mothers unrestrained by the meals prepared by her (Hebestreit et al., 2017). Moreover, mothers with high educational level can positively affect a healthy dietary pattern for their children, while children of mothers with low educational level tend to consume high sugary and fat snacks (Smithers et al., 2012). Despite the relatively lower amount of data collected about children, the observed trend is worth further investigation and analysis in future studies.

4 Conclusion

Thyme is a famous worldwide commodity added to several dishes as main ingredient or as flavor enhancer. This study showed that almost all the participants in Lebanon consumed thyme products with the highest mean intake for thyme pie and the least mean intake for crackers with thyme. Also, this study permitted to assess the variation in consumption patterns of thyme products between different socio-demographic, economic factors, age and gender. The use of FFQ can be a useful approach for estimating thyme products intake, since it is based on assessing both the quantity and frequency of thyme products consumption. This approach is needed for investigating dietary intake of thyme products and health outcomes relationships, such as estimating the risk assessment of chemicals and food contaminants that could be consumed through thyme products. For future studies, the effects of COVID-19 pandemic and the current economic crisis in Lebanon on the consumption patterns is worth investigating. In addition, it would be interesting to compare consumption patterns in different countries and use dietary records and recalls as reference methods to validate this questionnaire.

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