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Demographic and lifestyle factors associated with adherence to the Mediterranean diet in relation to overweight/obesity among Israeli adolescents: findings from the Mabat Israeli national youth health and nutrition survey

Wen Peng[1,2], Rebecca Goldsmith[3] and Elliot M Berry[4,*]

[1]Braun School of Public Health, Hebrew University – Hadassah Medical School, Jerusalem, Israel: [2]Endocrinology Department, Affiliated People's Hospital of Jiangsu University, Zhenjiang, People's Republic of China: [3]Nutrition Department, Public Health Services, Ministry of Health, Jerusalem, Israel: [4]Department of Human Nutrition and Metabolism, Braun School of Public Health, Hebrew University – Hadassah Medical School, 9112102 Jerusalem, Israel

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Abstract

Objective: To investigate demographic and lifestyle factors associated with adherence to the Mediterranean diet (MD) in Israeli adolescents.

Design: Cross-sectional.

Setting: School-based.

Subjects: Schoolchildren (*n* 5268) aged 11–19 years answered self-administered questionnaires on food consumption, eating habits and lifestyle; a subset (*n* 578) also completed 24 h food recalls.

Results: Using a modified KIDMED index, 25·5 % of the students had poor, 55·2 % had average and 19·3 % had good MD adherence. Jewish middle-school children had the highest proportion (28·2 %) of poor MD adherence. Olive oil usage, derived from 24 h food recalls, was 18·1 % in Jewish families *v.* 71·1 % in Arab homes. In Jewish boys, the odds (OR; 95 % CI) of having poor MD adherence was higher in those who watched television/videos/listened to music for ≥2 h/d (1·25; 0·98, 1·58) and those who sometimes/don't read food labels (1·69; 1·31, 2·18). In Jewish girls, the odds for having poor MD adherence was significantly higher in those whose mother's schooling was <12 years (2·06; 1·41, 3·00) and those who sometimes/don't read food labels (1·35; 1·08, 1·69). In Arab boys, watching television/videos/listening to music for ≥2 h/d was significantly associated with poor MD adherence (1·89; 1·16, 3·07). In Arab girls, no aerobic activity or ball games weekly was associated with poor MD adherence (1·38; 0·91, 2·09).

Conclusions: Israeli adolescents had overall a high rate of poor MD adherence. Jewish middle-school children were at the highest risk. Interventions aimed at increasing physical activity, reducing sedentary time, improving mother's education and promoting reading of food labels are recommended.

Keywords
Mediterranean diet
KIDMED
Israeli adolescents
Overweight/obesity
MABAT

Childhood and adolescent overweight and obesity are major public health challenges in both their magnitude and consequences. In the USA, data in 2012 showed that more than one-third of children and adolescents were overweight and 18 % were obese[1]. In Israeli adolescents, the prevalence was slightly lower, with 13–15 % being overweight and 4–9 % being obese depending on gender and ethnicity[2]. Overweight and obesity in childhood and adolescence have significant negative impacts on health, which last long into adulthood. Studies have shown that adolescent obesity is associated with increased risk of end-stage renal failure[3], CVD[4,5] and some types of cancer[5,6]. A recent Israeli follow-up study has shown that overweight and obesity in adolescence are strongly associated with increased cardiovascular mortality in adulthood[7].

Lifestyle including dietary change is one of the main causes of overweight and obesity. Among various dietary patterns, the Mediterranean diet (MD) has been accepted as one of the healthiest dietary models in the world. The MD has shown its health benefits in adults by reducing CVD, type 2 diabetes, certain cancers and some neuro-degenerative diseases[8,9]. Meanwhile, the MD is also a common heritage of the culture and tradition in countries

*Corresponding author: Email elliotb@ekmd.huji.ac.il

around the Mediterranean basin. In 2013, the MD was inscribed as an Intangible Cultural Heritage of Humanity by the United Nations Educational, Scientific and Cultural Organization[10]. Nevertheless, against the background of global Westernization and urbanization, a trend of erosion in adherence to the MD is occurring, especially among children and adolescents[11].

On the other hand, the characteristics of eating behaviour in adolescents also affect their dietary patterns. Adolescence is a critical time for the development of eating habits, which are a complex set of behaviours influenced by physiological, psychological, social and genetic factors[12]. Disordered eating, as one of the most common chronic conditions in adolescents[13], influences adolescents' eating behaviours, thus affecting their diet. Data from an Israeli national survey showed that some 30 % of Israeli girls met the criteria of disordered eating using a modified SCOFF questionnaire[14].

Given the high prevalence of overweight/obesity and disordered eating in children and adolescents, as well as the healthy and cultural implications of the MD, it is important to investigate the dietary patterns in adolescents. This is to clarify the dietary features in this key population, identify the high-risk groups and suggest possible interventions for improvement. Since the Mediterranean Diet Quality Index (KIDMED), a tool to evaluate adherence to the MD in children and adolescents, was developed in 2004, it has been widely used in many Mediterranean basin countries, including Spain[11,15,16], Italy[17,18], Greece[19–22], Turkey[23] and Cyprus[24]. However, adherence to the MD among Israeli adolescents has not yet been described.

To rectify this, the current paper describes the factors associated with adherence to the MD in Israeli adolescents based on an Israeli national youth health and nutrition survey (Mabat Youth Survey, 2003–2004). The data also allow study of possible associations between MD adherence and body weight.

Methods

Population and sampling

The study population, study design and sampling have been described in detail elsewhere[2]. Briefly, 6274 schoolchildren in grades 7 to 12, aged 11–19 years, were enrolled into a cross-sectional, nationally representative, school-based study: the Mabat Youth Survey. Self-administered questionnaires including FFQ, eating habits and lifestyle questionnaires were completed by 6274 adolescents, among whom 5268 finished the FFQ. The compliance rate for completion of the FFQ in Jewish and Arab participants was 87·7 and 76·1 %, respectively. Adolescents who were in middle school, who were from low socio-economic status (SES) backgrounds or who did not perform aerobic activity or ball games weekly, had a higher rate of not finishing the FFQ. Five hundred and seventy-eight of the 5268 adolescents who completed an FFQ were also interviewed using the 24 h food recall method. Because the FFQ contained the majority of information on the dietary patterns, only the 5268 adolescents who completed the FFQ were included in the present KIDMED study. The original questionnaire was developed in Hebrew and then translated into Arabic. Data were collected in both Jewish and Arab, religious and non-religious schools. Schools from the Haredi (ultra orthodox) sector or boarding schools were not included.

Data resources

Adherence to the MD in adolescents was assessed using a modified KIDMED index[11]. The KIDMED index components were extracted from the self-administered FFQ or eating habits questionnaires. Other data related to the KIDMED index, which were not asked about specifically in the FFQ or eating habits questionnaires, were derived from the 24 h food recalls. Ethnicity (Jews or Arabs) was defined by the location of the school and the language of questionnaires used in the school. SES was taken from the Ministry of Education's classification of the welfare level of schools based primarily on the socio-economic level of the location. Other demographic and lifestyle factors were determined from answers to the self-administered questionnaires. Anthropometric indicators were measured by trained personnel.

Composite variables

KIDMED score

The modified KIDMED index used in the present study was composed of fourteen items adapted from the original sixteen-item KIDMED index. Items on olive oil usage at home and nut consumption (Table 1, items 15 and 16) were not included, because neither was specifically asked about in the FFQ of the Mabat Youth Survey. Olive oil usage at home was derived from the 578 adolescents who finished an additional 24 h food recall, but nut consumption was not available. Calculation of the modified fourteen-item KIDMED score was applied as shown in Table 1. In the original KIDMED index, three items (items 9, 11 and 12 in Table 1) specifically referred to consumption of designated food categories at breakfast. However, since the FFQ contained no information on meal times, daily consumption of designated food categories was defined as positive in the modified KIDMED index. From the 24 h food recalls, it was found that dairy products (item 11) and commercially baked goods or pastries (item 12) were not typically consumed at breakfast by Israeli schoolchildren. Cereals or grains (item 9) were a major component of breakfast, but were also eaten throughout the day.

The original KIDMED score was classified into three categories: (i) ≥8, good; (ii) 4–7, average; and (iii) ≤3, poor. Based on the fraction of the upper limit to the score range, and the fact that two +1 points were lost in the

Table 1 Definition of the modified KIDMED index used in the Mabat Youth Survey (2003–2004)

No.	Score	Item	Comment
1	+1	Fruit or fruit juice daily	From FFQ
2	+1	Second fruit daily	From FFQ
3	+1	Fresh or cooked vegetables daily	From FFQ. Potatoes, pickles or vegetable soup were not included
4	+1	Fresh or cooked vegetables >1 time/d	From FFQ. Potatoes, pickles or vegetable soup were not included
5	+1	Regular fish consumption (at least 2–3 times/week)	From FFQ
6	−1	Fast-food restaurant >1 time/week	From question in eating habits questionnaire on times of monthly eating fast food (falafel, hamburger, pizza). Answer with >4 times/month was defined as positive
7	+1	Pulses >1 time/week	From FFQ
8	+1	Pasta or rice almost daily (≥5 times/week)	From FFQ
9	+1	Cereals or grains (bread, etc.) for breakfast	From FFQ. Daily consumption was defined as positive, without specifically referring to breakfast
10	−1	No breakfast	From questionnaire on eating habits. Answer with 'didn't eat breakfast yesterday' was defined as positive
11	+1	A dairy product for breakfast (yoghurt, milk, etc.)	From FFQ. Daily consumption was defined as positive, without specifically referring to breakfast
12	−1	Commercially baked goods or pastries for breakfast	From FFQ. Daily consumption was defined as positive, without specifically referring to breakfast
13	+1	Two yoghurts and/or some cheese (40 g) daily	From FFQ. One yoghurt and 20 g cheese were also defined as positive
14	−1	Sweets and candy several times daily	From FFQ. Several was defined as ≥3
15	+1	Olive oil usage at home	No information in FFQ. Extracted from 24 h food recalls. Not included in the modified KIDMED score
16	+1	Regular nuts consumption (at least 2–3 times/week)	No specific information in Mabat Youth Survey. Not included in the modified KIDMED score

KIDMED, Mediterranean Diet Quality Index.

fourteen-item KIDMED index, we defined cut-off points for the modified fourteen-item KIDMED index as follows: (i) ≥7, good; (ii) 3–6, average; and (iii) ≤2, poor.

BMI

BMI was categorized based on the age- and sex-specific cut-off values of the Centers for Disease Control and Prevention/National Center for Health Statistics 2000 growth charts. Four categories were defined as underweight (<5th percentile), normal weight (5th to 85th percentile), overweight (85th to 95th percentile) and obese (>95th percentile), which was previously described elsewhere[2].

Disordered eating

Disordered eating was assessed using an adapted four-item SCOFF questionnaire compared with the original five-item SCOFF questionnaire, which was used to screen for eating disorders[25]. The question on weight loss was modified from original 6·35 kg (1 stone) in three months to 3 kg in our questionnaire[14], in order to adapt to the general lower body weight of adolescents as compared with adults. The cut-off point for the four-item screening test was the same as the original one; that is, two or more affirmative answers in the questionnaire was categorized as disordered eating (positive)[14].

Statistical analyses

All statistical analyses were performed using the statistical software package IBM SPSS Statistics Version 20.0. The χ^2 test was used to compare the distribution of KIDMED scores. Student's t test or one-way ANOVA was used to compare the mean of KIDMED scores. When one-way ANOVA showed significant difference among groups, the Bonferroni correction was used to account for the inflation in Type I error in the multiple comparisons. Adjusted odds ratios were calculated by binary logistic regression. A P value of <0·05 was considered as significant.

Results

Among the 5268 schoolchildren between 11 and 19 years old, 43·5 % (n 2290) were boys and 56·5 % (n 2978) were girls; 50·6 % (n 2665) were in middle school and 49·4 % (n 2603) were in high school; 74·7 % (n 3936) were Jews and 25·3 % (n 1332) were Arabs.

Among the Jewish children, 20·3 % (n 322) of the boys and 15·7 % (n 306) of the girls were overweight or obese; among the Arab children, 23·1 % (n 122) of the boys and 21·7 % (n 159) of the girls were overweight or obese.

KIDMED score by demographic and lifestyle factors

Table 2 shows the distribution of the modified fourteen-item KIDMED scores by school level, gender and ethnicity. Items 1–4 showed that 20–30 % more Arab adolescents than Jewish adolescents consumed fruits and vegetables daily. By contrast, Arabs ate fewer dairy products (items 11 and 13) and more sweets and candies (item 14) than Jews. Regarding eating habits, Arabs consumed more fast foods (as shown in item 6), with the highest rate (73·5 %) in Arab boys in high school, which was more than 30 % higher than that in Jewish boys of the same age group (41·7 %). Girls generally had a 15–20 % higher rate of skipping breakfast than boys, with Jewish girls in high school skipping breakfast the

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Table 2 Distribution of the modified fourteen-item KIDMED index in Israeli adolescents aged 11–19 years by school level, gender and ethnicity; Mabat Youth Survey (2003–2004)

		Middle school (*n* 2665)						High school (*n* 2603)					
		Boys		Girls		Total		Boys		Girls		Total	
		n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
1	Fruit or fruit juice daily												
	Jews	453	47·0	566	51·1	1019	49·2	395	51·5	574	52·2	969	51·9
	Arabs	208	73·2	256	82·3	464	78·0	195	70·7	326	70·7	521	70·7
2	Second fruit daily												
	Jews	346	35·9	417	37·7	763	36·9	298	38·9	438	39·9	736	39·4
	Arabs	186	65·5	218	70·1	404	67·9	165	59·8	271	58·8	436	59·2
3	Fresh or cooked vegetables daily												
	Jews	419	43·5	579	52·3	998	48·2	370	48·2	626	57·0	996	53·4
	Arabs	207	72·9	232	74·6	439	73·8	217	78·6	335	72·7	552	74·9
4	Fresh or cooked vegetables >1 time/d												
	Jews	340	35·3	467	42·2	807	39·0	308	40·2	540	49·1	848	45·4
	Arabs	184	64·8	205	65·9	389	65·4	190	68·8	299	64·9	489	66·4
5	Regular fish consumption (at least 2–3 times/week)												
	Jews	378	39·3	445	40·2	823	39·8	350	45·6	417	37·9	767	41·1
	Arabs	121	42·6	121	38·9	242	40·7	89	32·2	133	28·9	222	30·1
6	Fast-food restaurant >1 time/week												
	Jews	351	37·7	289	27·0	640	32·0	312	41·7	299	28·0	611	33·6
	Arabs	143	55·9	130	43·6	273	49·3	194	73·5	212	47·1	406	56·9
7	Pulses >1 time/week												
	Jews	809	84·0	939	84·8	1748	84·4	682	88·9	947	86·2	1629	87·3
	Arabs	269	94··7	284	91·3	553	92·9	261	94·6	409	88·7	670	90·9
8	Pasta or rice almost daily (≥5 times/week)												
	Jews	486	50·5	544	49·1	1030	49·8	391	51·0	506	46·0	897	48·1
	Arabs	126	44·4	147	47·3	273	45·9	103	37·3	161	34·9	264	35·8
9	Cereal or cereal product daily												
	Jews	686	71·2	737	66·6	1423	68·7	573	74·7	774	70·4	1347	72·2
	Arabs	233	82·0	256	82·3	489	82·2	247	89·5	356	77·2	603	81·8
10	No breakfast												
	Jews	226	24·0	443	40·8	669	33·0	195	25·8	480	44·5	675	36·8
	Arabs	31	11·0	90	29·0	121	20·5	67	25·1	185	41·0	252	35·1
11	Dairy product daily												
	Jews	707	73·4	754	68·1	1461	70·6	545	71·7	686	62·4	1231	66·0
	Arabs	173	60·9	161	51·8	334	56·1	155	56·2	222	48·2	377	51·2
12	Commercially baked goods or pastries daily												
	Jews	356	37·0	404	36·5	760	36·7	286	37·3	403	36·7	689	36·9
	Arabs	116	40·8	165	53·1	281	47··2	118	42·8	170	36·9	288	39·1
13	Two yoghurts and/or 40 g cheese daily												
	Jews	409	42·5	412	37·2	821	39·7	332	43·3	381	34·7	713	38·2
	Arabs	83	29·2	72	23·2	155	26·1	74	26·8	76	16·5	150	20·4
14	Sweets and candy several times daily												
	Jews	94	9·8	143	12·9	237	11·4	81	10·6	113	10··3	194	10·4
	Arabs	73	25·7	93	29·9	166	27·9	73	26·4	119	25·8	192	26·1

KIDMED, Mediterranean Diet Quality Index.
Among 5268 participants, 181 and 100 responses were missing on items 6 and 10, respectively.

most (44·5 %; item 10). Besides the fourteen items in Table 1, olive oil usage at home was summarized from 578 adolescents from their 24 h food recalls, which showed that 18·1 % (80/443) of Jewish and 71·1 % (96/135) of Arab families used olive oil at home.

Table 3 shows the categorization of the fourteen-item KIDMED scores. Of the total population, 25·5 % (*n* 1276) had poor, 55·2 % (*n* 2761) had average and 19·3 % (*n* 968) had good KIDMED scores. Further analysis by school level, gender and ethnicity showed that Jewish middle-school children had the highest proportion (28·0 % in boys and 28·4 % in girls) with a poor KIDMED score, while Arab middle-school children had the highest proportion (boys 26·9 % and girls 23·2 %) with a good KIDMED score.

Table 4 presents the comparison of KIDMED scores stratified by demographic features and selected lifestyle factors. In Jews, high-school children had higher KIDMED scores than middle-school children, and the difference was close to significant in Jewish boys ($P = 0·053$). In contrast, in Arabs, middle-school children had significantly higher KIDMED scores than high-school children (Arab boys $P = 0·023$; Arab girls $P < 0·001$). No significant difference was observed in KIDMED scores between groups according to SES. Mother's school education (≥12 years) was positively associated with higher KIDMED scores in all the groups, with a significant difference in Jewish boys ($P = 0·012$) and Jewish girls ($P = 0·001$). Both Jewish boys and Arab boys who smoked had lower KIDMED scores

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Table 3 Categorization of the modified fourteen-item KIDMED scores in Israeli adolescents aged 11–19 years by school level, gender and ethnicity; Mabat Youth Survey (2003–2004)

	Middle school (*n* 2519, missing = 146)							High school (*n* 2486, missing = 117)						
	Boys		Girls		Total			Boys		Girls		Total		
KIDMED category	*n*	%	*n*	%	*n*	%	*P* (boys *v.* girls)	*n*	%	*n*	%	*n*	%	*P* (boys *v.* girls)
Poor (score ≤2)														
Jews	256	28·0	299	28·4	555	28·2	0·838	174	23·5	291	27·7	465	26·0	0·049
Arabs	44	17·4	54	18·1	98	17·8	0·823	54	21·2	104	23·6	158	22·7	0·465
P (Jews *v.* Arabs)	0·001**		<0·001**		<0·001**			0·438		0·101		0·091		
Average (score = 3–6)														
Jews	484	52·9	551	52·3	1035	52·6	0·801	422	57·1	562	53·5	984	55·0	0·128
Arabs	141	55·7	175	58·7	316	57·4	0·479	151	59·2	275	62·4	426	61·2	0·412
P (Jews *v.* Arabs)	0·424		0·051		0·048*			0·556		0·002**		0·005**		
Good (score ≥7)														
Jews	175	19·1	203	19·3	378	19·2	0·932	143	19·4	198	18·8	341	19·1	0·786
Arabs	68	26·9	69	23·2	137	24·9	0·314	50	19·6	62	14·1	112	16·1	0·055
P (Jews *v.* Arabs)	0·007**		0·141		0·004**			0·929		0·026*		0·086		

KIDMED, Mediterranean Diet Quality Index.
*$P<0·05$. **$P<0·01$.

Table 4 Modified fourteen-item KIDMED scores in Israeli adolescents aged 11–19 years by demographic features and lifestyle factors; Mabat Youth Survey (2003–2004)

	Jewish boys				Jewish girls				Arab boys				Arab girls			
	n	Mean	SD	*P*	*n*	Mean	SD	*P*	*n*	Mean	SD	*P*	*n*	Mean	SD	*P*
Grade																
Middle school	915	4·14	2·39	0·053	1053	4·14	2·49	0·832	253	4·92	2·41	0·023*	298	4·74	2·28	<0·001**
High school	739	4·36	2·32		1051	4·16	2·49		255	4·45	2·19		441	4·11	2·23	
Socio-economic status																
Low	704	4·19	2·36	0·552	1042	4·22	2·49	0·169	266	4·77	2·27	0·309	374	4·34	2·25	0·721
High	950	4·27	2·37		1062	4·07	2·49		236	4·56	2·38		355	4·40	2·31	
Mother's education																
<12 years of schooling	79	3·67	2·10	0·012*	135	3·54	2·42	0·001**	146	4·45	2·20	0·287	235	4·13	2·16	0·139
≥12 years of schooling	1198	4·37	2·40		1496	4·31	2·48		278	4·70	2·38		411	4·40	2·31	
Night sleeping time/d																
<6 h	79	4·09	2·40	0·489	90	3·97	2·69	0·450	14	4·50	1··95	0·731	26	4·00	2·58	0·427
≥6 h	1482	4·28	2·37		1952	4·17	2·48		464	4·72	2·32		681	4·36	2·27	
Smoking (cigarette or hookah)																
Yes	361	4·12	2·33	0·198	313	4·11	2·60	0·816	89	4·20	2·35	0·027*	10	3·40	2·17	0·185
No	1197	4·30	2·37		1672	4·14	2·47		401	4·81	2·31		664	4·35	2·26	
Aerobic activity or ball games weekly																
Yes	1348	4·31	2·38	0·009**	1129	4·24	2·51	0·080	440	4·75	2·28	0·094	571	4·42	2·26	0·177
No	306	3·92	2·27		975	4·05	2·47		68	4·25	2·51		168	4·15	2·31	
Watch television/videos or listen to music																
≥2 h/d	684	4·07	2·30	0·010*	1114	4·00	2·48	0·003**	219	4·30	2·34	0·001**	445	4·14	2·19	0·001**
<2 h/d	937	4·37	2·40		958	4·32	2·48		284	5·00	2·23		284	4·70	2·36	
Dieting																
Yes	243	4·22	2·32	0·886	681	4·27	2·63	0·105	70	5·21	2·32	0·039*	196	4·27	2·18	0·506
No	1396	4·25	2·37		1407	4·08	2·42		436	4·60	2·31		540	4·40	2·30	
Read food labels																
Always/often	588	4·61	2·32	<0·001**	1000	4·34	2·51	<0·001**	244	4·98	2·30	0·003**	460	4·43	2·22	0·400
Sometimes/no	1019	4·05	2·37		1061	3·94	2·46		251	4·37	2·32		266	4·29	2·34	
Body weight																
Underweight	90	3·61	2·29	0·021*	74	3·81	2·16	0·061	21	4·43	2·80	0·821	21	5·14	2·03	0·360
Normal weight	1116	4·34	2·39		1488	4·16	2·46		349	4·71	2·26		525	4·33	2·32	
Overweight	201	4·09	2·27		231	4·12	2·56		63	4·52	2·38		118	4·19	2·19	
Obese	109	4·05	2·51		64	4·91	2·69		44	4·89	2·63		36	4·50	2·44	

KIDMED, Mediterranean Diet Quality Index.
*$P<0·05$, **$P<0·01$.

than those who did not, and the difference was statistically significant in Arab boys ($P=0·027$). In all the groups, students who performed aerobic activity or ball games weekly had higher KIDMED scores than their comparison group, with significance in Jewish boys ($P=0·009$). Watching television/videos or listening to music for ≥2 h/d

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was significantly associated with poorer KIDMED scores in all groups. Children who always/often read food labels consistently had better KIDMED scores than children who sometimes/don't read food labels, and the difference was significant in Jewish boys, Jewish girls and Arab boys. In Jewish boys, one-way ANOVA showed that body weight was associated with KIDMED score ($P=0{\cdot}021$); a further *post hoc* Bonferroni test revealed that the real difference existed between the underweight group and the normal weight group ($P=0{\cdot}032$).

Explanatory factors of KIDMED score

Table 5 shows the adjusted odds ratios for having poor KIDMED scores by gender, ethnicity and selected lifestyle factors.

In Jewish boys, being in high school was negatively associated with having a poor KIDMED score (OR = 0·72; 95 % CI 0·57, 0·92). Watching television/videos/listening to music for ≥2 h/d, sometimes/not reading food labels and being underweight were positively associated with having a poor KIDMED score, with statistical significance for sometimes/not reading food labels (OR = 1·69; 95 % CI 1·31, 2·18) and being underweight (OR = 1·88; 95 % CI 1·19, 2·98). Overweight and obesity were not explanatory factors for having a poor KIDMED score.

In Jewish girls, SES, mother's school education, sedentary lifestyle and reading food labels were associated with adherence to the MD. The odds of having a poor KIDMED score was significantly higher in groups who had higher SES (OR = 1·33; 95 % CI 1·06, 1·67), whose mother's years of education was <12 years (OR = 2·06; 95 % CI 1·41, 3·00) and who sometimes/don't read food labels (OR = 1·35; 95 % CI 1·08, 1·69).

In Arab boys, watching television/videos/listening to music for ≥2 h/d and sometimes/not reading food labels were associated with having a poor KIDMED score. The odds of having a poor KIDMED score if watching television/videos/listening to music for ≥2 h/d was 1·89 times higher than that of the comparison group in Arab boys.

In Arab girls, no aerobic activity or ball games weekly or sometimes/not reading food labels were associated with a poor KIDMED score, but without statistical significance.

A further analysis into reading food labels showed that the proportion always/often reading food labels was significantly higher in girls than in boys (52·4 *v.* 39·6 %, $P<0{\cdot}001$). A higher percentage of Arab children

Table 5 Adjusted odds ratios of having a poor KIDMED score (*v.* average/good) among Israeli adolescents aged 11–19 years by gender, ethnicity and lifestyle factors; Mabat Youth Survey (2003–2004)

	OR	95 % CI	*P*
Jewish boys (*n* 1459, missing = 271)			
School level			
High/middle school	0·72	0·57, 0·92	0·007**
Watch television/videos/listen to music daily			
≥2 h/ <2 h	1·25	0·98, 1·58	0·073
Read food labels			
Sometimes and no/always and often	1·69	1·31, 2·18	<0·001**
Body weight			
Underweight/normal weight	1·88	1·19, 2·98	0·007**
Overweight/normal weight	1·07	0·75, 1·52	0·709
Obese/normal weight	1·15	0·72, 1·84	0·555
Jewish girls (*n* 1588, missing = 618)			
Socio-economic status			
High/low	1·33	1·06, 1·67	0·014*
Mother's education in school			
<12 years/ ≥12 years	2·06	1·41, 3·00	<0·001**
Watch television/videos/listen to music daily			
≥2 h/ <2 h	1·20	0·95, 1·50	0·120
Read food labels			
Sometimes and no/always and often	1·35	1·08, 1·69	0·008**
Arab boys (*n* 412, missing = 148)			
Mother's education in school			
<12 years/ ≥12 year	0·67	0·39, 1·14	0·136
Watch television/videos/listen to music daily			
≥2 h/ <2h	1·89	1·16, 3·07	0·011*
Read food labels			
Sometimes and no/always and often	1·50	0·92, 2·45	0·107
Arab girls (*n* 726, missing = 46)			
School level			
High/middle school	1·30	0·89, 1·91	0·179
Aerobic activity or ball games weekly			
No/yes	1·38	0·91, 2·09	0·135
Read food labels			
Sometimes and no/always and often	1·24	0·86, 1·79	0·256

KIDMED, Mediterranean Diet Quality Index.
*$P<0{\cdot}05$, **$P<0{\cdot}01$.

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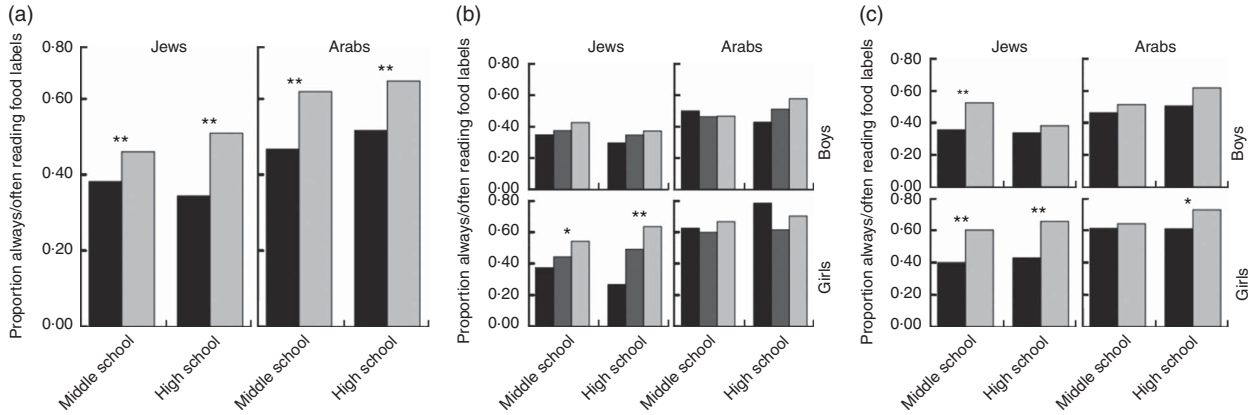

Fig. 1 The proportion of Israeli adolescents aged 11–19 years who always/often read food labels by gender, ethnicity, school level and selected factors; Mabat Youth Study (2003–2004). Always/often reading food labels was significantly associated with (a) gender (■, boys; □, girls), (b) body weight (■, underweight; ■, normal weight; □, overweight/obese) and (c) dieting (■, no dieting; □, dieting): $^{*}P<0{\cdot}05$, $^{**}P<0{\cdot}01$

always/often read food labels than Jewish children (57·5 *v.* 43·2 %, $P<0{\cdot}001$). When stratified by school level and ethnicity, the proportion of always/often reading food labels in girls was always significantly higher than that in boys (Fig. 1(a)).

When analysing the association between reading food labels and body weight, the proportion always/often reading food labels in the overweight/obesity group was almost always higher than that in the normal weight group, except in Arab boys in middle school (Fig. 1(b)). After stratification by gender, ethnicity and school level, the number of cases in the underweight category (<5th percentile BMI) in some Arab groups was as small as less than ten. Therefore, the rate of reading food labels in underweight group in Arab children might not be reliable.

Dieting was also shown to be associated with frequency of reading food labels. Generally, adolescents who were dieting were more likely to always/often read food labels. The difference in the rate of always/often reading food labels between those who were and were not dieting was greater in Jews than in Arabs (Fig. 1(c)).

KIDMED score and disordered eating

When comparing the fourteen-item KIDMED scores between disordered eating (+) and disordered eating (–) groups, no difference in KIDMED scores were observed between the two groups when stratified by gender and ethnicity (data not shown).

Discussion

The present paper is a first attempt to describe the adherence to the MD using a modified KIDMED index in Israeli adolescents based on a nationwide health and nutrition survey – the Mabat Youth Survey. It has described the dietary patterns in Israeli adolescents, identified the high-risk group in terms of poor quality of eating and eating habits, and provided the direction for intervention programmes.

KIDMED distribution

The compliance to the MD was not very satisfactory in Israeli adolescents when compared with other youth populations of comparable age around the Mediterranean basin region. The overall distribution of fourteen-item KIDMED scores in the present study was that 25·5 % of the total participants had poor, 55·2 % had average and 19·3 % had good adherence to the MD. In other populations, Spanish children and adolescents seemed to have the best adherence to the MD, with only 2–7 % having a poor and 30–50 % having a good KIDMED score, according to different studies[11,16,26]. Surveys in other countries, including Greece[19], Turkey[23] and the Balearic Islands[27], demonstrated that the percentage of poor adherence to the MD at comparable ages ranged from 15 to 27 %, while the proportion of good compliance to the MD was between 8 and 28 %. In spite of the difference in cut-off values of KIDMED categories due to two missing items in the present study, the high proportion of poor adherence to the MD in Israeli adolescents was still alarming. It should be noted that the adolescents who completed the FFQ and thus were included in the KIDMED study represented 87·7 and 76·1 % of the Jewish and Arab participants in the Mabat Youth Survey, respectively. Further analysis showed that the non-completers tended to be in middle school, with low SES and did not engage in physical activity regularly. Therefore, the true adherence to the MD in Israeli adolescents may be even less than the present data have shown. Geographically, Israel is in the Mediterranean basin; however, the diversity of the population in terms of ethnicity, religion, origin of immigration, family structure and more, may lead to a weaker tradition in compliance to the MD, which may explain the poor adherence to the MD in the present study.

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Further, looking at the KIDMED score distribution by school level, gender and ethnicity, Jewish middle-school children were identified as a high-risk group for low adherence to the MD, with an overall rate of having a poor KIDMED score of 28·2 % (similar in boys and girls, Table 3). This was mainly attributable to less fruit and vegetable consumption, and more skipping breakfast (Table 2). Therefore, intervention programmes aimed at reversing these trends should be developed to improve the dietary quality and eating habits of this high-risk group.

Factors associated with KIDMED score

School level was inconsistently associated with KIDMED score between Jews and Arabs. Arab high-school children had poorer adherence to the MD than Arab middle-school children in terms of both the proportion of having a poor KIDMED score (Table 3) and the mean of KIDMED scores (Table 4). The trend disappeared in Jewish girls, and even reversed in Jewish boys (Tables 3 and 4). In other studies, the association between compliance to the MD and age, which was represented by school level in our study, was not consistent in different populations. A negative association between age and KIDMED score was found in most studies, including among Greek[19,21,22], Spanish[16] and Balearic Islands[27] schoolchildren. In fewer studies, KIDMED score did not differ among age groups[20,24], although the age groups were not exactly the same as those in the present study. In addition to the effect of age, school education may also play a role in the trend of adherence to the MD by school level.

Mother's education was positively associated with better adherence to the MD in all groups of our study population (Table 4). In Jewish girls, the mother having less than 12 years of school education was the strongest explanatory factor for having a poor KIDMED score (Table 5). Similar findings were also observed in Spanish[11], Greek[19], Balearic Islands[27] and Turkish[23] adolescents, highlighting the influential impact of mothers' education on their children, which should also be a focus for intervention.

Physical activity and sedentary lifestyle, as expected, showed opposite associations with the KIDMED scores. Performing aerobic activity or ball games weekly, and watching television/videos or listening to music for <2 h/d were consistently associated with better adherence to the MD (Tables 4 and 5). Such associations between physical activity, sedentary lifestyle and the KIDMED score have also been suggested in other studies[22,28,29]. In a study on adolescents in Tuscany, with a sample size of 1127, the odds ratio for having a poor KIDMED score increased monotonically when frequency of physical activity decreased or time spent on sedentary activity increased, showing the consistency of the association[28].

Since SES was classified based on the location of schools, without assessment at the individual level, the analysis by SES might be not reliable. This might explain the finding that, in Jewish girls, high SES was associated with poor adherence to the MD.

Reading food labels and KIDMED score

Always/often reading food labels was positively associated with better adherence to the MD in all study groups after stratification by gender and ethnicity (Tables 4 and 5). However, previous studies showed that reading food labels did not always translate into healthy food choices directly[30]. One possible reason for our positive finding may be the facilitating role of nutrition knowledge in the association between reading food labels and better dietary quality. Evidence has shown that people who have better nutrition knowledge can utilize food label information better and make healthier food choices[30,31]. Another possible explanation is that the sub-populations who may be more conscious about their body weight, such as female students, heavier students and those who were dieting, may be more careful about their diets and therefore more likely to read food labels. In the present study, our data support the claim that these sub-populations do indeed read food labels more frequently (Fig. 1), but do not necessarily have higher KIDMED scores (Table 4). Because of the cross-sectional study design, the temporality of reading food labels and adherence to the MD was not known. Regardless of the pathway, for the positive association between reading food labels and better adherence to the MD, from the public health policy point of view, some facilitating factors should be considered to transform food label reading into healthy dietary choices and practices, such as providing key points of nutritional knowledge on the package, promoting reader-friendly food labels and advertising, etc.[30]. Also, psychological and social factors that affect eating behaviours in adolescence should also be considered.

The proportion of reading food labels among the Arab students was higher than that in the Jewish ones (Fig. 1(a)). This result was counter-intuitive, because Israeli law requires labelling in Hebrew only, which may have created some barriers in understanding food labels. A possible reason for the positive association was the differential selection bias between Jews and Arabs in the current KIDMED study. Among the national representative samples in the Mabat Youth Survey, the proportion of Jews and Arabs who completed the FFQ, thus being enrolled in the KIDMED study, was 87·7 and 76·1 %, respectively. The non-completers had a significantly higher percentage of being in middle school or from a low-SES background, who would be less likely to read food labels frequently. Another possible reason was a social desirability bias[32]. Since the questionnaires were self-administered, participants may tend to give the expected answers to various extents depending on demographic, psychological and other factors. Because of the possible selection bias (rate difference in completing the FFQ between Jewish and Arab students) and the

response bias (social desirability bias), the direct inter-ethnic comparisons might be not valid.

Overweight/obesity and KIDMED score

Overweight/obesity was not associated with adherence to the MD in the present study (Tables 4 and 5), which was consistent with studies in Greece[20,22]. In contrast, some studies have shown that overweight/obesity was associated with a higher KIDMED score[17,28], whereas another study found a negative association between obesity and the KIDMED score[15]. These contradictory results demonstrate the complexity of this question. One explanation is the mediating effect of parents' educational status: a study in Greece showed that adherence to the MD in adolescents was inversely associated with children's obesity status only in families where parents had a higher educational level[33] . On the other hand, these inconsistencies might reflect certain drawbacks of the KIDMED index, which focuses only on dietary quality and healthy eating behaviours without considering the quantities of food consumed, and is therefore limited in its ability to predict overweight/obesity-related health outcomes.

Study limitations

There are several limitations to the present research. The main one was that the Mabat Youth Survey in general, and the FFQ in particular, was not specifically developed for the purpose of calculating a KIDMED score. Therefore, there were some necessary compromises in translating the data generated from the Mabat Youth Survey questionnaires to the KIDMED score, which could affect the comparability of our results with other KIDMED studies. However, we think that using fourteen of the sixteen questions with appropriate scaling still gave meaningful results. Second, the rate of completing the FFQ and thus being included in the current KIDMED study among the participants in Mabat Youth Survey was significantly higher in Jews than in Arabs (87·7 *v.* 76·1 %). This differential selection bias may influence the inter-ethnic comparisons. Third, the Mabat Youth Survey questionnaires were self-administered, which may cause the respondents to over-report socially desirable responses (social desirability response bias). Fourth, the SCOFF questionnaire was validated extensively in females, particularly in females more than 18 years old, but the validity test in boys was limited. Lastly, the data presented here relate to the year of 2004. The new Mabat Youth Survey, carried out in 2015–2016, will provide a new data set. Then the methodology discussed herein can be used and will allow following of time trends, which it is hoped will show an improvement in adherence to the MD.

Conclusions

In general, Israeli adolescents had poor adherence to the MD, especially among Jewish middle-school students. Interventions aimed at increasing physical activity, reducing sedentary time, improving mother's education, promoting and facilitating reading of food labels are suggested, in order to improve nutritional status and promote the health of schoolchildren. Further research on the effectiveness of interventions targeting different factors in each subpopulation might be needed. The time trend of dietary pattern transition in adolescents also should be investigated.

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