Indicators of a healthy dietary pattern among adolescents -A cross-sectional study from 2009 until 2015

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Research

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Abstract

Background

Dietary pattern early in life is to some degree preserved into adulthood and may have implications for future health. There is scarce knowledge on associations between choices of certain foods among adolescents. The aim of this study was to explore how intakes of different food groups, correspond to each other from a health perspective among adolescents.

Methods

This cross-sectional study used data from 16-year-olds ($n=13\,451$), who completed a health questionnaire within School Health Services from 2009 until 2015, in a county from Southern Sweden. Dietary pattern based on the response-alternatives from the ten items regarding intake of food and food frequency intake were grouped as healthy, moderately healthy, and unhealthy intakes, based on Nordic Nutrition Recommendations.

Results

In the student cohort healthy reported intakes of different healthy food groups were closely connected to each other. Association between intakes of certain food groups were seen. High intake of fish, vegetables and fruit were associated to each other, as well as low intake of sweet drinks, sweets and snacks. The highest association was seen between high intake of fruit and high intake of vegetables, with $OR=23$ (95% CI 12 to 44).

Conclusion

Healthy food intakes were associated with each other among 16-year-old adolescents; High intake of fruit and vegetables could serve as a key indicator for a healthy dietary pattern in this age group. This knowledge increases the understanding of food patterns among adolescents and can be used for designing interventions. It also raises a hypothesis that focusing on offering healthy foods, more than restricting unhealthy foods could have a positive impact on the dietary pattern.

Background

Nutritious food is important for normal body function and growth as well as for prevention of diseases [1]. Since food consists of more than specific nutrients, modern dietary research has moved its focus from specific food items to dietary pattern (DP). The so-called Mediterranean diet is a DP which has been of special interest since several studies have shown a positive effect on health. A systematic review showed that consumption of the Mediterranean diet was associated with a lower risk for cardiovascular diseases, cancer and all-cause mortality among adults [2]. INTERHEART, the world's largest case-control study of cardiac infarction, showed that consumption of fruit and vegetables at least once a day was associated with lower risk of infarction ($OR: 0.70$, 95% CI: $0.64-0.77$) [3]. A study on Swedish adults

points out a healthy intake of fruit and vegetables and dietary fibre as the most important factors for prevention of cardiovascular disease and cancer mortality [4].

DP is associated with other lifestyle habits [5] and with environmental and socioeconomic factors [6]. Adolescents who make healthy food choices also have other healthy behaviours, such as being physically active and eating lunch and breakfast [7]. Sedentary habits and short sleep duration have been found to be associated with both adiposity and an unhealthy DP among adolescents [8]. Associations between intakes of certain foods have previously been described among young children, but there is only scarce knowledge of such relations among adolescents [9, 10]. It is likely that the food intake among small children mirrors their parents' DP. For adolescents, who have gained some autonomy, it is plausible that there will be influence from others than their families, which means that they may be open to new choices and hence interventions during adolescence are of interest [11]. The dietary recommendations from the Swedish National Food Agency (NFA) is quite similar to the Mediterranean diet, [12, 13] and are based on the Nordic Nutrition Recommendations (NNR) issued by the Nordic Council of Ministers [1]. The Swedish NFA recommends that children from 10 years of age eat 500 grams of fruit and vegetables a day, whole grain products rather than refined carbohydrates, fish at least twice a week, and unsaturated rather than saturated fats [12]. It is known from national reports that healthy dietary intake is uncommon in adolescence [14, 15]. DP is preserved into adulthood to some extent, and may have implications for future health [16, 17]. It is therefore of great importance to increase knowledge about DP in adolescence in order to find effective ways to stimulate a more healthy DP in this age group.

Objectives

The aim of this study is to explore how healthy and unhealthy reported intakes of different food groups, correspond to each other among 16-year-old adolescents.

Methods

Study design

This is a cross-sectional study from 2009 to 2015.

Setting

The Swedish Education Act states that all students shall be offered a health visit during upper secondary school [18]. In Jönköping County, the health questionnaire "My Health" are used in the health visits as a basis for a conversation as well as an opportunity to intervene and roughly measure lifestyle factors by the School Health Services. The study was based on self-reported dietary habits from "My Health", which is similar to an adult validated version [19]. The questionnaire was developed in cooperation between the County Council, the students in focus groups, and the School Health Services, which offers health visits, including a health dialogue to all students [20, 21].

The adolescents voluntarily responded to the paper-questionnaire in the classroom, with support of the school nurse when necessary. The health questionnaire included ten items concerning dietary intake (fish, vegetables, fruit, table drinks, sandwich fat, sandwich toppings, sweets, snacks (e.g. crisps...), pastries, juice, chocolate drinks and sweet drinks). For seven of these items, the pupils stated the frequency of their consumption during the past seven days. There were four to seven possible response alternatives. For three of the items the pupils just stated what type of food they used to consume. In the present study the response alternatives were grouped into three categories based on NNR: healthy, moderately healthy, and unhealthy intakes (Table 1).

Table 1

Reported intake of different food groups among 16-year-old adolescents from the academic year 2009 until 2015, according to a health questionnaire (My Health). The answer options presented (healthy, moderately healthy and unhealthy intake) are classified according to the Nordic Nutrition Recommendations.

Questions If you think of the past seven days ...	Classification of answer options according to Nordic Nutrition Recommendations	Answer options	Year: 2009– 2015 Adolescents n (%) N = 13 451
... how often did you have fish?	Healthy intake Moderately healthy intake Unhealthy intake	At least 3 times/week Twice/week Once/week Never Missing	827 (6) 4 419 (33) 5 710 (43) 2 468 (18) 27 (0.2)
... how often did you have vegetables?	Healthy intake Moderately healthy intake Unhealthy intake	At least 3 times/day About twice/day About once/day 5–6 times/week 3–4 times/week 1–2 times/week Never Missing	770 (6) 3 402 (25) 4 107 (31) 1 437 (11) 1 797 (13) 1 431 (11) 491 (4) 16 (0.1)
... how many fruits did you have?	Healthy intake Moderately healthy intake Unhealthy intake	At least 3 fruits/day About 2 fruits/day About 1 fruit/day About 3–4 fruits/week About 1–2 fruits/week No fruit Missing	666 (5) 1 854 (14) 3 284 (24) 2 880 (21) 3 237 (24) 1 513 (11) 17 (0.1)
... what table drink did you usually have?	Healthy intake Moderately healthy intake Unhealthy intake	Water Milk (0.5% fat) Milk (1.5% fat) Milk (3.0% fat) Soda or juice Missing	5 585 (42) 1 624 (12) 4 048 (30) 855 (6) 1 316 (10) 23 (0.2)
... what sandwich fat did you usually have?	Healthy intake Moderately healthy intake Unhealthy intake	None 30–40% fat 60% fat 80% fat Missing	999 (7) 7 066 (53) 3 268 (24) 1 948 (15) 170 (1)

Questions If you think of the past seven days ...	Classification of answer options according to Nordic Nutrition Recommendations	Answer options	Year: 2009– 2015 Adolescents n (%) N = 13 451
... what sandwich toppings did you usually have?	Healthy intake Unhealthy intake	None Fruit or vegetables Ham, turkey, egg, low-fat cheese, mackerel, or caviar Marmalade or honey Sausage or high-fat cheese Missing	1 222 (9) 894 (7) 9 743 (72) 460 (3) 1 020 (8) 112 (0.8)
... how often did you have at least one glass of chocolate drink or juice?	Healthy intake Moderately healthy intake Unhealthy intake	Never Once/week 2–3 times/week 4–5 times/week Almost every day Several times/day Missing	3 292 (25) 2 914 (22) 3 764 (28) 1 578 (12) 1 564 (12) 310 (2) 29 (0.2)
... how often did you have at least one glass of another sweet drink?	Healthy intake Moderately healthy intake Unhealthy intake	Never Once/week 2–3 times/week 4–5 times/week Almost every day Several times/day Missing	1 524 (11) 2 896 (22) 5 646 (42) 2 050 (15) 965 (7) 342 (3) 28 (0.2)
... how often did you have sweets or snacks?	Healthy intake Moderately healthy intake Unhealthy intake	Never Once/week 2–3 times/week 4–5 times/week Almost every day Several times/day Missing	995 (7) 3 560 (27) 6 670 (50) 1 501 (11) 591 (4) 114 (0.8) 20 (0.1)
... how often did you have pastries?	Healthy intake Moderately healthy intake Unhealthy intake	Never Once/week 2–3 times/week 4–5 times/week Almost every day Several times/day Missing	3 116 (23) 4 896 (36) 4 140 (31) 885 (7) 329 (2) 60 (0.4) 25 (0.2)

Participants

16-year-olds from upper secondary schools from a county in south-east of Sweden the academic year 2009 until 2015, who answered the health questionnaire “My Health”.

Variables

The variables consists of self-reported food intakes.

Measurements

The response alternatives are described in Table 1.

Bias

Self-reported data on food intake could be biased due to memory and social expectation.

Study size

The total number of participants during the period were 13 451 students, which corresponds to approximately half of the 16-year-olds in the whole county. The dropout rate is mainly due to schools who did not use the questionnaire in their health conversations in School Health Services.

Statistical methods

The answers to the questionnaire are presented as numbers and percentages (Table 1). To investigate the associations between intakes of different food groups from a health perspective, the data were analysed with multivariable logistic regression and adjusted for multiple comparisons with Hochberg's method [22, 23]. The results are presented as Odds ratios (ORs) with 95 percent confidence intervals (95% CI). Also, R^2 (percent of variation explained in the outcome by the explanatory variables) and Area Under Curve (AUC the probability that the model correctly ranks pairs of observations e.g. healthy vs. unhealthy intakes) are presented. There is a relation between R^2 and AUC, that is, if R^2 is low then AUC is low and vice versa. The better the model fit is, the higher the R^2 and AUC. Suitable statistical software was used for the data analysis. The term 'significant' always refers to statistical significance, where $p < 0.05$, if not stated other.

We choose to study the extremes; the healthy intakes versus the unhealthy intakes as outcomes. To study trends, the explanatory variables are for most cases classified into three groups (Table 1).

Results

Participants

The participants comprise 13 451 students (6 248 girls, 7 153 boys, 50 missing data concerning gender). Outcome data is presented in Tables 1 and 2.

Table 2

Multivariable logistic regression analyses of the associations between reported intake of food groups among 16-year-old adolescents in Jönköping County during the academic years 2009–2010 until 2015–2016. Total number of students during the period are 13 451. Final estimated models.

Outcome variable and explanatory variables		2009–2010–2015–2016			
Fish intake ≥ twice/week (healthy) vs. never fish (unhealthy)	R ² =0.15. AUC = 0.70 n = 7 598		Wald Chi ² p=	OR	95% CI
	Healthy fish intake	Unhealthy fish intake			
Vegetable intake, grouped to unhealthy, moderately healthy and healthy					
≤ twice/week Once/day to 5–6 times/week ≥ twice/day	405	655	< 0.0001	1.0 2.3 5.4	2.1– 2.5 4.6– 6.4
	2596	1344			
	2245	464			
Fruit intake, grouped to unhealthy, moderately healthy and healthy					
≤ 2 fruits/week once/day to 5–6 times/week ≥ 2 fruits/day	1355	1217	< 0.0001	1.0 1.5 2.2	1.4– 1.6 1.8– 2.5
	2655	917			
	1235	331			
Sandwich fat intake, grouped to unhealthy, moderately healthy and healthy					
80% fat 60% fat None or 30–40% fat	787	341	0.02	1.0 0.9 0.8	0.9– 1.0 0.7– 1.0
	1349	522			
	3055	1561			
Sweet drink intake, grouped to unhealthy, moderately healthy and healthy					

Outcome variable and explanatory variables		2009–2010–2015–2016				
≥ 4 times/week 2–3 times/week ≤ once/week	1116	797	0.0009	1.0	1.1–	
	2215	954		1.1	1.2	
	1911	712		1.3	1.1–	
					1.5	
Sweets and snacks intake, grouped to unhealthy, moderately healthy and healthy						
≥ 4 times/week 2–3 times/week ≤ once/week	756	540	0.0004	1.0	1.1–	
	2616	1155		1.2	1.3	
	1872	770		1.3	1.1–	
					1.6	
Intake of pastries, grouped to unhealthy, moderately healthy and healthy						
≥ 4 times/week 2–3 times/week ≤ once/week	506	251	< 0.0001	1.0	0.8–	
	1687	676		0.8	0.9	
	3050	1537		0.7	0.6–	
					0.8	

Table 2
contd.

Vegetable intake ≥twice/day (healthy) vs. ≤ twice/week (unhealthy)	R ² =0.43, AUC = 0.85 n = 5 958		Wald Chi ² p=	OR	95% CI
	Healthy vegetable intake	Unhealthy vegetable intake			
Fish intake, grouped to unhealthy, moderately healthy and healthy					
Never Once/week ≥ twice/week	464	655	< 0.0001	1.0	2.2–
	1457	859		2.4	2.6
	2245	405		5.6	4.7–
					6.8
Fruit intake, grouped to unhealthy, moderately healthy and healthy					
≤ 2 fruits/week Once/day to 5–6 times/week ≥ 2 fruits/day	758	1312	< 0.0001	1.0	3.8–
	1981	486		4.3	4.7
	1433	123		18.1	14.7–
					22.3
Table drink intake, grouped to unhealthy, moderately healthy and healthy					
Milk (3% fat), soda or juice Milk (1.5% fat) Water, milk (0.5% fat)	437	523	< 0.0001	1.0	1.4–
	1129	580		1.5	1.6
	2603	814		2.3	1.9–
					2.7
Sandwich fat intake, grouped to unhealthy, moderately healthy and healthy					

Vegetable intake ≥twice/day (healthy) vs. ≤ twice/week (unhealthy)	R ² =0.43, AUC = 0.85 n = 5 958		Wald Chi ² p=	OR	95% CI
	Healthy vegetable intake	Unhealthy vegetable intake			
80% fat 60% fat None or 30–40% fat	651 1109 2355 	278 361 1257 	< 0.0001	1.0 0.8 0.7	0.8– 0.9 0.6– 0.8
Sandwich topping intake, grouped to unhealthy, and healthy					
Marmalade or honey/Sausage or high-fat cheese None/Fruit or vegetables/Ham, turkey, egg, low-fat cheese, mackerel, or caviar	346 3795 	291 1613 	< 0.0001	1.0 1.7	1.3– 2.0
Sweet drink intake, grouped to unhealthy, moderately healthy and healthy					
≥ 4 times/week 2–3 times/week ≤ once/week	665 1699 1803 	706 777 436 	< 0.0001	1.0 1.4 2.0	1.3– 1.6 1.7– 2.5
Sweets and snacks intake, grouped to unhealthy, moderately healthy and healthy					
≥ 4 times/week 2–3 times/week ≤ once/week	493 2005 1671 	449 923 549 	0.0007	1.0 1.2 1.4	1.1– 1.3 1.2– 1.8

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Never	464	655	< 0.0001	1.0	2.2–
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≥ twice/week	2245	405		5.6	4.7– 6.8
Fruit intake, grouped to unhealthy, moderately healthy and healthy					
≤ 2 fruits/week	758	1312	< 0.0001	1.0	3.8–
Once/day to 5–6 times/week	1981	486		4.3	4.7
≥ 2 fruits/day	1433	123		18.1	14.7– 22.3
Table drink intake, grouped to unhealthy, moderately healthy and healthy					
Milk (3% fat), soda or juice	437	523	< 0.0001	1.0	1.4–
Milk (1.5% fat)	1129	580		1.5	1.6
Water, milk (0.5% fat)	2603	814		2.3	1.9– 2.7
Sandwich fat intake, grouped to unhealthy, moderately healthy and healthy					

Vegetable intake ≥twice/day (healthy) vs. ≤ twice/week (unhealthy)	R ² =0.43, AUC = 0.85 n = 5 958		Wald Chi ² p=	OR	95% CI
	Healthy vegetable intake	Unhealthy vegetable intake			
80% fat 60% fat None or 30–40% fat	651 1109 2355 	278 361 1257 	< 0.0001	1.0 0.8 0.7	0.8– 0.9 0.6– 0.8
Sandwich topping intake, grouped to unhealthy, and healthy					
Marmalade or honey/Sausage or high-fat cheese None/Fruit or vegetables/Ham, turkey, egg, low-fat cheese, mackerel, or caviar	346 3795 	291 1613 	< 0.0001	1.0 1.7	1.3– 2.0
Sweet drink intake, grouped to unhealthy, moderately healthy and healthy					
≥ 4 times/week 2–3 times/week ≤ once/week	665 1699 1803 	706 777 436 	< 0.0001	1.0 1.4 2.0	1.3– 1.6 1.7– 2.5
Sweets and snacks intake, grouped to unhealthy, moderately healthy and healthy					
≥ 4 times/week 2–3 times/week ≤ once/week	493 2005 1671 	449 923 549 	0.0007	1.0 1.2 1.4	1.1– 1.3 1.2– 1.8

Table 2
contd.

Vegetable intake ≥twice/day (healthy) vs. ≤ twice/week (unhealthy)	R ² =0.43, AUC = 0.85 n = 5 958		Wald Chi ² p=	OR	95% CI
	Healthy vegetable intake	Unhealthy vegetable intake			
Fish intake, grouped to unhealthy, moderately healthy and healthy					
Never Once/week ≥ twice/week	464	655	< 0.0001	1.0	2.2–
	1457	859		2.4	2.6
	2245	405		5.6	4.7–
					6.8
Fruit intake, grouped to unhealthy, moderately healthy and healthy					
≤ 2 fruits/week Once/day to 5–6 times/week ≥ 2 fruits/day	758	1312	< 0.0001	1.0	3.8–
	1981	486		4.3	4.7
	1433	123		18.1	14.7–
					22.3
Table drink intake, grouped to unhealthy, moderately healthy and healthy					
Milk (3% fat), soda or juice Milk (1.5% fat) Water, milk (0.5% fat)	437	523	< 0.0001	1.0	1.4–
	1129	580		1.5	1.6
	2603	814		2.3	1.9–
					2.7
Sandwich fat intake, grouped to unhealthy, moderately healthy and healthy					

Vegetable intake ≥twice/day (healthy) vs. ≤ twice/week (unhealthy)	R ² =0.43, AUC = 0.85 n = 5 958		Wald Chi ² p=	OR	95% CI
	Healthy vegetable intake	Unhealthy vegetable intake			
80% fat 60% fat None or 30–40% fat	651 1109 2355 	278 361 1257 	< 0.0001	1.0 0.8 0.7	0.8– 0.9 0.6– 0.8
Sandwich topping intake, grouped to unhealthy, and healthy					
Marmalade or honey/Sausage or high-fat cheese None/Fruit or vegetables/Ham, turkey, egg, low-fat cheese, mackerel, or caviar	346 3795 	291 1613 	< 0.0001	1.0 1.7	1.3– 2.0
Sweet drink intake, grouped to unhealthy, moderately healthy and healthy					
≥ 4 times/week 2–3 times/week ≤ once/week	665 1699 1803 	706 777 436 	< 0.0001	1.0 1.4 2.0	1.3– 1.6 1.7– 2.5
Sweets and snacks intake, grouped to unhealthy, moderately healthy and healthy					
≥ 4 times/week 2–3 times/week ≤ once/week	493 2005 1671 	449 923 549 	0.0007	1.0 1.2 1.4	1.1– 1.3 1.2– 1.8

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Vegetable intake ≥twice/day (healthy) vs. ≤ twice/week (unhealthy)	R ² =0.43, AUC = 0.85 n = 5 958		Wald Chi ² p=	OR	95% CI
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80% fat 60% fat None or 30–40% fat	651 1109 2355 	278 361 1257 	< 0.0001	1.0 0.8 0.7	0.8– 0.9 0.6– 0.8
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Sweet drink intake, grouped to unhealthy, moderately healthy and healthy					
≥ 4 times/week 2–3 times/week ≤ once/week	665 1699 1803 	706 777 436 	< 0.0001	1.0 1.4 2.0	1.3– 1.6 1.7– 2.5
Sweets and snacks intake, grouped to unhealthy, moderately healthy and healthy					
≥ 4 times/week 2–3 times/week ≤ once/week	493 2005 1671 	449 923 549 	0.0007	1.0 1.2 1.4	1.1– 1.3 1.2– 1.8

Main results

Reported intakes of different food groups in detail are presented in Table 1. The participants reported a healthy intake according to NNR in 88 percent for sandwich toppings, in 60 percent for sandwich fat, in 54 percent for table drink, in 39 percent for fish, in 31 percent for vegetables and in 19 percent for fruit. They also reported a low intake of unhealthy food in 60 percent for pastries, in 46 percent for juice/chocolate drinks, in 34 percent for sweets/snacks and in 33 percent for sweet drinks. DP based on the response-alternatives from the ten items regarding intake of food and food frequency intake were grouped as healthy, moderately healthy, and unhealthy intakes, based on NNR. However most adolescents report food intakes according to the moderately healthy group. It is difficult to see specific patterns in this large group, since they also report intakes from all three defined groups.

The main results from the multivariable logistic regression analysis of association between the healthy versus the unhealthy reported intakes of food are described in Table 2. Most healthy intakes of food were associated with other healthy intakes. During the seven-year period, a high intake of fruit was mainly associated with a high intake of vegetables, but also with a high intake of fish, a low intake of juice/chocolate drinks and other sweet drinks. The highest association was seen between high intake of fruit and high intake of vegetables, with OR = 23 (95% CI 12 to 44) (Table 2).

A low intake of sweet drinks was also found to be associated with other healthy intakes, as for example low intake of sweets/snacks and pastries and high intake of healthy food groups (Table 2).

Among the healthy intakes a few weak associations were inversely associated from a health perspective. A healthy intake of vegetables was associated with an unhealthy intake of sandwich fat. The same scenario was seen between intake of fish and pastries (Table 2).

For outcome variables such as fruit, vegetables, sweet drinks and sweets/snacks the variation in outcome were explained by 40 to 43 percent by the explanatory variables in the logistic regression model. The variations explained for sandwich fat and sandwich toppings were two and three percent. For the rest of the outcome variables the variations explained were between 13 and 20 percent (Table 2).

Discussion

Key results

In this cross-sectional study among 16-year-old adolescents there seem to be some healthy dietary patterns. Healthy intakes of food groups among the adolescents were associated with each other, with a few exceptions. The strongest association between healthy intakes was between a high intake of fruit and a high intake of vegetables. There was also a pronounced association between low consumption of sweet drinks and low intake of sweets/snacks as well as between low intake of pastries and low intake of sweets/snacks. Most adolescents report food intakes in a mixed way, from a health perspective.

Strengths and limitations

The high participant rate and data from seven academic years, could strengthen the findings. However, causality is not possible to establish, because of the cross-sectional design. Collecting data with self-reported answers have limitations since there is a risk that the answers might not reflect the true dietary intake due to memory and social interaction. However, this method is considered to be an acceptable method in large health surveys as in the Västerbotten Intervention Program [24–26]. In our study, the questionnaire served as a conversation underlay between the adolescent and a school nurse and by that the reliability could be strengthened since missing, unclear or unserious responses could be corrected before registered in the database. We chose to study habits in late adolescence, because this age group has better opportunities than younger age groups to make their own decisions about what to eat. The questions in our study were based on a larger validated questionnaire for adults [19]. These questions are further developed to be useful in health dialogues in School Health Services [20]. The limited number of food questions in the questionnaire restricts the possibilities of interpretation, however, questionnaires with a small number of detailed questions could diminish the risk of double reporting. It might also decrease the risk of missing more recent food stuffs, which might not be covered in a detailed FFQ as discussed by Huseinovic et al [27]. A restricted number of questions could therefore enhance the quality of the answers, when the aim is to study food groups. When interpreting the results, it is important to be aware that the high ORs from the logistic regression depended on a few individuals in some subgroups, especially when it came to those who reported a very healthy DP.

Interpretation

To the best of our knowledge, our study on is one of few studies analysing DP among 16-year-old adolescents. DP among infants in Denmark was studied, revealing similar DP as in our study; a close association between intake of fruit, vegetables, and fish, and also a close association between intake of sweets, cakes, and sugary drinks [9]. In a Brazilian study concerning DP healthy pattern was also identified, with a high intake of healthy foods and a low intake of unhealthy foods [28]. This is in line with the results from our study, where a mixed dietary pattern from a health perspective was most common.

In our study, a high intake of vegetables and a low intake of sweet drinks seems to be associated with an unhealthy intake of sandwich fat (Table 2). There has been a trend in Sweden during the latest decade to eat butter instead of margarine and this phenomenon has been described as healthy in the public, especially among those who advocates a Low Carbohydrate High Fat type of diet [29]. This might partly explain our results where intake of unhealthy sandwich fat (high % of fat) was associated with intake of healthy foods, although the explained variation for sandwich fat is rather low in our data. Socioeconomic aspects on food choices could also be a piece of the puzzle that explains the underlying reasons behind a dietary pattern. Because of high expenses, consumption of some food groups such as butter and juice, have been associated with high socioeconomically status in Sweden, historically. It is important to take into account that young people's choice of sandwich fat is governed by what is offered at home and in school. In fact, the choice of sandwich fat might mirror the adult use. In our study, we found associations between a low intake of different unhealthy sweet-tasting foods and a high intake of healthy foods.

Surprisingly, high intake of pastries and unhealthy sandwich fat was found to be weakly associated with some healthy food intakes (Table 2).

Fruit and vegetables as indicators of a healthy DP?

The INTERHEART-study, points out an association between high consumption of fruit and vegetables and lower risk of cardiac infarction [3]. In addition, high intake of fruit and vegetables in childhood predicts lower level of arteriosclerosis in adulthood, and adolescents with the highest fruit and vegetable consumption report the best health as adults [30, 31]. Most adolescents report a moderately healthy food intake. The results from our study indicate the presence of a healthy DP closely related to the NFA recommendations among some of the 16-year-old adolescents. Some food intakes seemed to be stronger indicators of what can be defined as a healthy diet. In our study a healthy intake of fruit and vegetables had a strong association to each other and intake of other healthy foods and also a high percentage of variations explained by the model. That is also the case, but not as strong, for a low intake of sweets and snacks and low intake of sweet drinks. Among teenagers, in the before mentioned Brazilian study, it was concluded that vegetables were important for the differentiation between different DPs, in line with our results [28]. A study from Sweden among adults found five DPs with different associations with other lifestyle habits; A 'fruit pattern' was associated with healthy habits as high physical activity and non-smoking [32]. Taking the results from our study and the other studies into consideration similar connections between different food choices are seen at different ages during childhood and adolescence. Fruit and vegetables might be indicators of a healthy DP. To stimulate consumption of fruit and vegetables is important per se, as a high intake of fruit and vegetables is associated with good health and as it perhaps can stimulate other healthy food choices. Therefore, it is worth asking, whether an intervention aiming to increase the consumption of a healthy food group, as fruit and vegetables, also will lead to a change of other food choices in a healthier direction. Some studies point in that direction [33, 34]. The answers to these questions are important when trying to design interventions to promote a healthy diet, and so further studies are required.

Conclusions

Intake of healthy foods were associated with each other among 16-year-old adolescents and healthy dietary pattern was found over a seven-year period. Those who reported a high intake of vegetables tended to report eating fruit and fish more often, and sweets, cakes and pastries less often. A high intake of fruit and vegetables could serve as key indicators for a healthy DP. This knowledge increases the understanding of food patterns among adolescents and can be used for designing interventions for health promotion. It also raises a hypothesis that focusing on offering healthy food alternatives, more than restricting unhealthy food alternatives could have positive impact on the dietary pattern.

Abbreviations

DP:Dietary pattern; NNR:Nordic Nutrition Recommendations; NFA:The Swedish National Food Agency; OR:Odd's Ratio; CI:Confidence Interval; AUC:Area Under Curve; FFQ:Food Frequency Questionnaire

Declarations

Acknowledgement Bo Rolander for statistical support.

Authors' contributions MNT, MN, MG, KH and HL designed the study. MNT and MN performed the data analysis. MNT drafted the manuscript and MNT, MN, MG, KH and HL revised the manuscript of the present study. All authors have accepted the final version of the manuscript.

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Patient consent for publication Not required.

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Data sharing statement No additional data are publicly available due to Swedish legislations.

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