

## Systematic Review

# A Systematic Review on Diet Quality among Iranian Youth: Focusing on Reports from Tehran and Isfahan

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## Abstract

**Background:** Lifestyle and dietary pattern in adolescence and young adulthood not only affect the general state of health in these years, but also leave long-term effects. Due to the importance of diet in youth, this systematic review summarized observational studies representing dietary intakes among Iranian adolescents and young adults.

**Methods:** PubMed, Scopus and Web of Science databases were searched up to September 2013 using keywords related to diet, youth and Iran. Relevant papers were identified through applying a series of exclusion criteria in screening steps. Data were tabulated in 4 tables according to the level of assessed dietary exposure including energy or nutrients, foods or food groups, diet quality indices or dietary patterns, and dietary habits.

**Results:** Out of 1348 retrieved papers, 17 papers were eligible to enter this systematic review. Most studies were conducted in Tehran and Isfahan. Totally, 13113 individual were studied including 7327 girls and 5785 boys aged 10 to 28 years. Receiving lower or higher energy than required resulted in two burdens of malnutrition. Fiber intake was nearly half of the recommended amounts. Among micronutrients, calcium, phosphorus, folate and iron had the most common insufficient intakes. The youth consumed low whole grain, fruits, vegetables, dairy and unsaturated fatty acids and low diverse diet. Skipping breakfast was rife. Eating fast foods and unhealthy snacks was another prevalent inappropriate dietary habit.

**Conclusion:** Dietary intakes and habits of young people are not favorable. Implementing informative programs and developing practical policies should be noted to improve the diet quality of adolescents and young adults.

**Key words:** Adolescent, diet, Iran, systematic review, young

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## Introduction

Years of adolescence and young adulthood, usually defined as 10–19 and 10–24 years, respectively,<sup>1,2</sup> have an important effect on general health and prevalence of non-communicable diseases.<sup>3,4</sup> Studies have revealed that lifestyle and dietary patterns of the youth are associated with the prevalence of some chronic diseases in adulthood, including cardiovascular events.<sup>4,5</sup> Despite the importance of this period of life, previous studies have mostly focused on infants, children and the elderly. Consequently, there is little data available on dietary intake and diet quality of the youth.

Unhealthy eating among Iranian adolescents and young adults results in either malnutrition or obesity.<sup>6–8</sup> Malnutrition accompanies insufficient nutrient intake and increased rate of some disease like osteoporosis in later life.<sup>9,10</sup> On the other hand, meta-analysis and pooled analysis showed that overweight and obesity coexist with the risk factors for developing type 2 diabetes mellitus, atherosclerosis and cardiovascular diseases.<sup>11,12</sup>

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In addition, nutrition transition has an important role in developing non-communicable diseases in developing countries such as Iran.<sup>13</sup> The increasing consumption of fast food has jeopardized the nutritional status of the youth.<sup>14–16</sup>

For these reasons, we conducted this systematic literature review to examine dietary intake and nutritional habits of Iranian adolescents and young adults. We reviewed all studies which assessed dietary intake, from single micronutrients, foods, and food groups to dietary quality indices, dietary patterns and dietary habits.

## Material and Methods

### Search strategy and terms

We carried out a systematic literature search of the following electronic databases from the year of their establishment to September 2013: PubMed (1966 onward), Web of Science (1945 to November 2012) and Scopus (1960 onwards).

We used the same search strategy in all electronic databases. Key terms were categorized in three groups and used in combination with each other as follows:

- (“nutritional assessment” OR “nutritional status” OR “nutritional quality” OR “nutritional adequacy” OR diet OR dietary OR food OR nutrient)

AND

- (youth OR young OR adolescent OR teen OR teenager)

AND

- (Iran\*)

No limitation was applied in the search strategy to prevent bias in the results. For example, instead of limiting results to the human studies, animal studies were excluded while screening the titles and abstracts. Although limiting the language to “English” resulted in exclusion of unrelated papers and consequently fewer articles for screening, it also resulted in missing some relevant papers such as Bazhan, et al.,<sup>17</sup> which only had the abstract in English and the full text was written in Persian; or that of DoostMohammadian, et al.,<sup>18</sup> which only had a title in English and even the abstract was written in Persian.

#### Inclusion and Exclusion Criteria

A series of inclusion/exclusion criteria was established. Titles and abstracts of the selected studies were screened according to the exclusion criteria. The next step was screening the full text of the remaining articles. And finally, if a study met all the inclusion criteria, it was identified as eligible and entered the data extraction step. The following articles were excluded in the title and abstract screening step:

- Studies on subjects other than adolescents and young adults
- Studies on animals
- Studies focusing on particular samples, like unhealthy subjects
- Interventional studies
- Studies that did not evaluate dietary intake using dietary questionnaires
- Studies on irrelevant issues like food security, attitude towards food and so on.

These studies were excluded in the full-text screening step:

- Studies that were carried out on a wide range of age groups, including adolescents or young adults, while the data was not presented for individual age subgroups
- Articles that did not present any descriptive measures about diet and reported data in terms of correlation, odds ratio and so on
- Results that were reported in subgroups based on diseases or other variables (papers that reported data based on gender or age were not excluded)
- Studies that were not published as full reports, such as conference abstracts or letters to editors.

#### Data extraction

At first, the information from each paper was tabulated in one table. Four tables were then derived from the first table according to the level and type of dietary evaluation; the subgroup tables are nutrients or energy, foods or food groups, diet quality indices or dietary patterns and dietary habits. Consequently, a paper could appear in one table or more based on its information. The authors and year of publication, city and place of sampling (if the sample belonged to a certain study mentioned in its title), sample size, sex and age of participants, dietary assessment instrument, dietary measurements and main finding are the variables that were extracted. The study design was not included in the tables because obviously all studies were cross-sectional. The methodological quality of the studies included was assessed based on study design, recruitment of subjects, dietary assessment, and statistical power.<sup>19</sup> The meta-analysis could not be done due to wide title (i.e. considering different part of diet quality from nutrient intake to dietary pattern) and consequently the large number of different variables.

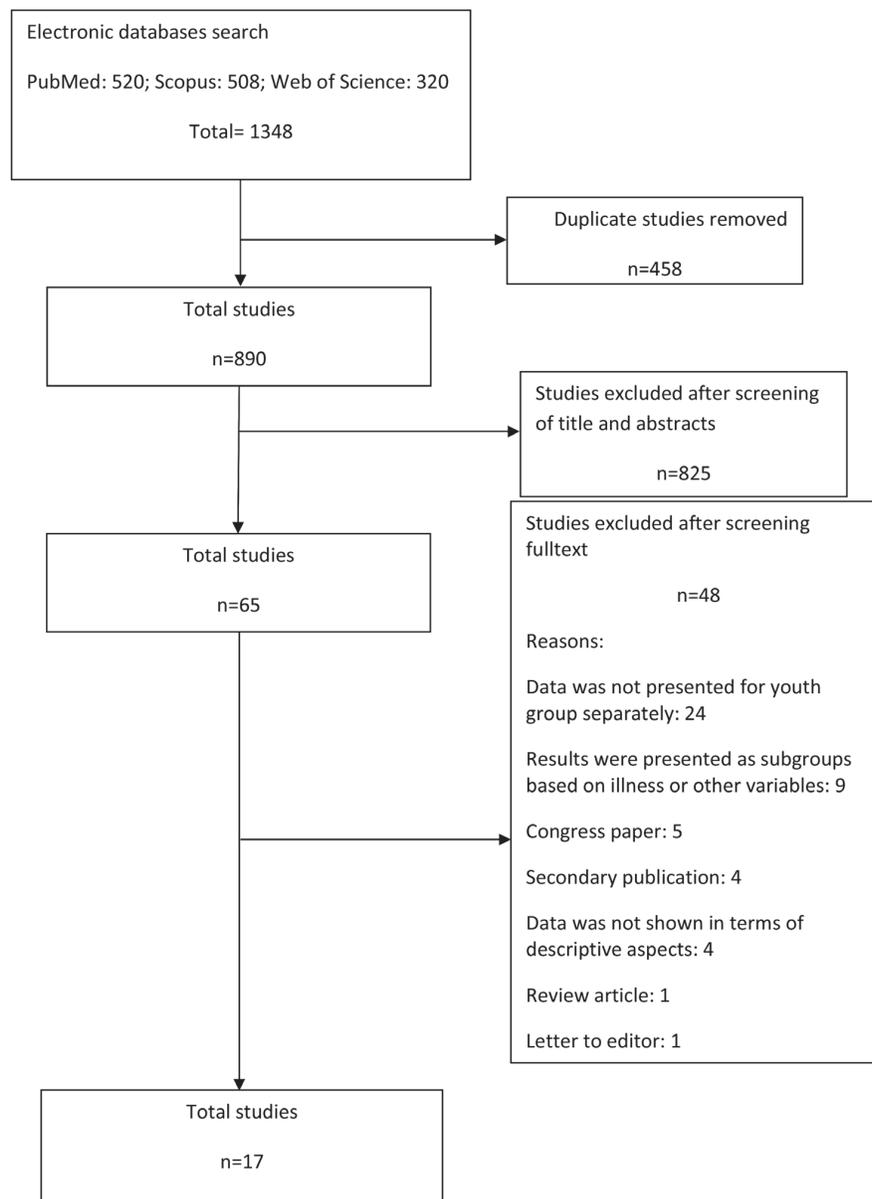
## Results

### Description of studies included

Through a search of three electronic databases, 1348 articles were identified, 1331 of which were excluded based on the reasons listed in Figure 1. Nine studies were excluded due to representing data in subgroups based on BMI,<sup>14,20–25</sup> metabolic syndrome<sup>24,26</sup> and other variables.<sup>25,27,28</sup> Among the 17 papers<sup>17,18,29–43</sup> that met all the inclusion criteria of the systematic review, participants from 6 studies were from Tehran,<sup>31–35,40</sup> 5 from Isfahan,<sup>29,36,38,39,43</sup> 2 from Tabriz<sup>30,42</sup> and the others were from Semnan,<sup>18</sup> Lahijan,<sup>17</sup> Shiraz,<sup>37</sup> and Ahvaz.<sup>41</sup> Although studies that were conducted in Isfahan by Azadbakht, et al., had the same participants,<sup>36,38,39,43–45</sup> they represented different dietary exposures. Hence, priority was given to sample size for data extraction. In other words, data was first extracted from the paper with more participants,<sup>39</sup> followed by other studies provided that they represented new exposure variables.<sup>36,38,43</sup> Thus, 4 studies which had the same populations were excluded.<sup>44–47</sup> The sample size of the included papers ranged from 84<sup>37</sup> to 7669<sup>34</sup> with a median of 400 participants per study,<sup>17,29</sup> although all studies had lower than 1000 participants except for one study i.e., 7669 subjects.<sup>34</sup> Not accounting papers with same population,<sup>36,38,43</sup> a total of 13113 subjects were studied including 7327 girls and 5785 boys in 14 articles. To assess dietary exposure, 8<sup>30,34,36,38–40,42,43</sup> and 5<sup>29,31,32,35,37</sup> studies used semi-quantitative Food Frequency Questioner (FFQ) and recall, respectively, and the others used WHO & FAO’s dietary diversity questionnaire,<sup>41</sup> recall and record,<sup>33</sup> recall and record and FFQ,<sup>18</sup> recall and FFQ and food habit questionnaire.<sup>17</sup> The studies included were assessed for methodological quality; so, 12 articles<sup>17,18,29,32,34–36,38–40,42,43</sup> had acceptable quality, 3 of which<sup>32,35,39</sup> had higher quality due to considering over- and under-reporting for dietary intakes. On the other hand, 5 papers<sup>30,31,33,37,41</sup> had lower quality, one of which<sup>37</sup> had the lowest quality; the mentioned paper did not select subjects randomly. Information from each paper was arranged in the following tables according to the level of evaluated exposure. It should be noted that data from 3 papers are given simultaneously in Tables 1, 2 and 4,<sup>17,34,38</sup> a paper in Table 1 and 4,<sup>18</sup> and a paper in Tables 1 and 2.<sup>37</sup>

### Energy, macro- and micronutrients

Data on energy macro- and micro-nutrients intake of 9 studies were summarized in Table 1.<sup>17,18,29,31,34,35,37,38,43</sup> Energy intakes for youth under 18 years of age in different studies are less than 2000 kcal per day<sup>18,31,37</sup> except for one study which reported 2338 kcal.<sup>17</sup> Energy consumption for young girls aged 18 to 28 years was evaluated as 2196 kcal daily.<sup>38</sup> In addition, a paper showed that 14–18 year-old boys and girls received 2155 and 1670 kcal, respectively, while their needs were estimated to be 2700 and 2300 kcal daily using Harris–Benedict equations.<sup>29</sup> The percent of energy from carbohydrate, protein, fat and saturated fat in different studies ranged from 54%<sup>34</sup> to 62.84%,<sup>18</sup> 11%<sup>35</sup> to 15%,<sup>34</sup> 28.8%<sup>17</sup> to 37%,<sup>18</sup> and 9.8%<sup>38</sup> to 12%,<sup>37</sup> respectively. Daily fiber intake in 11–16, 12–16 and 18–28 year-old subjects was 9.9,<sup>31</sup> 11.6,<sup>37</sup> and 14 gram,<sup>38</sup> respectively. Reports of some micronutrients intake were lower than the recommended dietary allowances (RDA), namely, lower intake for 3 (vitamin A, calcium and phosphorus) out of 6 assessed micronutrients,<sup>17</sup> 5 (zinc, calcium, phosphorus, magnesium, folate) out



**Figure 1.** Flow diagram of study screening and selection process.

of 7 assessed micronutrients,<sup>31</sup> and 3 (folate, iron, and calcium) out of 13 assessed micronutrients<sup>38</sup> in 14–17, 11–16 and 18–28 year-old subjects, respectively.

#### Foods and food groups

The results of 5 articles on foods or food groups are shown in Table 2.<sup>17,34,37,38,42</sup> The mean intake of fruits and vegetables in different samples as serving per day are as follows: 2.58 and 2.68,<sup>42</sup> 2.2 and 3.2,<sup>38</sup> 1.82 and 1.77,<sup>37</sup> 3 and 3.5 for boys, 3.5 and 3.9 for girls.<sup>34</sup> Furthermore, one of them reported minimum and maximum intake for both fruits and vegetables as 0.5 and 5 serving per day, respectively.<sup>38</sup> Consumptions of whole grain versus refined grain was 1 vs. 6 servings,<sup>38</sup> and 83 vs. 119 gram and 56 vs. 130 gram per day, respectively.<sup>34</sup> In addition, the minimum intake of whole versus refined grain was 0 vs. 4 and the maximum intake was 3 vs. 13 servings in 18 to 28

year old subjects.<sup>38</sup> Low versus high fat dairy intakes were 0.5 vs. 1.3 servings daily in 18 to 28 year old young adults.<sup>38</sup> For adolescents, daily dairy intake was 1.7 and 1.6 servings<sup>34</sup> and 209.3 grams.<sup>17</sup> Non-hydrogenated versus partially hydrogenated vegetable oils daily intake was 15 vs. 17 grams.<sup>38</sup> Among 402 Tabrizi adolescents, only 30%, 34.6% and 12.4% received optimal intake of daily fruits (3–5 servings), vegetables (3–5 servings) and high fat foods (<2 servings), respectively.<sup>42</sup>

#### Diet quality indices and dietary patterns

Table 3 presents relevant information on dietary quality indices and dietary pattern from 6 studies.<sup>30,32,36,39–41</sup> Dietary diversity score was assessed at 6.81, 6.78 and 6.26 out of maximum 10 in studies which were carried out on young individuals in Ahvaz,<sup>41</sup> Isfahan,<sup>36,39</sup> and Tehran,<sup>32</sup> respectively. The mean dietary energy density and healthy eating index (HEI) score of

**Table 1.** Energy and nutrients intake among Iranian young individuals.

Author, year (reference)	City	gender/ Sample size/ Age range (mean) (years)	Dietary assessment instrument	Evaluated Dietary variables	Findings <sup>1</sup>	
Falah, et al., 2013 <sup>43</sup>	Isfahan <sup>2</sup>	Girls/ 160/ 19–29, (20.73)	168-item semi- quantitative FFQ	Linoleic acid n-3 EPA	Linoleic acid (gr): 13.57±8.72 n-3 EPA (gr): 0.01±7.21	
Azadbakht, et al., 2012 <sup>38</sup>	Isfahan <sup>2</sup>	Girls/ 289/ 18–28 (21)	168-item semi- quantitative FFQ and food habit questionnaire	Energy Macronutrients Different fatty acids Some micronutrients	Energy (kcal) 2196±26/ - <sup>3</sup> Protein (g) 90±41 / 197 Fat (g) 68±30/ - Cholesterol (mg) 154±10/ - Saturated fatty acids (g) 24±10/ - Polyunsaturated fatty acids (g) 20±8/ 140 Monounsaturated fatty acids (g) 5±0.5/ - Carbohydrate (g) 323±100/ 251 Vitamin C (mg) 159±106/ 213 Thiamin (mg) 1.5±0.6/ 136 Riboflavin (mg) 2.3±0.8/ 211 Niacin (mg) 29±9/ 146 Pyridoxine (mg) 1.6±0.7/ 128 Cobalamin (µg) 4.8±0.7/ 201 Folate (µg) 310±147/ 77 Vitamin A (µg) 970±63/ 138 Iron (mg) 13±5/ 76 Calcium (mg) 900±503/ 90 Phosphorus (mg) 1591±597/ 227 Fiber (g) 14±1/ 56 Zinc (mg) 9±3/ 113 Selenium (µg) 69±32/ 126	Folate, iron, calcium and fiber intake were lower than the recommended dietary allowances (RDA) amounts (70, 76, 90, 56% of RDA, respectively).
Bazhan, et al., 2009 <sup>17</sup>	Lahijan	Girls/ 400/ 14–17	24-h dietary recall, food habits and 106- item FFQ	Energy % of energy from Macronutrients Macronutrients Some micronutrients	Energy (kcal): 2338 ± 611 Protein (%) : 11.9 ± 1.8 Fat (%): 28.8 ± 6.7 Carbohydrate (%): 59.3 ± 7.0 Protein (g) : 69.6 ± 60.6 Carbohydrate (g) : 346.6 ± 104.3 Fat (g) : 74.8 ± 53.9 Vitamin A (µg) : 492.6 ± 519.1 Riboflavin (mg) : 1.4 ± 0.6 Cobalamin (µg) : 4.4 ± 10.0 Calcium (mg) : 843.1 ± 429.1 Phosphorus (mg) : 897.7 ± 465.4 Iron (mg) : 24.6 ± 14.7	
DoostMohammadian, et al., 2009 <sup>18</sup>	Semnan	Girls/ 256/ 14–18	24-h recall, 1-day food record and FFQ	Energy % of energy from Macronutrients Macronutrients	Energy (kcal): 1957 ± 485.84 Carbohydrate (%): 62.84 ± 7.60 Protein (%) : 12.88 ± 2.7 Fat (%): 35.09 ± 7.05 Carbohydrate (g) : 257.23 ± 71.32 Protein (g) : 62.70 ± 19.80 Fat (g) : 76.84 ± 7.60	
Hejazi, et al., 2009 <sup>37</sup>	Shiraz	Girls and boys/ 84(33 girls, 51 boys)/ 12-16 (14.2)	three 24 h diet recalls (one weekend and two week days)	Energy % of energy from fat and SFA fiber	Energy (kcal): 1531.00 ± 479.00 Total fat (%) : 37.00 ± 0.07 Saturated fat (%) : 12.00 ± 0.02 total dietary fiber (g): 11.60 ± 5.00	Consumption of fat and saturated fat was high.

Mahmoodi, and Kimiagar, 2000 <sup>31</sup>	Tehran	Girls and boys/ 881 (429 girls, 452 boys)/ 11-16 (13.2)	24-h recall	Energy Fiber Protein Some micronutrients	Energy(kcal): 1997 ± 718 Fiber(g): 9.9 ± 6.9 Protein(g): 59.1 ± 26.1 Zinc(mg): 7.5 ± 3.7 Calcium(mg): 646.2 ± 366.5 Phosphorus (mg): 672.9 ± 348.1 Iron(mg):19.7 ± 9.8 Copper(mg): 1.3 ± 4.5 Magnesium(mg): 135.4 ± 68.5 Folate(µg): 167.3 ± 117.2	As for dietary intake, compared with the RDA, 50% of the subjects consumed less than 50% of their requirement for zinc RDA based on a 24-h dietary recall. Zinc intake in subjects was 7.5 ± 3.7 µg which was higher in boys than girls.
Mirmiran, et al., 2007 <sup>34</sup>	Tehran	Girls and boys/ 7669 (3599 girls, 4070 boys)/ 10-18 (14)	168-item semi-quantitative FFQ	% of energy from macronutrients Different fatty acids Sodium	boys/girls Saturated fatty acids (%): 10 ± 1.2/15 ± 2.3 Polyunsaturated fatty acids (%): 14 ± 2.9/10 ± 2.7 Monounsaturated fatty acids (%): 7 ± 1.3/5 ± 1.1 Cholesterol (mg/ day): 230 ± 23/380 ± 36 Protein (%): 15 ± 5.6/13 ± 4.9 Carbohydrate (%): 54 ± 19/ 57 ± 19 Sodium (mg/dl): 4500 ± 136/ 6800 ± 145	
Mirmiran, et al., 2006 <sup>35</sup>	Tehran <sup>4</sup>	Girls and Boys/ 642(391 girls, 251 boys)/10-24	two non-consecutive 24-h dietary recalls	% of energy from Macronutrients Macronutrients	boys10-18/ boys19-24/ girls10-18/ girls19-24 Protein (g): 75 ± 18/ 85 ± 21/ 68 ± 31/ 64 ± 15 <sup>5</sup> Protein (%): 11.1 ± 1.5/ 11.4 ± 1.7/ 11.0 ± 1.7/ 11.2 ± 1.8 Carbohydrate (g): 401 ± 94/ 438 ± 81/ 330 ± 64/ 324 ± 59 Carbohydrate (%): 59.2 ± 6.2/ 59.1 ± 6.5/ 57.0 ± 7.2/ 56.4 ± 7.9 Fat (g): 90 ± 31/ 97 ± 31/ 84 ± 27/ 84 ± 26 Fat (%): 29.6 ± 6.6/ 29.2 ± 7.2/ 32.2 ± 7.1/ 32 ± 7.6	
Tazhibi and Bahraini, 2012 <sup>29</sup>	Isfahan	Girls and boys/ 400(200 girls, 200 boys)/14-18	24-h dietary recall	Total Intake energy Estimated energy requirement (Harris-Benedict equations)	boys/ girls Total energy intake: 2155 ± 30.7/ 1670 ± 18.7 Estimated energy requirement: 2700 ± 21.36/ 2300 ± 4.63	Because of their age (14-18 years), called the growth age, energy intake was lower than their needs.
<sup>1</sup> Findings are as mean ± SD intake per day, unless mentioned; <sup>2</sup> Participants were students of Isfahan University of Medical Sciences; <sup>3</sup> Mean±SD / % of RDA for nutrients; <sup>4</sup> Participants were from Tehran Lipid and Glucose Study; <sup>5</sup> values calculated after excluding under and over-reporters as the ratio of energy intake (EI) to BMR <1.35 and ≥ 2.4, respectively. FFQ = food frequency questionnaire.						

410 Isfahani youth were 1.5 kcal per gram and 57.5, respectively.<sup>39</sup> Only 2 of the papers evaluated the dietary pattern.<sup>30,40</sup> Both papers used factor analysis to derive dietary patterns. The study that was conducted on 257 Tabrizi girls achieved 6 major dietary patterns, including (1) Western pattern (2), Sweet junk foods pattern (3), Asian pattern (4), Salty junk foods pattern (6), and Iranian traditional dietary pattern.<sup>30</sup> The other study identified two dietary patterns which were named healthy and unhealthy.<sup>40</sup>

#### Dietary habits

Findings on dietary habits of the Iranian youth from 5 articles are gathered in Table 4.<sup>17,18,33,34,38</sup> The frequency of having breakfast within 2 days by Tehrani adolescents was assessed using 24-hour recall and a 1-day record.<sup>33</sup> In this population, 9.6% did not have breakfast on either day and 31.5% had breakfast on only one of the two days. In 18-28 and 14-17 year old individuals, 52%<sup>38</sup> and 10.5%<sup>17</sup> never had breakfast,

respectively, while only 25% of Isfahani girls had breakfast every day.<sup>38</sup> The mean frequency of main and snack meals consumption was 2.53 and 2.64 times per day, respectively.<sup>18</sup> In Lahijan, 7.7%, 0.5%, 13.2%, 1.2%, and 25.5% of girls did not eat snack between breakfast and lunch, lunch, snack between lunch and dinner, dinner and snack before sleep, respectively.<sup>17</sup> Fifty percent (50%) of Isfahani students consumed fast food never or once a week while 42% ate fast food twice a week.<sup>38</sup> In another sample, the mean frequency of fast food consumption was 0.85 times per week.<sup>18</sup> A paper estimated that 16% of the population ate salty snacks more than twice a week.<sup>38</sup> Furthermore, another study on 7669 girls and boys showed that daily consumption of unhealthy snacks, like salty and sweet snacks, outweighed healthy snack; the items and amount of snacks are given in Table 4 in detail.<sup>34</sup> In another sample, the frequency of fruits and vegetable consumption, and dairy (except for cheese) was 6.03, and 4.88 times per week, respectively.<sup>18</sup> Among Isfahani students, 36% consumed sweetened drinks every day,

**Table 2.** Foods and food groups intake among Iranian young individuals.

Author/ year (reference)	city	gender / Sample size/ Age range (mean) (years)	Dietary assessment instrument	Dietary evaluated variables	Findings <sup>1</sup>
Shokrvash, et al., 2013 <sup>42</sup>	Tabriz	Girls and boys/ 402 (207girls, 195 boys) 12–15	118-item semi-quantitative FFQ	fruit and vegetables and high fat foods	<p>Fruit intake (servings): <math>2.58 \pm 0.96</math>            Frequency(%) for optimal intake of daily fruit ( 3–5 servings): 122(30.0)            Vegetables intake (Servings): <math>2.68 \pm 0.99</math>            Frequency (%) for optimal intake of daily vegetables ( 3–5 servings): 139(34.6)            High fat Foods intake(servings): <math>3.56 \pm 0.82</math>            Frequency (%) for optimal intake of daily high fat foods( &lt; 2servings): 50(12.4)</p> <p>Only one third (30.3% and 34.6%) of adolescents had the optimal consumption of fruit and vegetables, respectively. Compared to boys, girls recorded higher level of fruits (35.7 % <i>versus</i>. 24.6%) and vegetables (36.2 % <i>versus</i>. 32.8%) intake. It was found that the boys were at risk of low levels of daily fruit and vegetable consumption. The lack of family support represents an increased risk for deficient daily fruit and vegetable consumption. It seems that family support should be an integrated part of any health education/promotion programs to improve daily fruits and vegetables consumption among adolescents.</p>
Azadbakht, et al., 2012 <sup>38</sup>	Isfahan <sup>2</sup>	Girls/ 289/ 18–28 (21)	168-item semi-quantitative FFQ and food habit questionnaire	Food groups different oils	<p>amount of food groups intake Min, Max, Mean±SD            Partially hydrogenated vegetable oils (gr): 10, 32, <math>17 \pm 2</math>            Non-hydrogenated vegetable oils (gr): 9, 45, <math>15 \pm 1</math>            Fruits (serving): 0.5, 5, <math>2.2 \pm 0.4</math>            Vegetable (serving): 0.5, 5, <math>3.2 \pm 1.0</math>            Meat, Poultry and Fish (serving): 0.5, 4, <math>2.5 \pm 0.5</math>            Whole grains (serving): 0, 3, <math>1.0 \pm 0.2</math>            Refined grains (serving): 4, 13, <math>6.0 \pm 1.2</math>            Legumes (gr): 10, 40, <math>15 \pm 3</math>            Low fat dairy (serving): 0, 2, <math>0.5 \pm 0.11</math>            High-fat dairy (serving): 0, 2, <math>1.3 \pm 0.16</math></p>
Bazhan, et al., 2009 <sup>17</sup>	Lahijan	Girls/ 400/ 14–17	24-hr dietary recall, food habits and 106-item FFQ	Food groups Sugars Beverages Oils	<p>Grains: <math>513/8 \pm 152</math> g            Legumes: <math>79.7 \pm 51.2</math>            Meat, Poultry and Fish: <math>86.2 \pm 49.3</math>            Dairy: <math>209.3 \pm 192.9</math>            Vegetable: <math>173.8 \pm 128.4</math>            Fruits : <math>298.1 \pm 214.1</math>            Sugars: <math>29.8 \pm 22.1</math>            Beverages: <math>209.9 \pm 99.6</math>            Oils: <math>34.7 \pm 17.4</math></p>
Hejazi, et al., 2009 <sup>37</sup>	Shiraz	Girls and boys/ 84(33 girls, 51 boys)/ 12–16 (14)	three 24 hr diet recalls (one weekend and two week days)	Food groups soft drink water milk	<p>Fruits (serving): <math>1.82 \pm 1.96</math>            Vegetable (serving): <math>1.45 \pm 1.54</math>            Fried-fat Vegetable (serving): <math>0.32 \pm 0.73</math>            Whole grains (serving): <math>1.00 \pm 1.10</math>            Soft drink (mL): <math>360.00 \pm 44.00</math>            Water (mL): <math>540.00 \pm 60.00</math>            Milk (mL): <math>180.00 \pm 17.00</math></p> <p>Consumption of doft drinks was high. Fruit and vegetable intake was low</p>
Mirmiran, et al., 2007 <sup>34</sup>	Tehran	Girls and boys/ 7669 (3599 girls, 4070 boys)/ 10–18 (14)	168-item semi-quantitative FFQ	Food groups	<p>Boys/ girls            Whole grains (g): <math>83 \pm 20/56 \pm 17</math>            Refined grains (g): <math>119 \pm 11 /130 \pm 15</math>            Vegetable (servings): <math>3.5 \pm 1.1/ 3.9 \pm 1.2</math>            Fruit (servings): <math>3\pm 1.2/ 3.5 \pm 1.6</math>            Meat (servings): <math>3.0 \pm 1.1/1.5 \pm 0.6</math>            Dairy (servings): <math>1.7 \pm 0.7/1.6 \pm 0.6</math></p>

<sup>1</sup>Findings are as mean  $\pm$  SD intake per day, unless mentioned; <sup>2</sup>Participants were students of Isfahan University of Medical Sciences; FFQ = food frequency questionnaire.

**Table 3.** Diet quality indices and dietary patterns among Iranian young individuals.

Author, year (reference)	City	Gender/ Sample size/ Age range (mean) (years)	Dietary assessment instrument	Dietary evaluated variables	Findings <sup>1</sup>
Vakili, et al., 2013 <sup>41</sup>	Ahvaz	Girls/ 506/ 15 to 18.	WHO & FAO's dietary diversity questionnaire	DDS	DDS: 6.81±1.75  DDS: 6/78±1/12 Minimum DDS: 4/08 ± 1/25 maximum DDS: 8/31 ±1/55 DDS in Food groups Grain group: 0.76±0.33 Vegetable group: 1.52 ± 0.27 Fruit group: 1.78 ± 0.68 Meat group: 1.29 ± 0.31 Dairy group: 1.43 ± 0.50
Azadbakht, et al., 2011 <sup>36</sup>	Isfahan <sup>2</sup>	Girls/ 289/ 18–28	168-item semi-quantitative FFQ	DDS DDS in Food groups	Significant positive correlation was observed between DDS and the mean adequacy ratio (MAR) ( $r = 0.42, P < 0.001$ ). 50% of people had DDS $\geq 6$ . There was a significant and positive correlation between DDS and most of the nutrient adequacy ratios (NARs). So, DDS is an appropriate method to evaluate nutrient intake adequacy in this group of adolescents.
Mirmiran, et al., 2004 <sup>32</sup>	Tehran <sup>3</sup>	Girls and boys/ 304 (162 girls and 142 boys)/ 10-18	2-day non-consecutive 24-h recalls	DDS DDS in Food groups	DDS: 6.26 ± 1.08 DDS in Food groups: Grain: 0.95 ± 0.27 Vegetable: 1.36 ± 0.32 Fruit: 1.46 ± 0.61 Meat: 1.12 ± 0.32 Dairy: 1.34 ± 0.53
Azadbakht, et al., 2011 <sup>39</sup>	Isfahan <sup>2</sup>	Girls/ 410/ 18–28	168-item semi-quantitative FFQ	dietary energy density HEI	Dietary energy density (kcal/g): 1.5 ± 0.2 HEI: 57.5 ± 16.0
Alizadeh, et al., 2012 <sup>30</sup>	Tabriz	Girls/ 257/ 11-15	162-item semi-quantitative FFQ	dietary patterns	six major dietary patterns: (1) Western pattern high in pizza, meats and fruit juice; (2) Sweet junk foods pattern high in dried fruits, jams, honey and sugar; (3) Asian pattern high in legumes, potato and other vegetables; (4) Salty junk foods pattern high in carrot, puffs and potato chips and (6) Iranian traditional dietary pattern high in hydrogenated fats, garlic and broth.  Asian-like food was the healthiest one
Koochakpour, et al., 2011 <sup>40</sup>	Tehran <sup>3</sup>	Girls and boys/ 504(279 girls, 225 boys)/ 10-19	168-item semi-quantitative FFQ	dietary patterns	The healthy dietary pattern score was higher in boys than girls and also older age groups  Two dietary patterns were derived. In the healthy dietary pattern, whole grain, low fat dairy and vegetables, and in the unhealthy pattern, sweetened drinks, fast food and refined cereal pattern were included

<sup>1</sup>Findings are as mean ± SD intake per day, unless mentioned; <sup>2</sup>Participants were students of Isfahan University of Medical Sciences; <sup>3</sup>Participants were from Tehran Lipid and Glucose Study; DDS = dietary diversity score, FFQ = food frequency questionnaire, HEI = healthy eating index.

**Table 4.** Dietary habits among Iranian young individuals.

Author, year (reference)	City	Gender / Sample size/ Age range (mean) (years)	Dietary assessment instrument	Dietary evaluated variables	Findings <sup>1</sup>
Amini et al., 2007 <sup>33</sup>	Tehran	Girls and boys/ 398 (199 girls, 199 boys)/ 10-15	24-hr food recall and a 1-day record	Breakfast consumption	Having breakfast (within 2 days): 0 day: 37 1 day: 121 2 days: 226
Azadbakht, et al., 2012 <sup>38</sup>	Isfahan <sup>2</sup>	girls/ 289/ 18-28 (21)	168-item semi-quantitative FFQ and food habit questionnaire	Breakfast consumption Tea or coffee, Fast food, Beverages, Sugars consumption kind of oil type of Spices method of cooking	Having Breakfast <sup>3</sup> Everyday: 25% Not regularly: (2 times a week or lower) 23% Never: 52% Tea or coffee: Tea (750 ml or less): 50% Tea (more than 750 mL): 50% Coffee (120 ml or more): 2% Fast foods: Fast food consumption (never or once a week): 50% Fast food consumption (twice a week): 42% Fast food consumption (more than twice per week): 8% Salty snacks (more than twice per week): 16% High fat snacks (more than twice per week): 49% Different kind of oil Non-hydrogenated vegetable oils (everyday): 51% Hydrogenated vegetable oils (everyday): 75% Specific oils for frying (everyday): 35% Animal oils (everyday): 3% Beverages Sweetened drinks (everyday): 36% Cola: 30% Sugars Sugars with drinking tea (more than 10 g a day): 74% Sauces (commonly used during a week) Vinegar: 3% Lemon juice :37% mayonnaise and high fat salad dressings: 56% Most common method of cooking on a weekly basis Boiling and steaming: 28% Frying: 68% Grilling: 4%
Mirmiran, et al., 2007 <sup>34</sup>	Tehran	Girls and boys/ 7669 (3599 girls, 4070 boys)/ 10-18 (14)	168-item Semi-quantitative FFQ.	Salty, sweet and healthy snacks consumption	Salty snacks Crisps (g): 20 ± 13/25 ± 15 Corn balls (g): 10 ± 7/16 ± 10 Salty biscuits (g): 1.0 ± 6/1.2 ± 7 Snacks full of saturated fatty acids Sausage sandwiches (number/week): 5 ± 1/3 ± 0.5 Sweet snacks Commercial juice (cups): 0.5 ± 0.2 /1.0 ± 0.3 Soft beverage (cups): 0.5 ± 0.9/1.0 ± 0.7 Creamy wafers (g): 3.5 ± 1.0/3.5 ± 1.1 Candies (g): 4 ± 2/ 5 ± 1.5 Cakes (g): 22 ± 5/ 30 ± 9 Chocolate (g): 7 ± 4 /8 ± 5 Toffee (g): 2 ± 0.6/ 2 ± 0.7 Healthy snacks Milk (cups): 0.5 ± 0.2/ 0.5 ± 0.3 Fruits (servings): 1.5 ± 0.3/1.5 ± 0.4 Nuts (g): 10 ± 0.4/2.5 ± 0.3 Dried fruits (g): 1.7 ± 0.3/ 1.6 ± 0.4 Cheese and bread (number): 0.5 ± 0.2/ 0.5 ± 0.9 Only 25% of boys and 15% of girls had good nutritional practice, 4.5% of them did not drink soft beverages and only 10% of adolescents used whole-grain biscuits as a snack. The most frequently consumed snacks among Tehrani adolescents were sausage sandwiches, cola, crisps and corn balls, creamy wafers, cakes, chocolate and toffee. Conclusion: A low percentage of Tehrani adolescents have good nutritional behavior.

**Table 4.** Dietary habits among Iranian young individuals.

Author, year (reference)	City	Gender / Sample size/ Age range (mean) (years)	Dietary assessment instrument	Dietary evaluated variables	Findings <sup>1</sup>
Doost Mohammadian, et al., 2009 <sup>18</sup>	Semnan	Girls/ 256 / 14–18 (14)	24-hr recall, 1-day food record and FFQ	Frequency of snack, main meals, fast food, Colas and some food groups consumption	Frequency of main meals consumption: 2.53 ± 0.63 Frequency of snack meals consumption: 2.64 ± 0.74 Frequency of Fruits and Vegetable consumption/week: 6.03 ± 2.11 Frequency of Meat consumption/week: 3.80 ± 2.83 Frequency of Dairy except for cheese consumption/week: 4.88 ± 2.36 Frequency of fast food consumption/week: 0.85 ± 1.14 Frequency of Cola consumption/week: 1.86 ± 1.73
Bazhan, et al., 2009 <sup>17</sup>	Lahijan	Girls/ 400/ 14–17	24-hr dietary recall, food habits and 106-item FFQ	Snack and main meals consumption	Breakfast consumption; yes: 89.5% no:10/5 <sup>3</sup> Snack between breakfast and lunch: yes: 92.3 no: 7.7 lunch consumption ; yes: 99.5 no: 0.5 Snack between lunch and dinner: yes: 86.8 no: 13.2 dinner consumption ; yes: 98.8 no: 1.2 Snack before sleep: yes: 74.5 no: 25.5

<sup>1</sup> Findings are as mean ± SD intake per day, unless mentioned; <sup>2</sup> Participants were students of Isfahan University of Medical Sciences; <sup>3</sup>values are presents (%); FFQ = food frequency questionnaire.

75% used hydrogenated vegetable oils every day, 56% reported using mayonnaise and high fat salad dressings on a weekly basis, and 68% declared that frying is the most commonly used method of cooking on a weekly basis.<sup>38</sup>

## Discussion

This comprehensive systematic review summarized the descriptive information about all aspects of dietary exposure in Iranian adolescents and young adults. The seventeen cross-sectional papers included in this review reported relatively unsatisfactory and unfavorable results on dietary intakes of this age group.

Most of the studies examined energy, macronutrients and food groups as dietary exposures. The mean energy intake for the overall sample of adolescents was lower than the values required for their growth age.<sup>29</sup> On the other hand, when they were arranged in subgroups according to BMI, the obese and overweight individuals obviously received higher amount of energy compared to others.<sup>17</sup> Taking the above-mentioned points together, it becomes clear that two burdens of malnutrition are threatening this age group. Distribution of macronutrients contribution to energy was relatively suitable.<sup>17,18,34,35</sup> However, it seems that the diet quality should be emphasized more than the quantity. Therefore saturated fat consumption should be decreased and instead unsaturated fatty acids intake should be raised. Furthermore, fiber intake was nearly half the recommended amounts in this population<sup>31,37,38</sup> and so, consumption of high fiber should be encouraged. Micronutrients deficiency could vary by sample and place. Although calcium, phosphorus, folate and iron might be the more common micronutrients that are lower than the standard values in most individuals,<sup>17,31,38</sup> dietary interventions or recommendations should be based on the individual conditions of each sample.

In almost all samples, fruit, vegetables, dairy and whole grain intakes were lower than the recommended amounts and con-

sumption of high fat foods and soft drink were higher than the acceptable values.<sup>17,34,37,38,42</sup> Therefore, refined grain should be substituted by whole grain and daily diet should include more fruits and vegetables. Following these guidelines could result in higher fiber intake, as well.

Nowadays the researchers' attention is shifting from nutrient-based to overall diet-based view. Among whole-diet indices, only DDS HEI and dietary energy density were examined in the Iranian youth.<sup>32,36,39,41</sup> The mean score for almost all studies was close to half of the full possible score which is not favorable. A study identified 6 dietary patterns using factor analysis.<sup>30</sup> Considering the principal component of each dietary pattern, 2 are healthy and 4 are unhealthy dietary patterns. It seems that the majority of participants had unhealthy diet but in various patterns.

Dietary habits may be the most important part of intervention programs aimed at improving dietary intakes. It seems that skipping breakfast and taking snacks between meals are more common, especially in adolescents and young adults.<sup>17,20,22,33,38</sup> In addition, food choices and preferences should be improved in this age group. The method of preparing dishes is another key element of healthy diet. In Iran, traditional foods are being replaced by fast foods and this transition is occurring at a faster rate among the youth.<sup>16,48</sup> Moreover, according to surveys, there is a tendency toward unhealthy snacks among the youth.<sup>49,50</sup> They prefer sweetened beverages, salty and sweet snacks over fruits and vegetables. This result is in line with the findings in adult populations.<sup>51</sup>

It is the first review that covered all aspects of diet and gathered data on different levels of dietary exposures. This paper considered different levels of diet quality including nutrient, food, and food group intake, diet quality indices, dietary patterns and dietary habits. The present review used a systematic approach to obtain relevant papers. There are some limitations that may be worth highlighting. The first is the wide scope of the review. Although comprehensiveness may be the strength of

this paper, the wide scope can also be considered a weakness for the present study. If the scope were narrow, more focus could be provided on the issue and a meta-analysis would have been possible. Because different dietary exposures represent diet quality to some degree and due to the small number of papers in each specific issue, this study considered all levels of diet exposures among both adolescents and young adults. The second limitation is that the studies were mostly from Tehran and Isfahan and few studies were conducted in other parts of Iran. Therefore, it may be not correct to extrapolate the results to all Iranian. Nevertheless, it should be noted that Tehran and Isfahan are populous cities and have heterogeneous populations.

Diet quality and dietary habits of Iranian youth should be improved. Most of the individuals of this age need to change their dietary patterns and food choices. Providing educational interventions for both the youth and their parents and developing policies may be effective.

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