

Association of physical activity and dietary behaviours in relation to the body mass index in a national sample of Iranian children and adolescents: CASPIAN Study

Roya Kelishadi,^a Gelayol Ardalan,^b Riaz Gheiratmand,^c Mohammad Mehdi Gouya,^b Emran Mohammad Razaghi,^b Alireza Delavari,^b Reza Majdzadeh,^d Ramin Heshmat,^d Molouk Motaghian,^c Hamed Barekati,^b Minou Sadat Mahmoud-Arabi^b & Mohammad Mehdi Riazi^b for the CASPIAN Study Group

Objective To examine the relation of dietary and physical activity (PA) patterns with the body mass index (BMI), and the associations between these patterns among children.

Methods A representative sample of 21 111 school students aged 6–18 years was selected by multistage random cluster sampling from 23 provinces in the Islamic Republic of Iran. PA and dietary pattern were assessed by self-administered validated questionnaires.

Findings Fruit and vegetables, dairy products and snacks (salty, fatty or sweet) had a similar consumption frequency of approximately twice a day. The type of fat most frequently consumed was hydrogenated solid fat (consumed by 73.8% of families). The PA level was significantly higher among boys than girls, in rural than in urban residents, and in intermediate students than high-school students. Among boys, the frequency of consumption of vegetables and plant proteins ($R^2=0.46$); and among girls, the frequency of consumption of dairy products and fruits, as well as high PA level had a significant inverse association with BMI ($R^2=0.57$). Among boys, the low frequency of consumption of fruits, the time spent on PA and the energy expenditure; and among girls, the time spent on PA and the energy expenditure, had significant relationships with overweight. When controlling for covariates, PA levels had significant relationships with the frequency of consumption of all food groups.

Conclusion Unhealthy lifestyles make Iranian young people prone to chronic diseases later in life. When examining their health benefits, the interrelationship of dietary and PA behaviours should be considered.

Bulletin of the World Health Organization 2007;85:19-26.

Voir page 24 le résumé en français. En la página 25 figura un resumen en español.

يمكن الاطلاع على الملخص بالعربية في صفحة 25.

Introduction

According to WHO estimates, by 2020, noncommunicable diseases (NCD) will account for approximately three quarters of all deaths in the developing world.¹ Interest in childhood precursors to chronic diseases is increasing because the behavioural and biological risk factors for chronic diseases persist from childhood into adulthood.²⁻⁴ Declining levels of physical activity (PA) as well as nutrition transition (i.e. the trend towards increased consumption of a diet high in saturated fat, sugar and refined foods, and low in fibre) among communities are thought to be partly responsible for the rising rate of such risk factors worldwide.⁵⁻⁷

In this regard, a potential emerging public health concern in developing countries is likely to be the increasing incidence of childhood overweight, which in the future is likely to create an enormous public health burden.⁸

In recent years, in addition to problems in adults, the epidemiological transition has made Iranian young people prone to chronic diseases in later life.⁹⁻¹¹

Although previous studies have determined the associations between PA and dietary habits in relation to overweight in developed countries, it is not clear if their findings can be generalized to other ethnic groups with very different cultures and lifestyles. Consequently, for the first time in the Islamic

Republic of Iran, and to our knowledge for the first time in the WHO Eastern Mediterranean Region, a national-level baseline survey has been performed as part of the Childhood & Adolescence Surveillance and PreventIon of Adult Non-communicable disease: CASPIAN Study. The current paper used the baseline data from this large study to examine the associations between dietary and PA patterns, as well as their relation to the body mass index (BMI) among a nationally representative sample of children and adolescents.

Methods

This cross-sectional study was performed at the national level in 2003–04 in a

^a Preventive Pediatric Cardiology Department, Isfahan Cardiovascular Research Centre (WHO Collaborating Centre in EMR), Isfahan University of Medical Sciences, PO Box 81465-1148, Isfahan, Islamic Republic of Iran. Correspondence to this author (email: Kelishadi@med.mui.ac.ir).

^b Ministry of Health and Medical Education, Islamic Republic of Iran.

^c Ministry of Education, Islamic Republic of Iran.

^d School of Public Health and Institute of Public Health Research, Tehran University of Medical Sciences, Islamic Republic of Iran.

Ref. No. 06-030783

(Submitted: 7 February 2006 – Final revised version received: 25 May 2006 – Accepted: 31 May 2006)

joint collaboration supported by a grant from WHO/WHO Regional Office for the Eastern Mediterranean and by the Iranian National Ministry of Health (MoH) and Ministry of Education (MoE). It was a multicentre study performed among 21 111 school students (96% participation rate), aged 6–18 years, living in urban areas and in the rural areas surrounding the central cities of 23 (out of 28) provinces in the Islamic Republic of Iran.

Approval for the study was granted by ethics committees and other relevant national regulatory organizations. The Data and Safety Monitoring Board of the project closely supervised the quality control and quality assurance of the survey at the national level.

The project team obtained written informed consent from parents and oral assent from students. They selected school students by multistage random cluster sampling. Schools were stratified according to location (urban or rural), and the socioeconomic characteristics of their catchment area, taking into consideration the proportion of the different types of schools (public or private) to avoid socioeconomic bias.

Questionnaires in the Farsi language were prepared based on the questionnaires used in the WHO STEPwise approach to noncommunicable diseases (Tools version 9.5) and the WHO Global School-based Student Health Survey (GSHS). The questions concerning the sociodemographic characteristics, the child's birth weight, and his or her feeding during infancy, as well as the family history of chronic diseases and family dietary habits were included in the parents' questionnaire. Students filled in a validated food frequency questionnaire. The validity of our questionnaire's content was affirmed by a panel of experts; item analysis and reliability measures were assessed in a pilot study.

The students' PA pattern was assessed by the questionnaire in which nine different metabolic equivalent (MET) levels were ranged on a scale from sleep/rest (0.9 METs) to high-intensity physical activities (>6 METs); this instrument was assessed by comparison with measurement of physical activity by accelerometry and keeping a PA diary.¹² The questionnaire had previously been modified and validated among Iranian young people,¹³ and was found to be significantly associated with the results obtained using the International Physical Activity Questionnaire (IPAQ).¹⁴

Table 1. Linear regression analysis of factors studied with the body mass index of a national sample of Iranian children and adolescents aged 6–18 years (n=21 111)

Sex	Regression coefficient	Standard error	P-value
Boys (n= 10 253)			
(Constant)	15.6	0.4	<0.0001
History of breastfeeding	−0.4	0.1	<0.0001
Mother's education	0.2	0.1	0.02
Father's education	0.2	0.09	0.04
Plant protein (times/week)	−0.08	0.02	0.001
Vegetables ^a (times/week)	−0.05	0.02	0.005
Positive family history of obesity ^b	0.2	0.05	0.03
Rural residence	−0.9	0.1	<0.0001
Girls (n= 10 858)			
(Constant)	13.3	0.5	<0.0001
History of breastfeeding	−0.5	0.1	<0.0001
Mothers' education	0.2	0.07	0.001
Positive family history of obesity	0.2	0.04	<0.0001
Fruits ^c (times/week)	−0.06	0.01	<0.0001
High physical activity level ^d	−0.3	0.1	0.002
Dairy product (times/week)	−0.03	0.01	0.007
Birth weight	0.3	0.1	0.04

^a Potatoes and chips not included.

^b Parents, grandparents, aunts, uncles.

^c Fresh, dried, juice.

^d 3rd tertile of physical activity.

For each activity level, the MET-value was multiplied by the time spent at that particular level. The MET-time at each level was added to obtain a total over 24 hours MET-time, representing the PA level on an average weekday. Energy expenditure was estimated by multiplying the total 24-hour MET-time by the body weight. In the current study, we categorized the PA level according to the tertiles computed in the population studied, and scored it from 1 to 3 corresponding to the 1st to the 3rd tertile.

Under the supervision of expert health care professionals, each student and one of the parents, who was invited to the school, filled in the self-administered questionnaire at the same time. The nurses recorded the student's age, and measured height and weight using standard protocols.¹⁵ BMI was computed as weight in kilograms divided by the square of height in metres. The BMI cut-off points used were those from the Centers for Disease Control and Prevention (CDC).¹⁶

The data entry staff entered data for all forms and questionnaires twice and checked for completeness and inconsistencies. The data checking process was

conducted first at the district and then at the national level.

Statistical analysis

After editing, the data were analysed using the SPSS software package version 13.0 (SPSS, Inc. Chicago, IL). The relationship between the time spent watching television and/or at a computer with BMI was assessed by the Pearson correlation coefficient. The linear regression analysis was performed between BMI as the dependent variable and possible related variables. Odds ratios from logistic regression models were employed to evaluate the gender-specific associations of overweight with possible associated factors.

Analyses of variance (ANOVA) were performed to determine significant interactions of PA level, age and BMI as the dependent variables, and gender, living area (urban versus rural) and BMI as the dependent variables; significant findings were further analysed using post hoc tests.

Analyses of covariance (ANCOVA) were conducted that included PA level (tertiles) as the independent variable, and the weekly consumption of different food groups as the dependent variables

Table 2. Logistic regression of factors studied and overweight in a national sample of Iranian children and adolescents aged 6–18 years ($n=21\ 111$)

	BMI < 85th percentile	BMI \geq 85th percentile	Odds ratio	Confidence intervals (95%)
Boys				
<i>n</i> (%)				
10 253 (48.6)	9 556 (93.2%)	697 (6.8%)		
<i>Frequency of consumption of fruits (fresh, dried, juice)</i>	(%)	(%)		
\leq once (per day)	46.8	51.5	0.6	(0.4–0.9) ^a
<i>Father's education</i>				
\geq 16 years	11.8	18.1		
Illiterate	13.4	8.1	0.1	(0.06–0.4) ^b
\leq 5 years	28.2	20.4	0.8	(0.4–1.4)
8 years	20.6	17.5	0.6	(0.3–1.1)
12 years	23.0	33.0	0.9	(0.5–1.5)
<i>Living area</i>				
Urban	71.5	80.3	1.6	(1.02–2.5) ^a
<i>Energy expenditure (kcal)</i>	2 113.8 (1 037)	3 178 (1 154)	1.004	(1.003–1.004) ^b
	Hours/day			
<i>Time spent on physical activities of different intensities</i>	Mean (SD)^c			
Sedentary (< 3 METs) ^d	18.0 (3.1)	18.1 (2.8)	0.7	(0.7–0.8) ^b
Moderate (3–6 METs)	4.4 (1.5)	4.3 (1.4)	0.4	(0.3–0.5) ^b
Vigorous (\geq 6 METs)	0.9 (0.1)	0.9 (0.03)	0.1	(0.1–0.2) ^b
Girls				
<i>n</i> (%)				
10 858 (51.4)	10 141 (93.3%)	717 (6.7%)		
	Mean (SD)	Mean (SD)		
<i>Energy expenditure (kcal)</i>	1 782.1 (784)	2 534 (863)	1.004	(1.004–1.005) ^b
	Hours/day			
<i>Time spent on physical activities of different intensities</i>	Mean (SD)			
Sedentary (< 3 METs) ^d	19.0 (2.9)	19.2 (3.0)	0.7	(0.6–0.8) ^b
Moderate (3–6 METs)	3.7 (0.4)	3.6 (0.3)	0.4	(0.3–0.4) ^b
Vigorous (\geq 6 METs)	0.4 (0.03)	0.5 (0.08)	0.2	(0.1–0.2) ^b

^a $P < 0.05$.^b $P < 0.0001$.^c SD, Standard deviation.^d MET, metabolic equivalent.

after controlling for BMI, age, gender and living area. Significant findings were further examined by linear regression models in which consumption of different food groups provided the dependent variables and PA level the independent variables, after controlling for age, gender, school level (e.g. intermediate or high), and living areas, then significant interaction terms were also plotted on graphs as well. The significant level was set at $P < 0.05$.

Results

This study included 10 858 girls (51.4%) and 10 253 boys (48.6%) with a mean age of 12.2 ± 3.3 years. In total, 84.6% of the participants were from urban and 15.4% from rural areas and 90%

were from public and 10% from private schools. Most students' fathers worked in the private sector (34.9%) or were governmental employees (31.5%), and most of their mothers (88.9%) were housewives.

The mean BMI of the subjects studied was 18.5 ± 3.8 kg/m², with no gender-specific difference. The prevalences of underweight and normal weight were 13.9% (8.1% of boys and 5.7% of girls), and 72.7% (36.6% of boys and 36.2% of girls), respectively. Overweight and obesity was seen in 8.82% (4.3% of boys and 4.6% of girls), and 4.5% (2.5% of boys and 2% of girls), respectively.

The type of fat most frequently consumed in food prepared in the students' homes was hydrogenated solid fat (73.8%). Most students (58.4%)

consumed breads prepared with white wheat flour, and 19.7% of students declared that they never added salt to the food they consumed at the table. The mean frequency of consumption of deep-fried foods at home was 3.98 times per week. These eating patterns did not differ significantly between the different provinces in the study.

Overall, the consumption frequency for fruit, vegetables, dairy products and snacks (salty, fatty or sweet) was similar — almost twice a day. The PA level was significantly higher among boys than girls, in rural than in urban residents, and in the intermediate- than in the high-school students. Of the subjects studied, 34.4%, 38.9% and 25.1%, were included in the first, second and third tertiles of PA, respectively. The

mean lengths of time spent on television viewing and/or at the computer (playing games or on the Internet) among boys and girls were 4.6 and 4.1 hours per day, respectively; and both were significantly correlated ($P < 0.0001$) with BMI ($r = 0.61$ and 0.48 , respectively).

As shown in Table 1, a history of breastfeeding, the frequency of consumption of dairy products and fruits, as well as high PA level showed a significant inverse association with BMI; R^2 was 0.467 among boys and 0.572 among girls. In this table, the dependent variable is BMI and the independent variables are frequency of consumption of different food groups, level of physical activity, parents' education, parents' occupation, school level, living area, type of milk and supplementary food consumed in infancy, birth weight, family history of obesity, family history of premature (<55 y) cardiovascular diseases, frequency of consumption of deep-fried foods, type of fat and bread consumed.

Low frequency of consumption of fruits, living in an urban area, the time spent on PA, the energy expenditure and the fathers' level of education remained in the logistic regression model for boys. For girls, only the time spent on PA and the energy expenditure remained in the model (Table 2). When controlling for BMI, age, gender and living area, there were significant results for PA levels and the frequency of consumption of all food groups (Table 3). As depicted in Fig. 1, for both boys and girls, the lowest and highest PA levels were associated with a higher frequency of consumption of most food groups studied.

Discussion

The present study revealed unhealthy dietary habits among Iranian children and adolescents which reflect the dietary patterns of their families. The high consumption of hydrogenated solid fat as well as deep-fried foods is common in Iranian families. Usually, the largest proportion of Iranian foods consists of bread and or rice; as indicated in this study, the consumption of whole-grain products is low in most families. In addition, the present study showed a similar frequency of consumption of dairy products, fruit, vegetables and salty, fatty or sweet snacks that indicates a low intake of healthy foods particularly fruits and vegetables and a considerable intake of unhealthy

Table 3. Results of analyses of covariance of physical activity levels and frequency of consumption (times/week) of food groups consumed (controlling for BMI, age, gender and living area) in a national sample of Iranian children and adolescents, aged 6–18 years: CASPIAN Study

Food groups	Physical activity level		
	1st tertile	2nd tertile	3rd tertile
	Mean (SE)	Mean (SE)	Mean (SE)
Dairy products	14.7 (0.1) ^c	15 (0.1)	15.2 (0.1) ^{d,e}
Animal protein ^b	7.6 (0.08) ^c	7.3 (0.08)	8 (0.1) ^{d,e}
Plant protein ^b	6.8 (0.09) ^c	6.5 (0.08)	7.2 (0.1) ^{d,e}
Fast foods ^b	2.4 (0.05) ^c	1.8 (0.04)	2.5 (0.06) ^e
Salty/fatty snacks ^b	4.7 (0.1) ^c	4 (0.09)	5.2 (0.1) ^{d,e}
Sweets/candies ^b	10 (0.1) ^c	9 (0.1)	10.9 (0.1) ^{d,e}
Vegetables ^{b,f}	7.8 (0.09) ^c	7.5 (0.08)	8.3 (0.1) ^{d,e}
Fruits (fresh, dried, juice) ^a	9 (0.1) ^c	8 (0.1)	9.5 (0.1) ^{d,e}
Fruits and vegetables ^b	16.9 (0.2)	15.2 (0.1)	17.8 (0.2) ^{d,e}
Carbohydrates ^b	23.8 (0.1) ^c	24.9 (0.1) ^c	25.2 (0.1) ^d

^a $P < 0.05$.

^b $P < 0.001$.

^c Significant difference between 1st and 2nd tertile.

^d Significant difference between 1st and 3rd tertile.

^e Significant difference between 2nd and 3rd tertile.

^f Potatoes and chips not included.

snacks among children and adolescents. Our findings are consistent with many recent studies among young people of different populations that have reported unhealthy dietary habits.^{17,18}

The Middle East has the highest dietary energy surplus of the developing countries, and because of the epidemiological transition, a rapid rise in risk factors for cardiovascular disease is a potential emerging public health issue.¹⁹ Data on the young people living in the Middle East are very limited in this regard, but it is widely assumed that the picture of health and nutritional status in this region has changed during the past four decades; the traditional diet has been replaced by a more westernized diet; and elderly people are now more likely to consume healthy foods than young people.^{20,21}

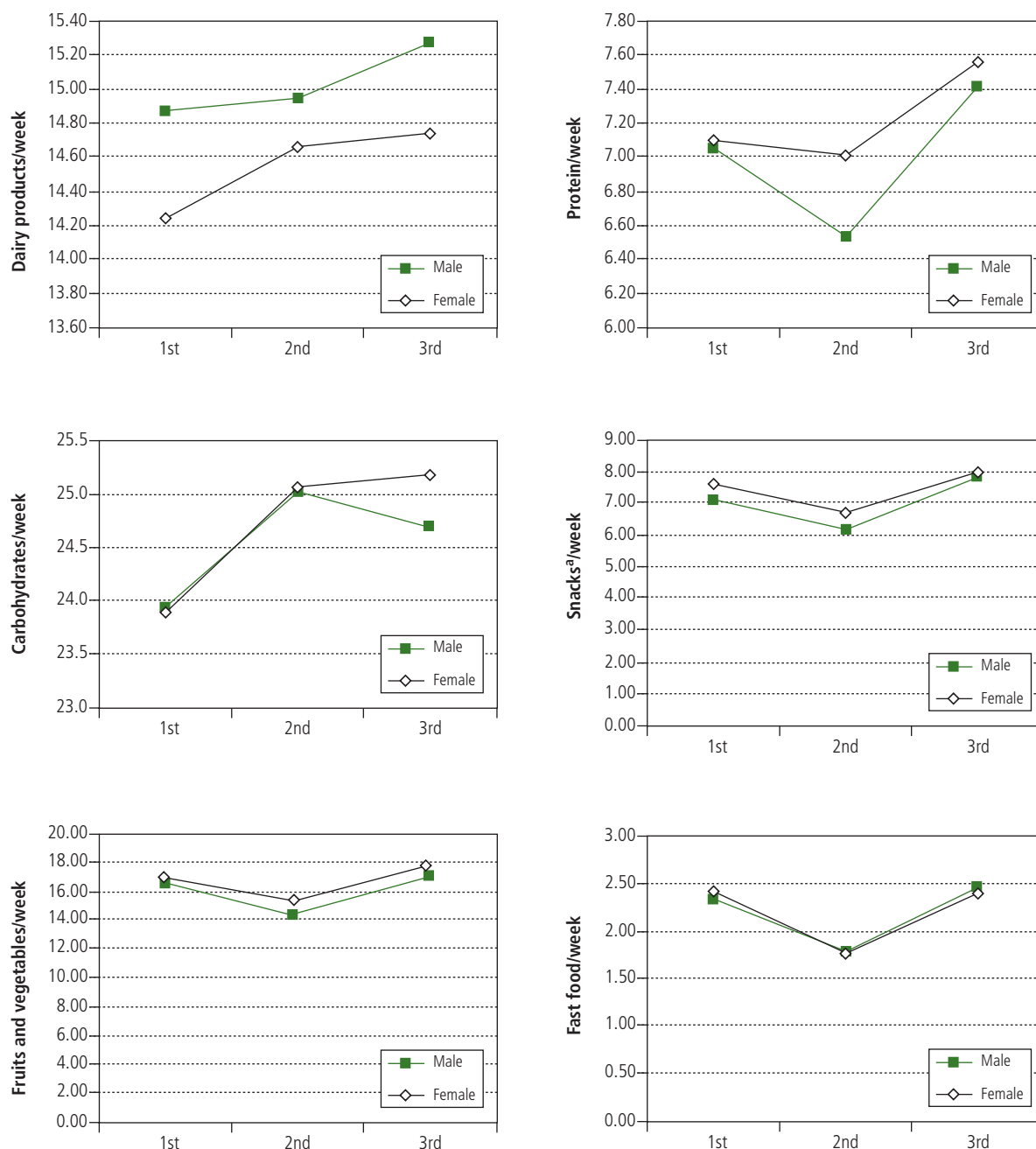
The Islamic Republic of Iran has undergone a rapid nutrition transition. This is suggested to be secondary to the rapid change noted in fertility and mortality patterns and to urbanization. This transition has led to a considerable imbalance in food consumption with low nutrient density characterizing the diet and over-consumption evident among more than a third of households.²² The few studies performed of dietary habits among Iranians have shown similar patterns in the general population.²³ Even a national study in very young children

revealed that the weekly frequency of consumption of junk food was higher than that of major food items.²⁴

During the past few decades, in developed countries, PA levels among both adults and children have declined steadily.^{25,26} Data from three national surveys among Iranian adults have shown that more than 80% of the Iranian population are physically inactive.²³ The few local studies performed in Iranian young people have revealed a similar pattern.^{27,28} The decrease in PA levels is suggested to be a result of an increase in time spent watching television and playing computer games, as well as of a decrease in opportunities for PA in schools and communities.

A complex interaction between genetic, environmental and behavioural factors is known to be the underlying cause of childhood obesity.²⁹ However, findings on the role of dietary pattern and PA rates in this global health problem are inconclusive.³⁰ In our study, a history of breastfeeding, higher intake of dairy products, fruit and vegetables as well as high PA level had a significant inverse association with BMI. Among boys, low consumption of fruits, living in an urban area, time spent on PA, energy expenditure and the fathers' education were significantly associated with overweight, and among girls, only the time spent on PA and the energy

Fig. 1. Reported frequency of consumption of different food groups (times/week) by physical activity level (1st to 3rd tertile) in a national sample of Iranian children, controlled for age, body mass index and living area: CASPIAN Study



^a Snacks, salty, fatty and sweet types.

expenditure were significantly associated with overweight. These findings are consistent with those of some previous studies.³¹⁻³³

Of particular interest in the context of our study are the inverse associations between overweight and fruit consumption. This finding is consistent with the results of Bernard et al.³⁴ Barba et al. were the first to report a significant inverse association between frequency of milk consumption and BMI in children.³⁵ In our study, such findings were significant

for boys, but not for girls. Although we did not find any significant association between the frequencies of consumption of fried foods, the type of oil and bread consumed, and the BMI, such dietary habits are considered to have long-term adverse effects on health that could not be shown in this cross-sectional study.

The current study showed that the time spent on sedentary activities, e.g. watching television and playing computer games, was more than twice that recommended for this age group.³⁶ This

time was inversely related to the BMI. Although a recent study did not find such an association,³⁷ many previous studies have confirmed the impact of television viewing on childhood obesity.³⁸ This habit can have both short- and long-term effects on health,³⁹ and greater efforts to reduce sedentary activities from an early age are critical national priorities.

We found significant interactions between the levels of PA and dietary habits. The higher frequency of consumption of fruits and vegetables among

the most active subjects is suggested to be because of their healthy dietary behaviour, as well as because the activation of neurochemicals increases fruit consumption as has been shown in the animal models.⁴⁰ However, the lower consumption of fruit in those subjects with intermediate PA than the least active ones is not consistent with this explanation. Contrary to research in animals showing that serotonin — activated by PA — may suppress protein intake,⁴¹ in our study the frequency of protein intake was significantly higher in the most active children than in the two groups with lower PA level. The present study found that the frequency of consumption of dairy products was positively associated with increased activity in both boys and girls. This is consistent with the study of Gillman et al.⁴², who found a positive association of calcium consumption with increased PA in adults, but is contrary to the study of Klesges et al., which showed a negative relationship between milk consumption and PA in young adults. The benefits of dairy products in the prevention and control of overweight may be explained in part by the positive association between consumption of dairy products with PA.^{44,45} Overall, the most active children and adolescents had healthier dietary behaviours than those with intermediate and low PA levels, except for the consumption of fast foods and snacks. This is suggested to be because of the easy availability of such products in environments where sports are played. However the higher consumption of such foods by those with lower activity levels could be the result of the influence of television advertisements, as demonstrated in previous studies in various communities, including the Islamic Republic of

Iran.⁴⁶ Since overweight can begin in early life,⁴⁷ increasing national control of such advertisements is desirable.

Translating the knowledge acquired in research into better care of individuals and populations is one of the objectives of our project. Based on the results obtained from the baseline survey, needs assessment and the existing health care and human resources, interventions are being designed and conducted by the Scientific/Executive Committee of the CASPIAN Study. This committee consists of a large team of policy-makers from the MoH and MoE, as well as academic members from different universities. It is conceptualizing the health of students and schoolchildren from an action-oriented perspective, to identify and prioritize prevention-oriented strategies for improving nutrition both at the school and the population levels, as well as providing facilities for increasing the curricular and extracurricular PA of youths. A multifaceted approach involving strategic communication, information dissemination and resource development is being used to ensure the sustainability of interventions.

Study limitations

We acknowledge that certain factors might have influenced the findings of the present study, such as the assumptions made regarding the few missing data and the potential recall bias in the process of recalling and recording food intake and PA. In view of the large number of subjects studied, only a quantitative food frequency questionnaire was used in the present survey, and such data can not provide figures for the precise nutrient and energy intake of the subjects studied. The findings of the analysis of factors associated with BMI

and overweight should be interpreted with caution given the cross-sectional nature of the associations.

Conclusion

The unhealthy dietary habits, as well as the sedentary lifestyle of the children in the study community, are major threats to the present and future health of this vulnerable age group and are likely to make the community prone to an epidemic of chronic disease over the next two decades. In addition, as our results showed that dietary and PA behaviours are interrelated, it is suggested that PA is taken into account when examining the benefits of health-enhancing dietary behaviours and vice versa. More research is warranted to assess the determinants of such relationships in different populations.

In the ongoing interventional phase of our project, the impact of school policy on healthy lifestyle is being considered from an integrated public health and clinical perspective. The active role of representatives from the MoH and MoE will facilitate the transfer of knowledge acquired in research into action at the school and population levels. ■

Acknowledgements

The project was funded by grant TSA03/11 WHO/EMR and by the Iranian Ministry of Health and the Ministry for Education. The authors would like to offer their sincere thanks to all members of the large team working in this project, as well as to the children and parents who participated in this study. We are grateful to Dr Beth Carlton Tohill for her incisive comments on this paper.

Competing interests: none declared.

Résumé

Relation entre l'indice de masse corporelle et l'association activité physique/ comportements alimentaires dans un échantillon national d'enfants et d'adolescents iraniens : Étude CASPIAN

Objectif Étudier la relation entre les pratiques en matière d'alimentation et d'activité physique et l'indice de masse corporelle (IMC), ainsi que les associations de ces pratiques parmi les enfants.

Méthodes Un échantillon représentatif randomisé, composé de 21 111 élèves âgés de 6 à 18 ans, a été sélectionné par une procédure de sondage en grappe à plusieurs degrés dans 23 provinces de la République Islamique d'Iran. Les pratiques en matière d'activité physique et d'alimentation ont été évaluées par des questionnaires validés auto-administrés.

Résultats Les fréquences de consommation de fruits et légumes, de produits laitiers et d'en-cas (salés, gras ou sucrés) étaient

similaires et de deux fois par jour environ. Les matières grasses les plus fréquemment consommées étaient des matières grasses solides hydrogénées (consommées par 73,8 % des familles). Le niveau d'activité physique était nettement plus élevé chez les garçons que chez les filles, chez les ruraux que chez les urbains et chez les étudiants de cycle intermédiaire que chez les étudiants de l'enseignement supérieur. Chez les garçons, la fréquence de consommation de légumes et de protéines végétales ($R^2 = 0,46$); et chez les filles, la fréquence de consommation de produits laitiers et de fruits, ainsi que la pratique d'une activité physique intensive, présentaient une corrélation inverse significative avec l'indice de

masse corporelle ($R^2 = 0,57$). Chez les garçons, la fréquence de consommation de fruits, le temps consacré à l'activité physique et les dépenses énergétiques; et chez les filles, le temps consacré à l'activité physique et les dépenses énergétiques, étaient significativement corrélés avec le poids. Les autres cofacteurs étant maintenus constants, les niveaux d'activité physique étaient significativement corrélés avec la fréquence de consommation de l'ensemble des groupes d'aliments.

Conclusion La pratique de modes de vie nuisibles à la santé a augmenté la prédisposition des jeunes Iraniens aux maladies chroniques à un stade ultérieur de la vie. Lorsqu'on examine les bénéfices pour la santé de l'activité physique et de comportements alimentaires sains, les interactions entre ces deux facteurs doivent être prises en compte.

Resumen

Asociación de la actividad física y los hábitos alimentarios en relación con el índice de masa corporal en una muestra nacional de niños y adolescentes iraníes: estudio CASPIAN

Objetivo Examinar la relación entre los hábitos alimentarios y el grado de actividad física (AF) por un lado y el índice de masa corporal por el otro, así como las asociaciones entre esas variables en la población infantil.

Métodos Se seleccionó una muestra representativa de 21 111 escolares de 6-18 años mediante técnicas de muestreo aleatorio multietápico por conglomerados en 23 provincias de la República Islámica del Irán. La AF y los hábitos alimentarios se evaluaron mediante cuestionarios validados autoadministrados.

Resultados La frecuencia de consumo de frutas y verduras, productos lácteos y refrigerios (salados, grasos o dulces) fue similar, de aproximadamente dos veces al día. El tipo de grasa consumido con más frecuencia eran las grasas sólidas hidrogenadas (73,8% de las familias). El nivel de AF fue significativamente mayor entre los varones que entre las muchachas, en los residentes en zonas rurales que en los de zonas urbanas, y en los alumnos de nivel

medio que en los alumnos de instituto. Entre los chicos, la frecuencia de consumo de verduras y proteínas vegetales ($R^2=0,46$), y entre las chicas la frecuencia de consumo de productos lácteos y fruta, así como un nivel alto de AF, estaban inversamente relacionados, de forma significativa, con el IMC ($R^2=0,57$). Entre los chicos, la baja frecuencia de consumo de fruta, el tiempo invertido en alguna AF y el gasto energético estaban relacionados sensiblemente con el exceso de peso. Al controlar las covariables, se observó que los niveles de AF estaban relacionados de forma significativa con la frecuencia de consumo de todos los grupos de alimentos.

Conclusión Los modos de vida poco saludables predisponen a los jóvenes iraníes a sufrir enfermedades crónicas más adelante en la vida. La relación entre los hábitos alimentarios y el nivel de AF es un aspecto a considerar a la hora de estudiar los beneficios para la salud asociados a esos factores.

ملخص

ترافق النشاط البدني مع السلوكيات الغذائية وعلاقتها بمنسب كتلة الجسم في عينة من الأطفال والمراهقين الإيرانيين: دراسة الأطفال والمراهقين لترصد وانتشار الأمراض غير السارية بين البالغين (CASPIAN).

الهدف: دراسة العلاقة بين أنماط الغذاء والنشاط البدني من جهة ومنسب كتلة الجسم، وترافق هذه الأنماط بين الأطفال. **الطريقة:** اختبرت عينة ممثلة تتألف من 21111 من أطفال المدارس الذين تتراوح أعمارهم بين 6 و18 عاماً في دراسة لعينات عنقودية عشوائية متعددة المراحل في 23 ولاية من ولايات جمهورية إيران الإسلامية، وقُيِّمَتْ أنماط الغذاء والنشاط البدني باستخدام استبيانات مصدوقة تستكمل ذاتياً. **الموجودات:** كان لكل من الفواكه والخضروات ومنتجات الألبان والوجبات السريعة (الغنية بالملح والسكريات وبالدهن) قيمةً متشابهة من حيث تكرارها لمرتين يومياً تقريباً. وكان أكثر الدسم استهلاكاً الشحوم الصلبة المهدرجة، إذ كانت تستهلك من قبل 73.8% من الأسر. أما مستوى النشاط البدني فقد كان أعلى وبدرجة ملموسة بين الفتيان منه بين الفتيات، ولدى سكان الأرياف منه لدى سكان المدن، ولدى طلاب المرحلة الإعدادية (المتوسطة) منه لدى طلاب المرحلة العليا (الثانوية). وقد كانت هناك علاقة عكسية واضحة بين منسب كتلة الجسم لدى الفتيان من جهة (R^2 يساوي 0.57) «حيث R^2

مربع مدى التمثيل» وبين تكرار استهلاك الخضروات والبروتينات النباتية المنشأ (R^2 يساوي 0.46)، أما لدى الفتيات فقد كان هناك علاقة عكسية بين منسب كتلة الجسم من جهة وبين تكرار استهلاك منتجات الألبان والفواكه ومستوى النشاط البدني. كما كان لكل من انخفاض تكرار استهلاك الفواكه وانخفاض الوقت الذي يُقضى في ممارسة النشاط البدني وصراف الطاقة لدى الفتيان، وانخفاض الوقت الذي يُقضى في ممارسة النشاط البدني وصراف الطاقة لدى الفتيات علاقة مباشرة وطردية مع زيادة الوزن. وعند تصحيح العوامل المرافقة وفقاً للشواهد نجد أن مستويات النشاط البدني علاقة هامة مع تكرار استهلاك جميع المجموعات الغذائية. **الاستنتاج:** أن أنماط الحياة المنافية للصحة تجعل حياة الإيرانيين الشباب معرضة للأمراض المزمنة في مرحلة متقدمة من حياتهم. وينبغي إيلاء دراسة المنافع الصحية والعلاقات المتبادلة للسلوكيات الغذائية وسلوكيات النشاط البدني ما تستحقه من اهتمام.

References

- World Health Organization. *Global strategy for non-communicable disease prevention and control* (Draft). Geneva: WHO; 1997. WHO document WHO/NCD/GS/97.1.
- Guo SS, Huang C, Maynard LM, Demerath E, Towne B, Chumlea WC, et al. Body mass index during childhood, adolescence and young adulthood in relation to adult overweight and adiposity: the Fels Longitudinal Study. *Int J Obes Relat Metab Disord* 2000;24:1628-35.
- McGill HC Jr, McMahan CA, Herderick EE, Zieske AW, Malcom GT, Tracy RE. Obesity accelerates the progression of coronary atherosclerosis in young men. *Circulation* 2002;105:2712-8.
- McGill HC Jr, McMahan CA, Zieske AW, Sloop GD, Walcott JV, Troxclair DA. Associations of coronary heart disease risk factors with the intermediate lesion of atherosclerosis in youth. *Arterioscler Thromb Vasc Biol* 2000;20:1998-2004.
- Andersen RE, Crespo CJ, Bartlett SJ, Cheskin LJ, Pratt M. Relationship of physical activity and television watching with body weight and level of fatness among children: results from the Third National Health and Nutrition Examination Survey. *JAMA* 1998;279:938-42.
- Molnar D, Livingstone B. Physical activity in relation to overweight and obesity in children and adolescents. *Eur J Pediatr* 2000;159:S45-55.
- Goran MI, Reynolds KD, Lindquist CH. Role of physical activity in the prevention of obesity in children. *Int J Obes Relat Metab Disord* 1999;23:S18-33.
- Monteiro CA, Conde WL, Lu B, Popkin BM. Obesity and inequities in health in the developing world. *Int J Obes* 2004;28:1181-6.
- Kelishadi R, Pour MH, Zadeegan NS, Kahbazi M, Sadry G, Amani A, et al. Fat intake and serum lipid profile in Iranian adolescents: IHHP-HHPC. *Prev Med* 2004;39:760-6.
- Azizi F, Rahmani M, Madjid M, Allahverdian S, Ghanbili J, Ghanbarian A, et al. Serum lipid levels in an Iranian population of children and adolescents: Tehran lipid and glucose study. *Eur J Epidemiol* 2001;17:281-8.
- Kelishadi R, Pour MH, Sarraf-Zadegan N, Sadry GH, Ansari R, Alikhassy H, et al. Obesity and associated modifiable risk factors in Iranian adolescents: IHHP-HHPC. *Int Pediatr* 2003;45:435-42.
- Aaddahl M, Jorgensen T. Validation of a new self-report instrument for measuring physical activity. *Med Sci Sport & Exercise* 2003;1196-202.
- Kelishadi R, Rabiee K, Khosravi A, Famori F, Sadeghi M, Roohafza H, et al. Assessment of physical activity in adolescents of Isfahan [in Farsi]. *J Shahrekord Uni Med Sci* 2004;3:55-65.
- Craig CL, Marshall AL, Sjörström M, Bauman AE, Booth ML, Ainsworth BE, et al., and the IPAQ Consensus Group and the IPAQ Reliability and Validity Study Group. International Physical Activity Questionnaire (IPAQ): 12-country reliability and validity. *Med Sci Sports Exerc* 2003;35:1381-95.
- Lohman TG, Roche AF, Martorell R. *Anthropometric standardization reference manual*. Campaign, IL: Human Kinetics Publishers; 1988.
- Kuczmariski RJ, Ogden CL, Grummer-Strawn LM. CDC growth charts: United States. *Adv Data* 2000;314:1-27.
- Yang GH, Ma JM, Liu N, Chen AP. Study on diet, physical activities and body mass index in Chinese population in 2002. *Zhonghua Liu Xing Bing Xue Za Zhi* 2005;26:246-51.
- Omar HA, Rager K. Prevalence of obesity and lack of physical activity among Kentucky adolescents. *Int J Adolesc Med Health* 2005;17:79-82.
- Galal O. Nutrition-related health patterns in the Middle East. *Asia Pac J Clin Nutr* 2003;12:337-43.
- Musaiger AO. Diet and prevention of coronary heart disease in the Arab Middle East countries. *Med Princ Pract* 2002;11 Suppl 2:9-16.
- al-Roomi KA, Musaiger AO, al-Awadi AH. Lifestyle and the risk of acute myocardial infarction in a Gulf Arab population. *Int J Epidemiol* 1994;23:931-9.
- Ghassemi H, Harrison G, Mohammad K. An accelerated nutrition transition in Iran. *Public Health Nutr* 2002;5:149-55.
- Sheikholeslam R, Mohamad A, Mohammad K, Vaseghi S. Non-communicable disease risk factors in Iran. *Asia Pac J Clin Nutr* 2004;13 Suppl 2:S100.
- Kolahdooz F, Sheikholeslam R, Naghavi M, Abdollahi Z. Junk food consumption: an indicator of changing dietary habit in Iranian children. *Asia Pac J Clin Nutr* 2004;13 Suppl:S121.
- Reilly JJ, Jackson DM, Montgomery C, Kelly LA, Slater C, Grant S, et al. Total energy expenditure and physical activity in young Scottish children: mixed longitudinal study. *Lancet* 2004;363:211-2.
- French SA, Story M, Jeffery RW. Environmental influences on eating and physical activity. *Annu Rev Public Health* 2001;22:309-35.
- Kelishadi R, Sadri GH, Tavasoli AA, Kahbazi M, Roohafza HR, Sadeghi M, et al. The Cumulative prevalence of atherosclerotic cardiovascular diseases' risk factors in Iranian adolescents. *J Pediatr* 2005;81:447-53.
- Kelishadi R, Hashemipour M, Ansari R, Rouhafza H, Sarraf-Zadegan N, Bashardoust N. Trend of physical activity level among adolescents of Isfahan 1994-2001 [in Farsi]. *Res Med Sci* 2002;7:112-7.
- Dorsey KB, Wells C, Krumholz HM, Concato JC. Diagnosis, evaluation, and treatment of childhood obesity in pediatric practice. *Arch Pediatr Adolesc Med* 2005;159:632-8.
- Janssen I, Katzmarzyk T, Boyce WF, Vereecken C, Mulvihill C, Roberts C, et al. and The Health Behaviour in School-Aged Children Obesity Working Group. Comparison of overweight and obesity prevalence in school-aged youth from 34 countries and their relationships with physical activity and dietary patterns. *Obes Rev* 2005;6:123-32.
- Hanley AJG, Harris SB, Gittelsohn J, Wolever TM, Saksvig B, Zinman B. Overweight among children and adolescents in a native Canadian community: prevalence and associated factors. *Am J Clin Nutr* 2000;71:693-700.
- Wolf AM, Gortmaker SL, Cheung L, Gray HM, Herzog DB, Colditz GA. Activity, inactivity and obesity: racial, ethnic and age differences among school girls. *Am J Public Health* 1993;83:1625-7.
- Obarzanek E, Schreiber GB, Crawford PB, Goldman SR, Barrier PM, Frederick MM, et al. Energy intake and physical activity in relation to indices of body fat: the National Heart, Lung, and Blood Institute Growth and Health Study. *Am J Clin Nutr* 1994;60:15-22.
- Bernard L, Lavallee C, Gray-Donald K, Delisle H. Overweight in Cree schoolchildren and adolescents associated with diet, low physical activity, and high television viewing. *J Am Diet Assoc* 1995;95:800-2.
- Barba G, Troiano E, Russo P, Venezia A. Siani Alnverse association between body mass and frequency of milk consumption in children. *Br J Nutr* 2005;93:15-9.
- Gentile DA, Oberg C, Sherwood NE, Story M, Walsh DA, Hogan M. American Academy of Pediatrics. Well-child visits in the video age: pediatricians and the American Academy of Pediatrics' guidelines for children's media use. *Pediatrics* 2004;114:1235-41.
- Forshee RA, Anderson PA, Storey ML. The role of beverage consumption, physical activity, sedentary behavior, and demographics on body mass index of adolescents. *Int J Food Sci Nutr* 2004;55:463-78.
- Fleming-Moran M, Thiagarajah K. Behavioral interventions and the role of television in the growing epidemic of adolescent obesity — data from the 2001 Youth Risk Behavioral Survey. *Methods Inf Med* 2005;44:303-9.
- Hancox RJ, Milne BJ, Poulton R. Association between child and adolescent television viewing and adult health: a longitudinal birth cohort study. *Lancet* 2004;364:257-62.
- Weicker H, Struder HK. Influence of exercise on serotonergic neuromodulation in the brain. *Amino Acids* 2001;20:35-47.
- Smith BK, York DA, Bray GA. Activation of hypothalamic serotonin receptors reduced intake of fat and protein but not carbohydrate. *Am J Physiol* 1999;277:R802-11.
- Gillman MW, Pinto BM, Tennstedt S, Glanz K, Marcus B, Friedman RH. Relationships of physical activity with dietary behaviors among adults. *Prev Med* 2001;32:295-301.
- Klesges RC, Harmon-Clayton K, Ward KD, Kaufman EM, Haddock CK, Talcott GW, et al. Predictors of milk consumption in a population of 17- to 35-year-old military personnel. *J Am Diet Assoc* 1999;99:821-6.
- Zemel MB. Calcium and dairy modulation of obesity risk. *Obes Res* 2005;13:192-3.
- Teegarden D. Calcium intake and reduction in weight or fat mass. *J Nutr* 2003;133:2495-515.
- Kelishadi R, Hashemipour M, Roohafza H, Sadeghi M. The relationship between TV advertisements and children's dietary pattern [in Farsi]. *J Isf Med School* 2004;21:71-5.
- Ludwig DS, Gortmaker SL. Programming obesity in childhood. *Lancet* 2004;364:226-7.