



NUTRITIONAL PROFILE OF ADOLESCENTS IN MOROCCO

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ABSTRACT

Introduction: according to the World Obesity Atlas 2023 report, more than four billion people are expected to suffer from obesity by 2035, compared to 2.6 billion in 2020. This 38% increase over a period of 15 years reflects the strong outbreak of the scourge in all regions of the world, particularly among children and adolescents aged 5 to 19. The aim of this work is to evaluate the nutritional profile of Moroccan adolescents aged 15 to 18 years.

Method: To achieve our objective, this study used data extracted from the database of the national survey on household consumption and expenditure 2013/2014 carried out by the High Commission for Planning in Morocco. Food consumption data were collected by a 24-h food recall taking into account seasonal variations and food waste. The nutritional analysis of the data was carried out by the Nutrilog software based on the Ciquel 2020 food composition table.

Results: This investigation concerned 5509 adolescents of which 2684 (48.7%) are boys and 2825 (51.3%) are girls. The average age of boys is 16.50 ± 1.11 years against 16.53 ± 1.11 years for girls. The proportion of adolescents residing in urban areas is dominant 59.46% for boys against 59.04% for girls. The Casablanca-Settat region is the most represented in the sample studied and includes 17.73% of boys and 16.81% of girls. The analysis of adolescent schooling shows that 3.06% of boys and 7.08% of girls have never been to school and 78.13% of boys and 68.07% of girls have at least college or qualifying secondary level. The proportion of adolescents involved in this study from disadvantaged households is 22.32% for boys against 22.97% for girls, while that of adolescents from wealthy households is 17.59% against 17.03%. relative to food consumption indicates that the average daily energy intakes are statistically different in boys and girls, 3282.22 ± 1708.74 kcal/day for boys against 2223.51 ± 51237.31 kcal/day for girls. The contribution of macronutrients in these intakes within the ranges recommended by the WHO. The intakes of certain micronutrients (Calcium, iron, Zinc and vitamin D) show significant deviations from the recommended levels.

Conclusion: The diet of Moroccan adolescents presents significant deviations from the recommendations. This situation has an impact on their nutritional status and on the development of the country. The implementation of strategies aimed at improving the health and well-being of this category of the population is necessary.

I. INTRODUCTION

The health and well-being of adolescents are essential prerequisites for achieving the Sustainable Development Goals (SDGs), particularly those relating to poverty, health security, education and the reduction of inequalities.^[1,2] Good nutrition during adolescence is necessary for growth and development and for the prevention of overweight and obesity and their consequences.^[3] The consequences of an unsuitable diet during the immediate or long-term period of adolescence on health. In the short term, insufficient dietary intakes of energy, protein or certain micronutrients are responsible for significant stunting rates and other health problems.^[4] Insufficient dietary intake, particularly of micronutrients, in adolescents increases the risk of the

occurrence of nutritional disorders, such as iron deficiency and calcium deficiency. They can also contribute to the reduction of resistance to diseases and of their mental and physical capacities.^[3] Poor nutrition during adolescence, which is a critical period of life, is associated with the onset of overweight and obesity and their metabolic abnormalities, such as high blood pressure, type 2 diabetes, metabolic syndrome, sleep disturbances and psychosocial problems.^[5, 6, 7, 8], all of which tend to persist into adulthood.^[9]

Inadequate nutrition in adolescents can also have long-term health consequences. It is responsible for increasing the risk of several non-communicable diseases (NCDs): cardiovascular diseases, type 2 diabetes and cancers, and

thus contributes significantly to the burden of preventable diseases and premature deaths.^[3] In 2017, In 2017, among adults over the age of 25, 11 million deaths and 255 million DALYs were attributable to dietary risk factors. The major dietary risk factors for death and DALYs worldwide are: high sodium intake which is responsible for 3 million deaths and 70 million DALYs, low whole grain intake which is responsible for 3 million deaths and 82 million DALYs and low fruit consumption which is responsible for 2 million deaths and 65 million DALYs.^[10]

According to the WHO, the countries of the Eastern Mediterranean region (EMR) are experiencing significant demographic and epidemiological changes with also changes in lifestyle including diet and sedentary lifestyle.^[11] This nutritional transition is characterized by high energy, lipid, added sugar and salt intakes.^[10,12] Morocco is classified among the countries where the nutritional transition is early.^[13] adolescents are among the most vulnerable population groups to the ongoing societal, lifestyle and dietary changes in countries in the region.^[14] Available data show that the region harbors one of the highest rates of childhood and adolescent obesity in the world and micronutrient deficiencies persist in many of its countries.^[15] Improving the nutritional situation of adolescents requires the implementation of actions based on reliable and up-to-date data to ensure access to adequate food. The objective of this study is to assess the nutritional profile of older Moroccan adolescents from 15 to 18 years old. In Morocco, the diet of adolescents is moderately diversified, little varied and poor in certain nutrients essential to their nutritional status and their

growth.^[16] The prevalence of overweight and obesity in adolescents is 21.6%. This proportion shows significant variations according to gender and physical activity.^[17]

MATERIAL AND METHOD

To monitor the levels and living conditions of the Moroccan population, the High Commission for Planning carries out periodic surveys on household consumption and expenditure. The 2013/2014 survey is the fifth national investigation of its kind. It aims to collect integrated data relating to expenditure, quantities consumed and the living conditions of the population.

OBJECTIVES OF THE SURVEY

The household consumption and expenditure survey is a multi-subject survey and aims to collect sufficiently detailed data on household food expenditure and consumption. Among its objectives is to assess the nutritional situation of the population and understand the food behavior of Moroccan households, in particular by: estimating the quantity of food consumed per person and per household according to the nature of the food products. analysis of food consumption according to the origin of each product and the main demographic and socio-economic characteristics of households.

Sampling

The survey's sampling plan is part of the "master sample", updated following the completion of the general population and housing census of 2004.

This plan follows the principles of a two-stage stratified survey. The sample selected for this survey comprises 15,970 households, i.e. a sampling fraction of 1/450.

	Urban	Rural	Together
Sample	10,380	5,590	15,970
Population in terms of households	4,706,309	2,484,147	7,190,456
Survey fraction	1/453	1/444	1/450

The objective being to provide a picture of the food consumption of households residing in Morocco, all socio-economic categories and regions are represented in the sample. The applied sounding is a sounding in space and time. The observation carried out with each household does not cover an entire year. It is therefore necessary to ensure a uniform distribution of the households in the sample throughout the year, in order to take into account seasonal variations. For this, data collection was spread over 12 months, in 6 periods of five "survey weeks" of 12 days each. The sample for each period was representative of the different socio-economic categories and regions of the country.

FIELD DATA COLLECTION

The organization of the work in the field is a major condition for the success of the operation. Any failure of the data collection staff in the execution of their schedule may affect the smooth running of the operation and may falsify the results.

2.1. Interview method

The observation method remains dependent to a large extent on the human and material resources mobilized. The households in the sample are observed in a single visit during a survey week.

Thus, each team made up of two investigators (a man and a woman) and a controller works in a primary unit for a period of 12 days distributed as follows:

- 1 day for contact with local authorities, enumeration of households in the drawing unit and choice of households to be surveyed.
- 8 days to complete the survey questionnaires including a 24-hour food recall for 7 days using photos of food and kitchen utensils.
- 3 days for coding, checking the questionnaires and moving between the primary units to be surveyed.

2.2. Survey staff training

The staff selected to carry out the field work for this operation is made up of experienced agents and

technicians from the regional offices of the High Commission for Planning. The choice of this staff was made among agents who had already taken part in similar surveys conducted by the Department of Statistics. The training of the chosen personnel was organized in two stages.

i/ training of trainers (regional supervisors) at the Directorate of Statistics. This training was provided by the central team for a period of five weeks

ii/ training of investigators and controllers at the level of the regional directorates. This training was provided by the regional supervisors for a period of two months.

This theoretical training was followed by practical training on filling in the questionnaires (mock test). This test lasted one month and involved the entire survey system (data collection, anthropometric measurements, encryption, consistency of responses).

3. Duration of execution and means mobilized for collection

Data collection was carried out between July 2013 and June 2014 and mobilized 16 supervisors, 77 controllers, 154 investigators, 77 drivers and 77 vehicles. Household collaboration was satisfactory and the non-response rate did not exceed 3%.

4. Field data collection

The survey was conducted by the Household Surveys Division of the Statistics Department, with, however, decentralization in terms of data collection and quantification of questions requiring a return to classifications. Thus, each of the regional directorates was responsible for carrying out the survey in its territorial field.

Field data collection work began on July 1, 2013 and ended on June 30, 2014.

The human resources (including the reserve) and materials mobilized for the execution of this operation consist of: 16 supervisors, 77 controllers, 154 investigators, 77 drivers and 77 vehicles.

5. Entry, clearance and use of data

Any statistical operation generally goes through several stages: the conceptual and methodological phase, the data collection phase and the data entry, clearance, exploitation and dissemination of results phase.

In this context, the regional offices of the High Commission for Planning have been tasked with collecting data in the field and codifying answers to questions requiring a return to classifications. The entry phase was centralized at the level of the Statistics Department.

An entry program was developed to enter the survey data. This includes a control program that performs an automatic check as the information is recorded.

Once the data has been entered, the managers responsible for carrying out this operation ensured the clearance of

the files after having received training on the application used for this task and on the practical techniques for checking the various consistency tests. data collected. To ensure good quality of the results obtained, nearly 2,000 validity and consistency tests either within the different modules or between the modules were designed, completed and corrected by the managers of the central team. The application was produced by the IT division team.

The clearance of the survey files required the development of a special data consistency control program which revolves around the following points:

- Control of identifiers (geographic code);
- Checking the completeness of the PUs surveyed;
- Presence control of mandatory cards;
- Attendance control of household members;
- Control by return to the basic documents;
- Control of the questionnaires;
- Expenditure quality control (price, quantity, etc.);
- Plausibility check of the results

2. Classification of average annual expenditure per person

One of the determinants used for the analysis and presentation of results is the average annual expenditure per person. This variable is subdivided into five (or ten) classes of equal size, in terms of people, called quintiles or deciles. These national classes (quintiles) and by area of residence are as follows.

i/ Classification according to quintile classes: the first quintile reflects the most disadvantaged 20% of the population while the fifth quintile indicates the wealthiest 20% of the population.

National Quintile in 2014

C1: less than 7149.77 DH

C2: from 7149.77 to less than 9964.29 DH

C3: from 9964.3 to less than 13639.8 DH

C4: from 13639.8 to less than 20395 DH

C5: 20395 DH and more

3. Waste survey

This statement is a very important tool for analyzing the nutrition of the population. It makes it possible to evaluate, for all the components of the meals prepared by the households, the total quantity to be consumed, the quantity of waste at the time of the preparation of the meals and the quantity of waste after taking the meal. This information is able to identify the quantity of the component actually consumed by the members of the household. Only one household per primary unit was surveyed, ie a total sample of nearly 1,450 households.

4. analytical nomenclature of goods and services

The analytical nomenclature of goods and services (NABS) is inspired by the COICOP nomenclature (Classification of Individual Consumption by Purpose) which is none other than the classification of household consumption functions and adapted to the Moroccan

case. The design of the said nomenclature is therefore in line with the recommendations of the United Nations Statistics Division with a view to harmonizing concepts and making international comparisons. It is notably used to calculate the consumer price index and the system of national accounts.

The NABS is broken down into 4 nested levels. In fact, it is made up of.

- 9 large groups at one position
- 64 two-position subgroups
- 303 subgroups with 3 positions
- Nearly 1440 goods and services coded at 4 positions

2. Food consumption analysis

Data relating to the food consumption of adolescents aged 15 to 18 were extracted from the database to be analyzed by the Nutrilog software using the Ciqual 2020 food composition table.

RESULTS

1.1. Characteristics of the adolescents surveyed

Table 1 below shows the characteristics of the population involved in this study. This investigation concerned 5509 adolescents of which 2684 (48.7%) are boys and 2825 (51.3%) are girls. The average age of boys is 16.50 ± 1.11 years against 16.53 ± 1.11 years for girls. The proportion of adolescents residing in urban areas is dominant 59.46% for boys against 59.04% for girls. The Casablanca-Settat region is the most represented in the sample studied and includes 17.73% of boys and 16.81% of girls. The analysis of adolescent schooling shows that 3.06% of boys and 7.08% of girls have never been to school and 78.13% of boys and 68.07% of girls have at least college or qualifying secondary level. The proportion of adolescents involved in this study from disadvantaged households is 22.32% for boys against 22.97% for girls, while that of adolescents from wealthy households is 17.59% against 17.03%.

Table 1: Characteristics of the adolescents surveyed.

		Male			Male			p
		Number	Mean±SD	95% CI	Number	Mean±SD	95% CI	
Age		2684	16.50±1.11	[16.46-16.55]	2825	16.53±1.11	[16.48-16.57]	0.98
Area	Urban	1596	59.46%		1668	59.04%		
	Rural	1088	40.54%		1157	40.96%		
Regions	Tanger-Tetouan-Al Hoceima	294	10.95%		315	11.15%		
	Oriental	222	8.27%		217	7.68%		
	Fes-Meknes	329	12.26%		385	13.63%		
	Rabat-Sale-Kenitra	353	13.15%		328	11.61%		
	Beni Mellal-Khenifra	250	9.31%		262	9.27%		
	Casablanca-Settat	476	17.73%		475	16.81%		
	Marrakesh-Safi	297	11.07%		324	11.47%		
	Drâa-Tafilalet	146	5.44%		160	5.66%		
	Souss Massa	184	6.86%		225	7.96%		
	Guelmim-Oued Noun	49	1.83%		28	0.99%		
	Laayoune-Sakia El Hamra	45	1.68%		65	2.30%		
	Dakhla-Oued Ed Dahab	39	1.45%		41	1.45%		
	Education level	Without any educational level	82	3.06%		200	7.08%	
Preschool		1	0.04%		0	0.00%		
Primary		467	17.40%		698	24.71%		
College secondary		1181	44.00%		864	30.58%		
Qualifying secondary		889	33.12%		976	34.55%		
Superior		46	1.71%		83	2.94%		
Other level		18	0.67%		4	0.14%		
Quintiles	C1: less than 7149.77 DH	599	22.32%		649	22.97%		
	C2: from 7149.77 to less than 9964.29 DH	549	20.45%		613	21.70%		
	C3: from 9964.3 to less than 13639.8 DH	521	19.41%		554	19.61%		
	C4: from 13639.8 to less than 20395 DH	543	20.23%		528	18.69%		
	C5: 20395 DH and more	472	17.59%		481	17.03%		

1.1. Food profile of Moroccan teenagers

Table 2 below shows the nutritional analysis of the food consumption data of the adolescents involved in this study. We note that the average daily energy intakes are statistically different in boys and girls, 3282.22 ± 1708.74 kcal/person/day for boys against 2223.51 ± 51237.31 kcal/person/day for girls.

Macronutrient intakes (carbohydrates, lipids and proteins) are higher in boys than in girls. They are respectively 495.54 ± 275.97 g/d, 92.73 ± 57.07 g/d,

99.99 ± 60.41 g/d in boys against 336.79 ± 195.36 g/d, 62.24 ± 42.06 g/d, 65.41 ± 42.41 g/d in girls. This trend is the same for fibers 44.20 ± 25.69 g/d in boys against 29.78 ± 18.11 g/d in girls.

This same table records the daily intakes of certain micronutrients among the adolescents included in this survey. In general, the daily intakes concerning the selected micronutrients are higher in boys than in girls: Calcium 733.52 ± 482.40 g/d against 493.90 ± 353.34 g/d, Iron 15.15 ± 8 , 81mg/d against 10.33 ± 6.24 mg/d,

Iodine 155.33±106.50µg/d against 105.09±82.29µg/d, 893.17±910.67µgER/d, Vitamin D 3.46±4.13µg/d
 Zinc 11.65±7.50mg/d against 7.93± 5.34mg/d, Vitamin against 2.21±2.50µg/d and folate 518.83±337.03µg/d
 A 1364.71±1335.17µgER/d against against 344.59±236.52µg/d.

Table 2: Nutritional profile of Moroccan adolescents.

	Male		Feminine		p
	Number N=2684		Number N= 2698		
	Mean ±SD	95% CI	Mean ±SD	95% CI	
Energy, total metabolizable (including fiber) (kcal)	3282.22±1708.74	[3217.56-3346.88]	2223.51±1237.31	[2177.87-22269.14]	0.00
Protein, total; calculated from total nitrogen(g)	99.99±60.41	[97.71-102.28]	65.41±42.41	[66.85-66.98]	0.00
Carbohydrates available(g)	495.54±275.97	[485.10-505.99]	336.79,±195.36	[329.42-344.00]	0.00
Lipid, total(g)	92.73±57.07	[90.57-94.89]	62.24±42.06	[60.98-63.79]	0.00
fibers; undetermined valuation method(g)	44.20±25.69	[43.23-45.17]	29.78±18.11	[29.11-30.45]	0.00
Calcium(mg)	733.52±482.40	[715.27-751.78]	493.90±353.34	[480.87-506.93]	0.00
Iron, total (mg)	15.15±8.81	[14.81-15.48]	10.33±6.24	[10.10-10.56]	0.00
Iodine(µg)	155.33±106.50	[151.30-1159.36]	105.09±82.29	[102.06-108.13]	0.00
Zinc(mg)	11.65±7.50	[11.36-11.93]	7.93±5.34	[7.73-8.13]	0.02
Vitamin A; expressed in retinol equivalents (µg)	1364.71±1335.17	[1314.19-1415.24]	893.17±910.67	[859.58-826.76]	0.00
Vitamin D(µg)	3.46±4.13	[3.31-3.62]	2.21±2.50	[2.12-2.31]	0.47
Folate, total (folacin; folic acid; vitamin B9)(µg)	518.83±337.03	[506.07-531.58]	344.59±236.52	[335.86-353.31]	0.00

1.2. Contribution of macronutrients in the daily energy intake

The figure below shows the average contribution of macronutrients (Carbohydrates, Lipids and Proteins) in the daily energy intake among the adolescents and adolescents surveyed. The average daily energy intake in boys is 3282.22±1708.74 Kcal/d. The average contribution of carbohydrates, lipids and proteins in these intakes is respectively 495.54±275.97g/d or 1982.16Kcal/d, 92.73±57.07g/d or 834.57Kcal/d and 99,

99±60.41g/d or 399.96Kcal/d, which represents respectively 60.30%, 25.50% and 12.20%.

Average daily energy intake in adolescent girls is 2223.51±1237.31 Kcal/d. The average contribution of carbohydrates, lipids and proteins in these intakes is respectively 336.79±195.36g/d or 1347.16Kcal/d, 62.24±42.06g/d or 560.16Kcal/d and 65.41 ±42.41g/d or 261.64Kcal/d, which represents respectively 60.60%, 25.19% and 11.77%.

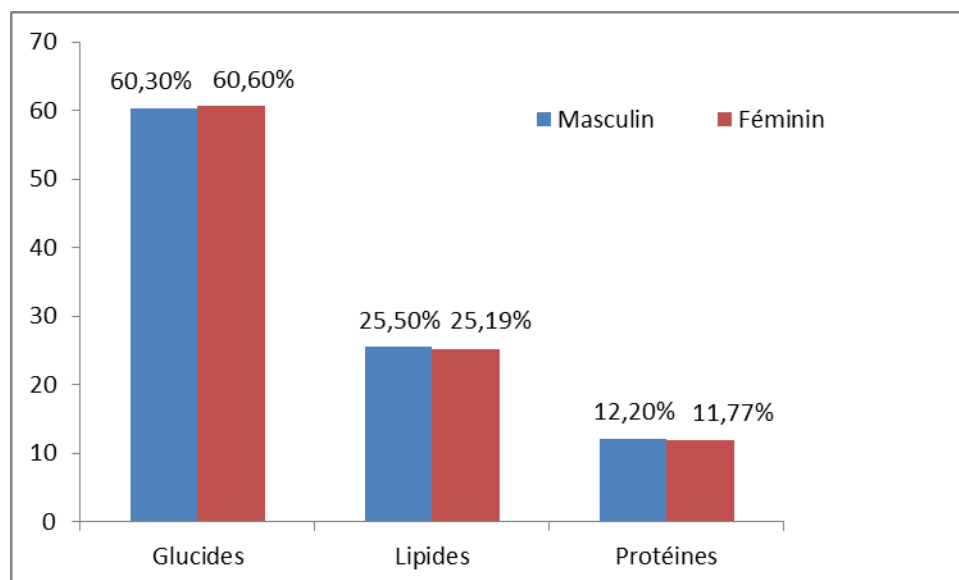


Figure no. 1: Contribution of macronutrients in the daily energy intake of Moroccan adolescents.

1.1. Daily intakes of certain micronutrients in adolescents

The table below shows the average intakes of certain micronutrients among Moroccan teenagers and teenagers. The comparison of the daily intakes of these micronutrients with those recommended by the FAO and the WHO shows that the daily intakes of.

- Calcium are insufficient in more than nine teenagers out of ten (90.7% and 91.1% respectively)
- Iron is insufficient in almost all teenage girls (98.9%) and in about three out of four teenage boys (73.4%)

- Iodine is insufficient in 38.7% of adolescents and 60.5% of adolescent girls
- Zinc are insufficient in 87.4% of adolescents and 92.3% of adolescents
- Vitamin A is insufficient in 27% of adolescents and 46.5% of adolescent girls
- Vitamin D is insufficient in 80.9% of adolescents and 90.7% of adolescent girls
- Folate is insufficient in boys 43.7% and girls 69.8%

Table 3: Daily intakes of certain micronutrients in adolescents.

Micronutrients	RDI (FAO/WHO)		Mean intake \pm SD		% insufficient intake	
	Male	Female	M (N=2684)	F (N=2825)	M (N=2684)	F (N=2825)
Calcium(mg/d)	1300	1300	733.52 \pm 482.40	493.90 \pm 353.34	90.7	91.1
Iron1(mg/d)	19	31	15.15 \pm 8.81	10.33 \pm 6.24	73.7	98.9
Iodine (μ g/d)	110	100	155.33 \pm 106.50	105.09 \pm 82.29	38.7	60.5
Zinc2(mg/d)	19.2	15.5	11.65 \pm 7.50	7.93 \pm 5.34	87.4	92.3
Vitamin A (μ gRE/d)	600	600	1364.71 \pm 1335.17	893.17 \pm 910.67	27	46.5
Vitamin D (μ g/d)	5	5	3.46 \pm 4.13	2.21 \pm 2.50	80.9	90.7
Folate (μ DFE/d)	400	400	518.83 \pm 337.03	344.59 \pm 236.52	43.7	69.8

1: low bioavailability diet (10%)

2: low bioavailability

DISCUSSION

Most of the studies available with children and adolescents have reported a low consumption of fruits, vegetables and fibers, an inadequate consumption of water, milk and dairy products, associated with a high consumption of sugary drinks. and frequent consumption of energy-dense foods. , nutrient-poor foods such as sweet and salty snacks. High fat and SFA intakes have also been observed in several studies conducted in the region, coupled with a number of micronutrient deficiencies including low intakes of calcium, iron and zinc and vitamins A, D, C and folate.^[21]

Macronutrient intakes: carbohydrates, lipids and proteins represent respectively 60.30%, 25.50% and 12.20% of daily energy intake in adolescents and 60.60%, 25.19% and 11.77% in adolescent girls. These contributions are within the ranges recommended by the WHO.

The daily fiber intake is 44.20 \pm 25.69g/d in adolescents against 29.78 \pm 18.11 in adolescent girls. These intakes are higher than those recommended by the FAO/WHO^[22] which is 25g/d. Other studies in Morocco have shown estimated fiber intakes 39.6 g/day in adolescents and 33.5 g/day in adolescent girls.^[23, 24] Similarly, in Tunisia, the average dietary fiber intake was estimated at 36 g/day, exceeding the recommended level of >25 g/day.^[25, 26]

The proportions of adolescents not reaching the recommended micronutrient levels vary according to the micronutrient studied. Our study revealed that the insufficient intakes in adolescents relate to calcium, iron, zinc and vitamin D. About nine out of ten adolescents have insufficient intakes of these micronutrients. This

situation is similar to other countries. Thus the proportions of adolescents not reaching the recommended intakes of iron, calcium and zinc are high in Iran, Pakistan, Palestine, Saudi Arabia and Lebanon.^[27, 28, 29, 30, 31]

II. CONCLUSION

This study contributes to the characterization of the dietary profile of Moroccan adolescents. The results highlighted poor eating habits among this population group. Indeed, micronutrient intakes do not reach recommended levels, which could be explained by low consumption of foods rich in minerals and vitamins and other practices that can reduce the bioavailability of certain micronutrients. These insufficient dietary intakes lead to nutritional deficiencies and represent public health problems, so it is important to develop and implement strategies to improve the diet of adolescents in our country. This strategy will improve the nutritional status of adolescents and will contribute to the achievement of the Sustainable Development Goals (SDGs)

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