

# PARENT-ADOLESCENT PATTERNS OF PHYSICAL ACTIVITY AND SEDENTARY BEHAVIORS IN NORMAL, OVERWEIGHT AND OBESE MOROCCAN ADOLESCENTS

Sara Ait Lachguer <sup>1\*</sup>, Miloud Chakit <sup>2</sup>, Hasna Kachache <sup>3</sup>, Jhadiel Kossou <sup>4</sup>,  
Rachid Boujdi <sup>5</sup>, Amina Bouziani <sup>6</sup> and Hasnae Benkirane <sup>7</sup>

<sup>1,2,3,7</sup> Biology and Health Laboratory, Faculty of Science,  
Ibn Tofail University, 14000, Kenitra, Morocco.

<sup>4</sup> School of Nutrition, Food Sciences and Technologies, Faculty of Agronomics Sciences,  
University of Abomey-Calavi, Cotonou, Republic of Benin.

<sup>5</sup> Materials and Subatomic Physics Laboratory, Faculty of Science,  
Ibn Tofail University, Kenitra, Morocco.

<sup>6</sup> Innovation and Research Laboratory for the Improvement of Teaching and Training Professions,  
Higher School of Education and Training, Ibn Tofail University 14000, Kenitra, Morocco.

\*Corresponding Author Email: [sara.aitlachguer@uit.ac.ma](mailto:sara.aitlachguer@uit.ac.ma)

DOI: [10.5281/zenodo.12669963](https://doi.org/10.5281/zenodo.12669963)

## Abstract

Physical activity (PA) has been linked to increased life expectancy and is deemed essential for the holistic development of motor, cognitive, emotional, and social aspects in children and adolescents. The role of parents as key influencers in promoting physical activity among adolescents has been firmly established. The aim of this study was to investigate the physical activity patterns within the parent-adolescent couple and explore the potential correlation between the current physical activity levels of parents and their adolescents. 84 adolescents aged 11 to 18 years from Rabat-Sale-Kenitra region of Morocco were involved, one of their parents aged 30 to 61 years. Anthropometric parameters for the parent-adolescent couples were measured in accordance with World Health Organization standards. Additionally, accelerometers were employed over a 7-day period to assess the physical activity of both adolescents and their parents. The association between the physical activity levels within the parent-adolescent couple was determined using Spearman's test. A notable disparity between girls and boys was recorded, with girls exhibiting a mean BMI Z-score ( $0.53 \pm 1.26$ ) approximately twice as high as that of boys ( $0.25 \pm 1.60$ ). A significant correlation was observed between adolescent sedentary behavior and parental sedentary behavior ( $r = 0.3$ ,  $p = 0.006$ ), as well as with light physical activity ( $r = 0.4$ ,  $p = 0.001$ ). Furthermore, a notable proportion of adolescents with insufficient physical activity levels had parents engaging in similar patterns. Alarming, the parent-adolescent couple was found to lead a sedentary lifestyle for more than 80% of the day. Parents exerted a substantial influence over the physical activity or sedentary habits of their children. These insights highlight the need for targeted interventions promoting a healthier, more active lifestyle among families.

**Keywords:** Physical Activity, Adolescents, Parental Influences, Social Support, Morocco.

## 1. INTRODUCTION

Physical activity and sports play pivotal roles as protective factors against numerous non-communicable diseases, demonstrating a robust association with cardiovascular health, fitness, bone health, quality of life, and the prevention of psychological distress [1–3]. Notably, physical activity has been linked to increased life expectancy [4], and is deemed essential for the holistic development of motor, cognitive, emotional, and social aspects in children and adolescents.

Extensive scientific evidence underscores the positive impact of regular physical activity on general health [5, 6]. This includes its influence on preventing various non-communicable diseases and its beneficial effects in their treatment [5]. The dichotomy of physical activity and sedentary behavior defines opposite ends of a healthy lifestyle spectrum [5], as evidenced by the significant association between physical inactivity

and adverse health outcomes [5]. In adolescence, physical activity emerges as a primary avenue for preventing obesity and chronic diseases [7,8]. Understanding the factors that facilitate physical activity among adolescents is crucial in this context.

The role of parents as key influencers in promoting physical activity among adolescents has been firmly established [9]. Parents serve as potent motivators through two mechanisms: acting as role models and providing verbal encouragement [10]. Longitudinal studies, such as the one involving 13,000 students, underscore the association between parental and adolescent's physical activity levels [11, 12]. However, it is essential to recognize that the parent-adolescent association is not universally consistent, and variations may stem from diverse social and cultural contexts in different studies. Therefore, investigations in various countries are imperative to comprehensively understand how parents' model physical activity levels for their offspring.

In 2019, responding to global initiatives prioritizing the prevention and control of non-communicable diseases (NCDs), the Ministry of Health in Morocco launched the national multisectoral strategy for NCD prevention and control for the period 2019–2029 [10]. This strategy aligns with the United Nations' commitment to NCDs as a priority for sustainable development. Among the nine targets set by Morocco for 2029, one specifically addresses physical activity, aiming to reduce insufficient physical activity (sedentary lifestyle) by approximately 10% [13]. In this context, our present study seeks to explore the influence of parental physical activity modes on those of their adolescents in Morocco.

## **2. MATERIALS AND METHODS**

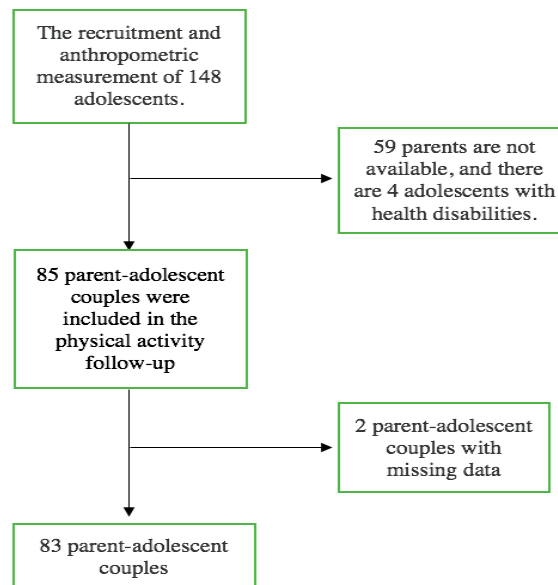
### **2.1 Study Design and Participant Selection**

This investigation is a pivotal component of a comprehensive inquiry into the physical activity patterns of parent-adolescent couples in Morocco. Employing an experimental case-control design, the study comprises two distinct cohorts: a group of adolescents with a normal weight status and a group of adolescents classified as overweight and obese. All participants voluntarily enrolled in the study, and parental consent was secured following a thorough explanation provided in an information letter.

The recruitment process targeted educational institutions, specifically high schools and colleges, as the primary venues for participant enrollment. The study focused on parent-adolescent couples with adolescents aged 11 to 18 years, involving one of the adolescent's closest parents.

### **2.2 Population and sampling**

A cohort of 148 adolescents was initially selected for the study, with 83 parent-adolescent couples eventually enrolled based on rigorous inclusion and exclusion criteria, as depicted in Figure 1. The inclusion criteria specified the inclusion of healthy adolescents aged 11–18 years and the requirement that one of the adolescent's closest parents be available for study participation. Conversely, exclusion criteria were applied to adolescents with health issues that could potentially limit physical activity, such as heart problems or asthma. This meticulous screening process aims to ensure the homogeneity and relevance of the study population, thereby contributing to the internal validity of the research findings.



**Figure 1: Flow chart of the 83 parent-adolescent couples recruited in the study.**

### 2.3 Anthropometric Data of Parent-Adolescent Couples

Anthropometric measurements involved assessing body weight, height, waist circumference, and hip circumference for both members of the parent-adolescent couples. These measurements adhered to the guidelines outlined in the "Guide to the Measurement of Anthropometric Indicators" [14].

To evaluate the nutritional status of the parents, the body mass index (BMI) was calculated (in  $\text{kg}/\text{m}^2$ ). Individuals with a BMI falling between 18.5 and 24.9 were categorized as normal, while those with a BMI exceeding 24.9 were classified as overweight.

For adolescents, the BMI z-score was utilized for evaluation. A BMI z-score between -2 and 1 signified a normal weight status, whereas a BMI z-score exceeding 1 indicated overweight status.

### 2.4 Measurement of Physical Activity in Parent-Adolescent Couples Using Accelerometers

The ActiGraph wGT3X-BT accelerometers were ensured to have a minimum battery level of 80% before deployment. They were programmed by entering the subject's ID, weight, and height, along with specifying the start and end date and time for data collection. Participants received instructions on the proper use of the accelerometers.

A total of 83 parent-adolescent couples wore the devices affixed to the right hip using an elastic belt for 7 consecutive days, from waking up to bedtime, with exceptions during showering or water activities. Accelerometer data were recorded at a frequency of 30 Hz and expressed as activity strokes per minute. These data were then converted into physical activity intensity levels using predefined reference thresholds [15]. The ActiLife software processed the accelerometer data to generate one measurement per second.

Following the 7-day data collection period, the accelerometers were charged, and information was extracted using the ActiLife software. Subsequently, the software

transformed various variables from the MOS.gt3x file into a usable Excel format. A compilation of these files was conducted to extract essential information characterizing the physical activity of the parent-adolescent couple. This information included sedentary time (%/day), light activity (%/day), moderate-to-vigorous physical activity (MVPA), and average daily step counts.

### 2.5 Ethical Considerations

The study adheres to ethical standards, with approval obtained from the Ethics Committee (approval number: 16\20) at the Faculty of Medicine of Rabat. Informed consent from parents further underscores the ethical integrity of the research. This meticulous design ensures a rigorous exploration of the interplay between adolescent weight status, parental influence, and physical activity patterns within the cultural context of Morocco.

### 2.6 Statistical Analysis

Following the completion of the field survey and retrieval of collection forms, data were meticulously entered in duplicate using a data entry mask developed with EPIDATA software. Subsequent to data cleaning, we presented central parameters (means, standard deviations, and percentages) for the entire parent-adolescent couple sample.

Appropriate statistical tests were employed based on the normality of continuous variables. For comparing anthropometric data means between sexes, the student t-test was utilized. The same test was applied to compare physical activity with nutritional status. To ascertain the relationship between the physical activity levels of parents and adolescents, the Spearman test was performed. All analyses adhered to a significance level of 5%.

## 3. RESULTS

### 3.1. Description of the study population

#### 3.1.1 Adolescents

The age range of the participants spanned from 11 to 18 years, with a gender distribution of 65.06%, comprising 54 girls and 29 boys. In terms of weight, male adolescents exhibited an average of 57.46 kg, while their female counterparts displayed an average weight of 55.81 kg.

The results show significant difference in height between genders ( $p = 0.001$ ). Specifically, male adolescents demonstrated an average height of 165.17 cm, contrasting with the average height of 158.38 cm observed in female adolescents. Nonetheless, no statistically significant disparities were identified in other anthropometric characteristics, such as weight, hip circumference, and waist circumference, when comparing the male and female cohorts (Table 1).

**Table 1: Anthropometric characteristics of adolescents by gender**

	Girls (n= 54)	Boys (= 29)	<i>p-value</i>
Age (years)	14.53 ± 1.96	14.51 ± 1.95	0.95
Weight (kg)	55.81 ± 13.43	62.04 ± 20.48	0.09
Height (cm)	158.38 ± 7.94	164.80 ± 9.57	0.001
Waist circumference (cm)	74.44 ± 9.95	77.17 ± 10.86	0.25
Hip circumference (cm)	95.81 ± 11.72	91.45 ± 12.32	0.11
BMI Z score	0.53 ± 1.26	0.66 ± 1.76	0.68

Examining the nutritional status of both adolescents and parents, our findings revealed that a greater proportion of adolescents maintained a normal weight in comparison to those classified as overweight (71% versus 29%).

### 3.1.2 Parents

In total, 83 parents participated in the study, ranging in age from 30 to 66 years old. Female parents exhibited a mean hip circumference of 109.41 cm, while male parents had an average hip circumference of 103.81 cm. Upon conducting a gender-based comparison using Student's t-test, statistically significant differences emerged in both age ( $p=0.001$ ) and height

( $p=0.001$ ) between fathers and mothers, with fathers being notably taller and older.

Moreover, a significant contrast in hip circumference was observed between gender ( $p=0.001$ ), with mothers presenting a notably higher hip circumference than fathers. Additionally, the body mass index (BMI) of the parents exhibited a significant disparity based on gender ( $p=0.001$ ) (Table 2). These findings collectively underscore distinct physiological characteristics between fathers and mothers within the study cohort.

**Table 2: Anthropometric characteristics of parents by gender**

	Mothers (n= 54)	Fathers (n= 29)	p-value
Age (years)	45.76± 6.65	52.41± 6.24	0.001
Weight (kg)	77.24± 13.83	78.25± 11.06	0.76
Height (cm)	160.46± 5.65	173.02± 6.14	0.001
Waist circumference (cm)	95.75± 12.82	96.80±8.42	0.83
Hip circumference (cm)	109.45± 17.66	103.92±5.72	0.11
BMI (kg/ m <sup>2</sup> )	29.93±4.76	26.06±2.82	0.001

According to the weight status, a noteworthy trend emerged, with a substantial majority (84.3%) falling into the overweight category, while a comparatively smaller percentage (15.5%) were identified as underweight.

## 3.2 Physical activity of parent-adolescent couples

### 3.2.1 Physical activity of adolescents according to their weight status

The investigation into levels of physical activity and sedentary behavior, stratified by the nutritional status of adolescents, yielded noteworthy results. Notably, adolescents classified as having a normal weight demonstrated a higher engagement in physical activity compared to their overweight counterparts. A statistically significant difference was observed in the daily duration of moderate to vigorous physical activity between normal and overweight adolescents ( $p=0.03$ ).

It was observed that normal-weight adolescents, on average, took 1561 more steps per minute per day than their overweight counterparts ( $p=0.04$ ). Contrarily, no statistically significant disparity was identified in the daily duration of sedentary and light activities between the two groups (Table 3). These findings underscore the association between nutritional status and distinct physical activity patterns among adolescents in our study cohort.

**Table 3: Level of physical activity and sedentary time according to adolescent weight status.**

	Normal	Overweight	<i>P-value</i>
Sedentary activity (% /day)	87.68±5.48	82.95±5.81	0.034
Light activity (% /day)	12.92±4.50	12.27±5.16	0.59
MVPA (min/day)	34.59±25.47	50.62±24.39	0.164
Steps Average Counts (min/day)	8125.02±3142.41	6564.00±3097.17	0.04

MPVA: moderate-to-vigorous physical activity.

### 3.2.2 Parents' physical activity according to their weight status

The assessment of physical activity levels and sedentary behavior, categorized by the nutritional status of parents, revealed consistent patterns. Irrespective of their nutritional status, no statistically significant differences in physical activity parameters were identified among parents belonging to either the normal or overweight groups. These results indicate a uniformity in physical activity engagement and sedentary behavior across both nutritional status categories among the parent participants in our study.

**Table 4: Physical activity level and sedentary time according to parents' weight status**

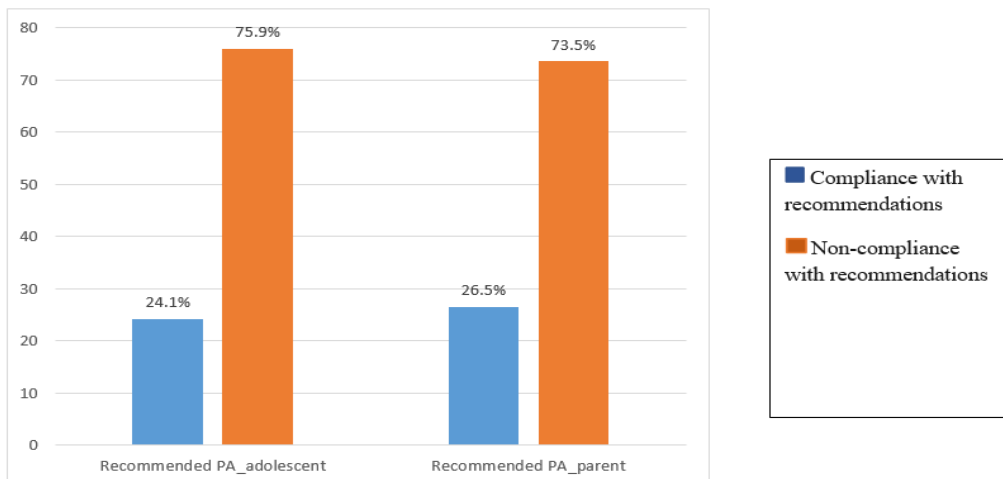
	Normal	Overloads	<i>P</i>
Sedentary activity (% /day)	83.24±8.59	83.13±5.25	0.889
Light activity (% /day)	12.41±6.69	13.76±5.14	0.804
MVPA (min/day)	54.82±32.84	51.66±25.16	0.018
Steps Average Counts (min/day)	7532.31+4755.41	7802.79+2930.18	0.148

### 3.3 Physical activity according to WHO recommendations for the parent-adolescent couple

The study assessed the adherence to World Health Organization (WHO) physical activity recommendations among parent-adolescent couples. Figure 2 illustrates the proportion of individuals meeting these guidelines. Among adolescents, a mere 24.1% fulfilled the WHO recommendation for moderate to vigorous physical activity (MVPA), defined as a minimum of 60 minutes per day. Alarming, the majority, comprising 75.9% of adolescents, fell short of the recommended duration of sufficient physical activity.

In contrast, the findings for parents were slightly more favorable. Only 26.5% of parents met the criteria outlined in the WHO recommendations for physical activity. This indicates that a substantial portion of both adolescents and parents within the study cohort failed to achieve the recommended levels of physical activity, highlighting the need for interventions and awareness campaigns to promote healthier lifestyles in these family units.





**Figure 2: Distribution of adolescents and their parents according to compliance with the recommendations of the MVPA.**

### 3.4 Relationship between Adolescents' Physical Activity and Parental Engagement

An examination of the correlation between the physical activity levels of parents and their adolescents revealed noteworthy trends. Among the adolescents of parents with insufficient physical activity (PA), only 18% exhibited adequate PA, whereas 40.9% of adolescents with parents engaging in sufficient PA demonstrated the same behavior. Conversely, a higher proportion of adolescents with inadequate PA were found to have parents with inadequate PA. This observed difference is statistically significant, with a p-value of 0.0426 (Table 5).

**Table 5: The relationship between the PA adequacy of the parent-adolescent couple**

Physical Activity PA	Inadequate PA	Adequate PA
Parents	82%	18%
Adolescents	59.1%	40.9%

In addition to examining overall physical activity levels, a correlation study was conducted to investigate the relationship between distinct modes of physical activity in parents and their adolescents. The findings revealed a positive and significant correlation between moderate to vigorous physical activity (PA) and the average number of steps ( $p=0.04$  and  $p=0.01$ , respectively). Notably, a robust correlation was also observed between sedentary behavior and light physical activity in both parents and adolescents (Table 6).

**Table 6: Correlation between physical activity of parents and adolescents**

	Correlation coefficient	<i>p</i>
Parent-Adolescent Sedentary	0.45	0.000
Parent-Adolescent PA light	0.49	0.000
Parent-Adolescent Average MVP	0.298	0.006
Parent-Adolescent Steps Average Counts	0.368	0.001

### **3.5 Correlation between Self-Reported Physical Activity and GTX3 Accelerometer Measurements**

The frequency of engagement in sports activities was assessed within parent-adolescent couples. Self-reported data on physical activity levels were collected through questionnaires, while concurrent measurements were obtained using GTX3 accelerometers.

## **4. DISCUSSION**

The primary objective of this study was to investigate the impact of parental physical activity patterns on the physical activity levels of adolescents in Morocco, with particular attention to factors such as the nutritional status of the adolescent-parent couple.

We identified that the prevalence of overweight adolescents in our study was 29%, contrasting significantly with the higher rate of 84.3% observed in parents [16]. This disparity, notably higher than national averages, is attributed to the specific sampling characteristics of our study, emphasizing a notable overweight proportion within our examined sample.

Furthermore, our findings align with national trends, indicating a pervasive increase in overweight and obesity. According to recent surveys from the Ministry of Health (2018)[17], 76.8% of adults and 13.7% of children under the age of 5 in Morocco were reported as overweight. International comparisons highlight similar concerns; a study in Luxembourg on children aged 5 to 15 revealed a prevalence of overweight at 16.1%, with 4.2% classified as obese, resulting in a total overweight prevalence of 20.3% [18–20].

In 2022, 1 in 8 people worldwide was obese. Global adult obesity has more than doubled since 1990, and adolescent obesity has quadrupled. In 2022, 2.5 billion adults (18 years and older) were overweight, with 890 million of them being obese. Additionally, 43% of adults aged 18 and older were overweight, and 16% were obese. The number of overweight children under 5 years old in 2022 was 37 million. Furthermore, over 390 million children and adolescents aged 5 to 19 were overweight, with 160 million of them being obese [21]. This alarming rise is largely attributable to sedentary lifestyles, insufficient physical activity, shifts in dietary habits (such as increased consumption of snacks and fast food), and broader lifestyle changes [22].

In this study, adolescents demonstrated a notable lack of physical activity, as evidenced by low rates of moderate-to-vigorous physical activity (MVPA), with 49.27 minutes per day for normal-weight individuals compared to 38.42 minutes per day for those classified as overweight.

This observed level of physical inactivity was markedly lower than findings from a study on Tunisian adolescents aged 12, where the intensity of physical activity was reported as 7.7 [23].

The average MVPA intensity for parents with a normal physical activity level was 53.62 minutes per day, whereas for overweight parents, it was notably lower at 44.96 minutes per day. This average was also lower than the 102 minutes per day reported in a study conducted in Portugal [24].



The observed low MVPA in our sample could be attributed to factors such as a lack of interest in and motivation for physical activity. Major barriers, including a sedentary lifestyle, lack of time, and diminished energy, may contribute to the high levels of inactivity within our sample [25–28]. Additionally, a substantial portion of physical activity occurred during the winter, a period when participants often preferred indoor activities, exacerbating sedentary behavior. Improved transportation conditions may also lead to decreased walking.

Furthermore, our study revealed that a significant percentage of both adolescents (75.9%) and parents (73.5%) did not meet the recommended daily physical activity level of more than 60 minutes of MVPA. Only 24.1% of adolescents and 26.5% of parents achieved adequate physical activity, aligning with similar findings in Spain and a global study indicating widespread non-compliance with physical activity recommendations [29, 30].

The prevalence of sedentary behaviors, such as watching television, surfing the internet, and playing video games, was noted as a contributing factor to the observed lack of physical activity in adolescents. For parents in France, time constraints were identified as a significant barrier to adopting a physically active lifestyle [31]. Gender differences in physical activity levels were also observed, with more men being more active than women in Belgium [32]. Hence, increased awareness is essential to incorporating physical activity into daily routines, emphasizing simple choices like walking instead of taking a taxi or using stairs instead of elevators [33].

The average sedentary time was similar for normal (89.19 minutes) and overweight adolescents (84.79 minutes), possibly due to prolonged sitting during classes. Notably, normal-weight adolescents spent more time on moderate and vigorous activities compared to their overweight counterparts. Similar findings from studies in Columbia and Canada indicated that obese children exhibit lower physical activity levels and higher television viewing time [34, 35].

Psychological determinants, including self-esteem and body image, were identified as factors influencing physical activity engagement in overweight adolescents. These children expressed more reluctance and depression related to physical activity, emphasizing the need for further exploration of these factors in future research [36,37].

Our results underscored a strong correlation between parental and child physical activity. Children with parents practicing adequate physical activity were more likely to achieve recommended levels compared to those with inactive parents. Positive correlations were observed between light physical activity and sedentary behavior, as well as the number of steps per minute and MVPA.

This suggests a significant positive influence of parents on their children's non-physical activity behaviors. Similar studies have consistently demonstrated that inactive or sedentary parents are associated with a higher prevalence of physical inactivity in their children [38]. In Brazil, parental physical activity, both current and previous, was found to be associated with adolescent physical activity levels [39]. This association has been explained by parental incentives and support for children to engage in physical activity, including financial support, encouragement, and participation.

## 5. CONCLUSION

This study has illuminated a concerning reality, indicating that two-thirds of our sampled population, encompassing both adolescents and their parents, were identified as inactive. Our observations underscore the substantial influence parents wield over the physical activity or sedentary habits of their children. In light of these findings, addressing the recommendations set forth by the World Health Organization (WHO) and the objectives of the national multisectoral plan to combat Non-Communicable Diseases (NCDs), particularly the target of a 10% reduction in inactivity among the Moroccan population, necessitates urgent and comprehensive actions. It is crucial to implement initiatives that not only target adolescents individually but also incorporate parents into intervention programs. This family-oriented approach recognizes the interconnected dynamics influencing physical activity patterns, aiming for a more effective and sustainable impact on the overall well-being of the Moroccan population.

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