ORIGINAL ARTICLE

Comparative Analysis of Dietary Habits and Nutritional Profiles: Sidi Ali Ben Aoun vs. Grand Tunis

Analyse comparative des habitudes alimentaires et des profils nutritionnels : Sidi Ali Ben Aoun vs. Grand Tunis

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Abstract

Introduction: Tunisia is affected by the nutritional and dietary transition.
Aim: To compare dietary habits and nutritional profiles between a rural agricultural area Sidi Ali Ben Aoun and an urban area Grand Tunis.
Methods: This is a comparative cross-sectional study conducted on a sample of 220 participants, including 110 from Ben Aoun and 110 from Grand Tunis. Data were collected based on a pre-established questionnaire about dietary lifestyle and habits survey. Validated scores were used: Alimentary Diversity of Households (SDAM), the Food Consumption Assessment score (SCAM), MEDI-LITE and IPAQ.
Results: The mean age was 37.2±15.3 years for the urban population versus 38.7±13.8 years for the rural population (p=0.43). In the rural population, males were 54.5% vs 48.2%; p=0.34. The occurrence of non-communicable diseases was lower in Ben Aoun (p<0.001). The adopted diet in the region of Ben Aoun aligned with the principles of the Mediterranean diet (MEDI-LITE score was 13.2±1.76 versus 7.35±2.65 in Grand Tunis, p<0.001). Both studied regions had a similar level of food security as assessed by the SDAM (p=0.006). However, household dietary diversity was more present in the rural region: the average SCAM was 11.4±0.79 in the rural group compared to 10±1.31 in the urban group (p<0.001).
Conclusion: The rural region (Sidi Ali Ben Aoun) was characterized by a healthier and more diverse diet compared to the urban region (Grand Tunis).

Keywords: Nutritional transition; dietary habits; mediterranean diet; food security; alimentary diversity.

Résumé

Introduction : La Tunisie est affectée par la transition nutritionnelle et alimentaire.
Objectif : Comparer les habitudes alimentaires et les profils nutritionnels entre une zone rurale agricole de Sidi Ali Ben Aoun et une zone urbaine du Grand Tunis.
Méthodes : Il s'agit d'une étude transversale portée sur un échantillon de 220 participants, dont 110 de Ben Aoun et 110 du Grand Tunis. Les données ont été recueillies à l'aide d'un questionnaire préétabli, d'une enquête sur le mode de vie et les habitudes alimentaires. Des scores validés ont également été réalisés : la Diversité Alimentaire des Ménages (SDAM), le score d'Évaluation de la Consommation Alimentaire (SCAM) et MEDI-LITE.
Résultats : L'âge moyen était de 37,2±15,3 ans pour la population urbaine contre 38,7±13,8 ans pour la population rurale (p=0,43). Nous avons constaté que l'incidence des maladies non transmissibles était plus faible à Ben Aoun (p<0,001). Le régime adopté dans la région de Ben Aoun était conforme aux principes du régime méditerranéen (le score MEDI-LITE était de 13,2±1,76 contre 7,35±2,65 au Grand Tunis, p<0,001). Les deux régions étudiées avaient un niveau de sécurité alimentaire similaire à celui évalué par le SDAM (p=0,006). Cependant, la diversité alimentaire des ménages était plus observée dans la région rurale : la moyenne du SCAM était de 11,4±0,79 dans le groupe rural contre 10±1,31 dans le groupe urbain (p<0,001).
Conclusion : La région rurale (Sidi Ali Ben Aoun) se caractérisait par une alimentation plus saine et plus diversifiée par rapport à la région urbaine (Grand Tunis).

Mots clés: Transition nutritionnelle, habitudes alimentaires, régime méditerranéen , sécurité alimentaire

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Introduction

Food is much more than a biological necessity; it serves as a living representation of the cultural, economic, and agricultural ecosystem from which it originates. In fact, dietary habits vary significantly depending on geographical environments.

There's an intimate link between the agricultural landscape and the dietary practices of rural inhabitants [1]. Predominant subsistence farming promotes access to local, fresh, and seasonal products, thereby contributing to notable nutritional diversity. Agricultural production, particularly its diversity, is associated with greater household dietary diversity, leading to a higher quality diet [2].

However, under the combined effects of urbanization, industrialization, and globalization, the relationship between urban areas and food has become increasingly complex [2].

Tunisia, like most developing countries, is affected by dietary and nutritional transition. This phenomenon is marked by the shift from a pre-industrial to a modern society [3]. The impact of this transition, largely observed in urban areas, is characterized by the shift from a traditional diet primarily based on agricultural products—such as cereals, vegetables, legumes, and olive oil—to a diet increasingly rich in ultra-processed foods, sugars, and fats, and consequently poorer in micronutrients and fiber.

These urban dietary habits have become major contributors to the growing epidemic of non-communicable chronic diseases, including obesity, diabetes, hypertension, and dyslipidemia [4].

In this context, we have undertaken a comparative analysis of dietary habits between a rural agricultural region, Sidi Ali Ben Aoun and an urban region, Grand Tunis.

The objectives of our study were to: compare the dietary habits of the two regions and to examine dietary diversity, consumption patterns and adherence to the mediterranean diet in both regions.

Methods

This was a cross-sectional comparative study conducted from november 26, 2023 to february 5, 2024.

Population

Our study included a total of 220 participants equally distributed between Ben Aoun and Grand Tunis. Recruitment was carried out in supermarkets and the weekly market of both regions. Selection was random within each region to minimize potential recruitment biases. The 110 rural participants were recruited from the seven Imadas of Ben Aoun, illustrated in figure 1: Ben Aoun (the center), La Rabta, Delegation Mansoura, Ouled Brahim, Essahla, and El Waara.

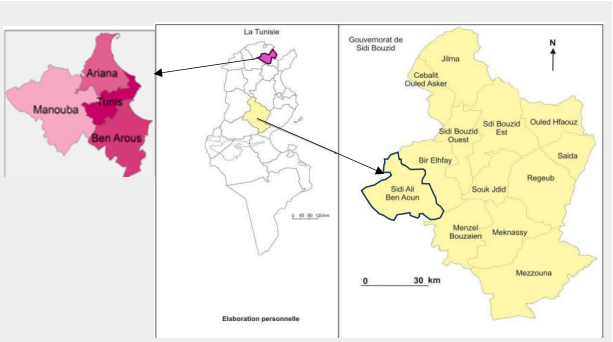


Figure 1. The delegation of Ben Aoun and great Tunis

The 110 urban participants were recruited from the four governorates of Grand Tunis: Tunis (Bardo, Cité Intileka, Bab Saadoun, the central market, El Manar University Campus), Ariana (Cité Elghazela), Manouba (Technopole, University Campus), and Ben Arous (El Mourouj 3 and 6). As the target population was the general population, participants were randomly selected within each region based on the following inclusion criteria: the permanent residency in the region and an age between 18 ans 70 years. We did not include participants with temporary residence in the region and those with a personal history of chronic diseases.

Study procedure

For each participant, we collected the following information: age, educational level, occupation, socioeconomic status based on the National Institute of Statistics classification [4] and personal medical history.

Participants were asked to specify their weight and height. The Body Mass Index (BMI) was then calculated based on these self-reported data. BMI was calculated by dividing weight in kilograms by the square of height in meters (kg/m²) and interpreted according to the WHO classification. According to this classification, BMI is defined as Underweight (< 18.5 kg/m ²), Normal weight (18.5 - 24.9 kg/m ²), Overweight (25.0 - 29.9 kg/m ²), and Obesity (≥ 30.0 kg/m ²), with obesity further subdivided into Class I (30.0 - 34.9 kg/m ²), Class II (35.0 - 39.9 kg/m ²), and Class III, also known as severe or morbid obesity (≥ 40.0 kg/m ²).

The International Physical Activity Questionnaire (IPAQ) [5]with it's formula; IPAQ = MET level * minutes of activity per day * days per week. The result, expressed in MET-minutes per week, indicates if physical activity is low, moderate, or intense. Low activity identifies individuals not meeting criteria for the other categories. Moderate activity is achieved by criteria such as performing 3 or more days of vigorous-intensity activity for at least 20 minutes per day, 5 or more days of moderate-intensity activity or walking for at least 30 minutes per day, or achieving a minimum total of 600 MET-minutes/week through any combination of these activities over 5 or more days. High activity indicates vigorous-intensity activity on at least 3 days accumulating at least 1500 MET-minutes/week, or 7 or more days of combined walking, moderate, or vigorous activities achieving at least 3000

MET-minutes/week.

Nutritional analysis

Each participant specified the number of meals per day, fast food consumption and olive oil consumption.
To assess dietary habits, we conducted a dietary survey based on food history methods. Participants provided details on their usual food intake over a typical week (5 weekdays + weekend). Food history was analyzed using the Nutrilog software.
The Score of Alimentary Diversity of households (SDAM) was used to evaluate the diversity of households [6]. The SDAM is based on the number of different food groups consumed. The study analyzed various food groups, assigning points to each group. Households with a SDAM of 12 had a well-diversified diet, while those with a SDAM of less than 12 had a deficit in one or more food groups.
The Food Consumption Assessment Score (SCAM) measures the amount of food consumed by a household. It is calculated by multiplying the number of days each food group is consumed (xi) by a weighting factor (ai), using the formula: SCAM = ∑ai*xi. The final score for each household ranges from 0 to 112 points. Based on the score, food security levels are classified as poor, borderline, acceptable, or high.
On this basis, four classes of food consumption have been established: ·
- The poor consumption class (severe food insecurity) consisting of households whose SCAM was less than or equal to 21.
- The class of poor food consumption (moderate food insecurity) which includes households whose SCAM was greater than 21 and less than or equal to 35.
- The acceptable food consumption class (marginal food security) composed of households whose SCAM was greater than 35 and less than or equal to 49.
- The high food consumption class (food security) composed of households whose food consumption score was above 49.
The MEDI-LITE score was used to assess the adoption of Mediterranean diets [7,8]. The score determines the hebdomadary frequency of consumption of Mediterranean foods based on a valid questionnaire. The food is divided into two groups: typical Mediterranean foods (olive oil, fruits, vegetables, legumes, and fish) and atypical Mediterranean foods (vegetables, carnations, and dairy products). The final score ranges from 0 (poor adhesion) to 18 (good adhesion).

Statistical Analysis

Data were entered and analyzed using SPSS version 23. For the descriptive analysis, frequencies were used for qualitative variables, and means or medians were calculated for quantitative variables. For the comparison of qualitative variables, Pearson's Chi-square test was used, or Fisher's exact test when appropriate. For the comparison of continuous variables, Student's T-test was used. Statistical significance was set at $p < 0.05$.

Results

The mean age of the population was 37.2±15.3 years for the urban population versus 38.7±13.8 years for the rural population (p=0.43). A higher illiteracy rate was observed in the rural population (12.7%) compared to the urban population (2.7%) (p=0.02).
In Ben Aoun, there was a higher proportion of farmers, while laborers were more prevalent in Grand Tunis. The distribution of professional activity differed significantly between the two populations (p<0.001). The socio-economic level was higher in Ben Aoun.
Personal histories of obesity, diabetes, hypertension, dyslipidemia, and anemia were significantly more frequent in the urban population. Sociodemographic results are illustrated in table 1.

Table 1. General characteristics of the studied population

Variable	Rural Population n=110 n (%)	Urban Population n=110 n (%)	P-value
Mean Age (years ± SD)	37.2 ± 15.3	38.7 ± 13.8	0.43
Male	60 (54.5%)	53 (48.2%)	0.34
Education Level			0.02
Illiterate	14 (12.7%)	3 (2.7%)	
Primary Education	9 (8.2%)	16 (14.5%)	
Secondary Education	27 (24.5%)	28 (25.5%)	
Higher Education	60 (54.5%)	63 (57.3%)	
Socioeconomic Level			0.009
Low	24 (21.8%)	37 (33.6%)	
Medium	69 (62.7%)	68 (61.8%)	
High	17 (15.5%)	5 (4.5%)	
Personal Medical History			
Obesity	19 (17.3%)	33 (30%)	0.02
Diabetes	9 (8.2%)	29 (26.4%)	<0.001
Hypertension	11 (10%)	27 (24.5%)	0.004
Dyslipidemia	3 (2.7%)	27 (24.5%)	<0.001
Cardiovascular Disease	4 (3.6%)	6 (5.5%)	0.51
Anemia	10 (9.1%)	25 (22.7%)	0.006
Current smokers	17 (15.5%)	28 (25.5%)	0.05
Physical activity			0.98
Low activity	15 (13.6%)	23 (20.9%)	
Moderate activity	78 (70.9%)	77 (70%)	
High activity	17 (15.5%)	10 (9.1%)	
Transport mode			0.06
Walking	82 (74.5%)	30 (27.3%)	
Bicycling	12 (10.9%)	0 (0%)	
Car	16 (14.5%)	34 (30.9%)	
Public transport	0 (0%)	46 (41.8%)	

The rural population had a lower average weight (70.6±11 kg vs. 73.8±9.42 kg) compared to the urban population, with statistically significant differences (p=0.02). Additionally, the rural population had a lower average

BMI (23.8±2.76 kg/m² vs. 26.1±3.48 kg/m²) compared to the urban population (p<0.001).

The rural population had a higher proportion of individuals eating three meals a day (75.5% vs. 40%) and having fixed mealtimes (80.9% vs. 34.5%) compared to the urban population. The differences were statistically significant (p<0.001 for both meal frequency and meal timing.

The rural population consumed olive oil significantly more frequently than the urban population, with 86.4% of rural participants consuming it 5 to 7 times a week compared to 24.5% of urban participants (p<0.001). Additionally, the annual consumption was much higher in rural areas, with an average of 60 liters per household in Ben Aoun compared to 5 liters in Tunis (p<0.001). In terms of consumption methods, the rural population preferred using olive oil for cooking (73.6%), marinating/seasoning (80%), and consuming it raw with bread (92.7%), whereas the urban population mostly used it for marinating/seasoning (68.2%) and less frequently for cooking (20%) (p<0.001).

Urban participants consumed fast food more frequently than rural participants (p<0.001). Table 2 shows the results of the dietary survey.

The average SDAM was 11.4±0.79 in the rural group compared to 10±1.31 in the urban group (p<0.001). In the rural population, 56.4% had maximum dietary diversity (SDAM=12) versus 12.7% of the urban population (p<0.001) and 43.6% of rural participants versus 87.3% of urban participants had a deficit in one or more food groups (p<0.001).

The average SCAM score was 81.6 ± 14.5 in the rural group compared to 67.7 ± 13.1 in the urban group (p < 0.001). Acceptable consumption levels were observed in 2.7% of rural participants versus 10% of urban participants, while 93.6% and 84.5% were in the very high food consumption category, respectively (p = 0.06). No significant difference in overall food consumption levels was found between the two populations, with both showing a high level of food security.

Adherence to the Mediterranean diet, measured by the MEDI-LITE score, was significantly higher in the rural group (mean 13.2±1.76) than in the urban group (mean 7.35±2.65; p<0.001). Furthermore, 41.8% of urban participants exhibited low adherence (MEDI-LITE 0-6), significantly more than in the rural group which showed better overall adherence (p<0.001).

Results of SDAM, SCAM and med-lite are illustrated in figure 3.

Table 2. Results of dietary survey

Nutrient	Rural Population (mean ± SD)	Urban Population (mean ± SD)	P-value
Energy Intake (Kcal)	2361 ± 231	2623 ± 62	<0.001
Macronutrients			
Carbohydrates (g/day)	213±31	326±2	<0.001
Carbohydrates (g/kg ideal weight/day)	3.55±1	5.2±1	<0.001
Proteins (g/day)	108±15	84.3±12	<0.001
Proteins (g/kg ideal weight/day)	1.68±0.2	1.44±0.1	0.003
Lipids (g/day)	108±14	98.1±4	<0.001
Lipids (g/kg ideal weight/day)	1.69±0.3	1.58±0.4	0.97
Fatty Acids and Cholesterol			
Saturated Fatty Acids (g/day)	27 ± 9.62	39.8 ± 11.11	<0.001
Monounsaturated Fatty Acids (g/day)	50.1 ± 11.19	31.2 ± 7.74	<0.001
Polyunsaturated Fatty Acids (g/day)	18.8 ± 6.72	11 ± 6.7	<0.001
Cholesterol (mg/day)	346 ± 154	350 ± 172	0.88
Micronutrients, Fiber, and Sugars			
Sodium (mg/day)	4572 ± 859.21	5998 ± 1002.36	<0.001
Magnesium (mg/day)	381 ± 89.12	274 ± 49.92	<0.001
Phosphorus (mg/day)	1692 ± 347.75	1117 ± 262.67	<0.001
Calcium (mg/day)	767 ± 186.23	531 ± 168.54	<0.001
Iron (mg/day)	14.3 ± 4.51	11.1 ± 2.77	<0.001
Selenium (µg/day)	117 ± 25.18	74.5 ± 22.89	<0.001
Vitamin A (µg/day)	3114 ± 1427.26	471 ± 393.58	<0.001
Vitamin D (µg/day)	22.1 ± 5.52	3.5 ± 4.2	<0.001
Vitamin E (mg/day)	18.4 ± 5.2	12.5 ± 4.6	<0.001
Thiamine (mg/day)	1.11 ± 0.21	0.90 ± 0.19	<0.001
Riboflavin (mg/day)	1.77 ± 0.34	1.24 ± 0.3	<0.001
Niacin (mg/day)	30.4 ± 8.68	15.7 ± 5.32	<0.001
Vitamin B6 (mg/day)	2.46 ± 1.16	1.51 ± 0.4	<0.001
Folate (µg/day)	422 ± 106.9	256 ± 83.7	<0.001
Vitamin C (mg/day)	123 ± 41	82.7 ± 42.5	<0.001
Fiber (g/day)	31.8 ± 6.64	24.4 ± 4.68	<0.001
Sugars (g/day)	86.4 ± 24	92.4 ± 27.8	0.08

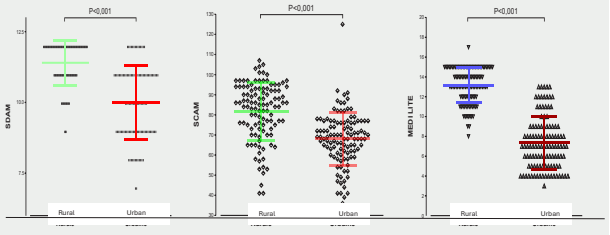


Figure 3. Scores of SDAM, SCAM and med-lite in both groups

SDAM: Score of Alimentary Diversity of Households, **SCAM**: Food Consumption Assessment Score, **MEDI-LITE**: Score assessing adherence to the Mediterranean Diet

Discussion

Our study involved 220 participants from two groups: rural (110 in Sidi Ali Ben Aoun) and urban (110 in Grand Tunis). The main differences found in rural populations included a lower prevalence of non-communicable diseases, a lower weight, a more regular meal schedule, reduced fast food consumption, higher consumption of olive oil, higher intake of mono- and polyunsaturated fatty acids, and greater household consumption according to SDAM and SCAM.

Health Status and Urbanization Effects

Our study found a higher prevalence of obesity, diabetes, hypertension, dyslipidemia, cardiovascular diseases, and anemia in the urban group, consistent with previous research [9]. An Algerian study reported a higher frequency of chronic diseases in urban areas compared to rural ones [10]. The International Diabetes Federation attributes the rise in diabetes prevalence in Africa to urbanization, which promotes sedentary lifestyles and unhealthy dietary changes [11]. Additionally, dyslipidemia prevalence in rural Morocco was lower than in urban areas [12] .

Fast Food Consumption and Dietary Habits

We found that the participants from Tunis consumed more Fast Food than those from Ben Aoun ($p<0.001$). Urban areas in Tunisia have experienced rapid growth, leading to an increase in fast-food outlets as part of the urban landscape [13]. The concentration of fast-food restaurants in cities correlates with higher consumption rates, as proximity to these outlets significantly influences dietary choices [14]. In contrast, rural areas have fewer fast-food options, which may limit access to such foods and potentially promote healthier eating habits [15].

Energy and Nutrient Intake

Our results showed a higher energy intake in urban areas compared to rural areas. This was in agreement with the study conducted by El Ati, which found that the Tunisian nutritional profile is characterized by a higher energy intake in urban areas (INS, 1983; INS, 1990; INS, 2000). Another study conducted on a representative sample of Tunisian households noted that the energy intake of the residents of GrandTunis exceeded that of the residents of the Central-Western region of Tunisia [16].

Household Food Consumption and Food Security

Despite the high energy intake observed in Grand Tunis, a lower intake of essential nutrients was identified. This is explained by the urban tendency to consume highly energetic and salty foods but nutrient-poor foods (chips, sodas...). According to a study conducted by the International Food Policy Research Institute, which relied on data from the past 20 years from about fifteen countries including China, Egypt, Nigeria, and the Philippines, there is a deterioration in nutritional conditions. In fact, cities, previously considered generally more favored, are now experiencing an increase in poverty and deficiency-related malnutrition [17]. According to the National Agronomic Institute of Tunisia, micronutrient deficiencies may be due to their low bioavailability and quality of the leafy vegetables consumed [18]. Indeed, traditional local vegetables grown in their original agricultural environment are generally richer in minerals, vitamins, and nutritional factors, and poorer in antinutritional factors (phytic or tannic acids, oxalates) than those grown elsewhere [19]. This may explain the lower fiber intake observed in urban areas.

Dietary Diversity and Agricultural Impact

Our results revealed a similar distribution of the two populations according to SCAM. In fact, none of the participants exhibited a low or very low level of food consumption (no moderate or severe food insecurity). This reflected a good level of food security in both of our groups. Our findings align with the FAO's review on the state of food security and nutrition in the world. Their analysis of food insecurity has proven that in 9 of the 11 African countries studied, the prevalence of moderate or severe food insecurity in urban and peri-urban areas is similar to that in rural areas, and in some cases, slightly higher, indicating that food insecurity is not necessarily linked to the place of residence [20–22].
On the other hand, we observed a higher SDAM in the rural group ($p<0.001$), meaning there was greater dietary diversity among households in Ben Aoun compared to Grand Tunis.

According to the FAO's review on global food security, even though the greatest diversity of available products is found in the capital or major cities, agricultural activity is also important in rural areas and can have positive effects on food diversity and quality at the household level [23].

Adherence to the Mediterranean Diet

Our results showed a better adherence to the Mediterranean diet in the rural group based on the responses to the nine items of the MEDI-LITE questionnaire. A Moroccan study conducted in 2008 on a set of 150 municipalities (59 rural and 91 urban) noted that the Mediterranean diet was increasingly being abandoned by residents in both urban and rural areas, especially among those living in luxurious and modern habitats [24]. Many studies have established the protective benefits of the Mediterranean dietary pattern in various chronic illnesses, including diabetes mellitus, cardiovascular disorders, cancer, aging disorders, and overall mortality risk [25].

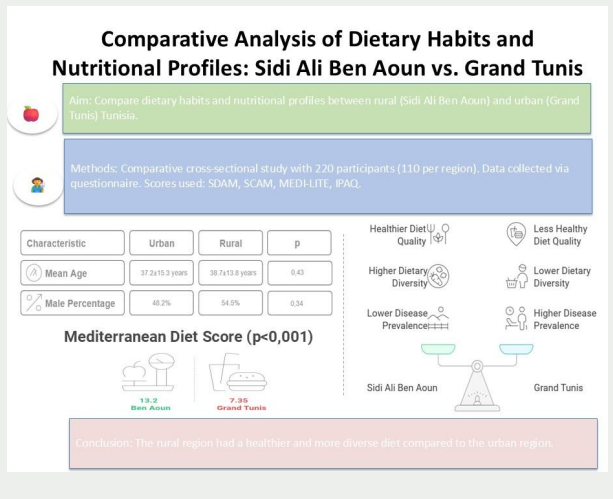
Study limitations

Our study had several limitations. Firstly, it would have been preferable to have more participants in each

region to enhance the precision of the statistical tests performed. There was a lack of systematic sampling and sample size calculation, which could have impacted on the overall findings. Furthermore, the number of subjects per household was not indicated; this information could be relevant for a more nuanced interpretation of household-level dietary assessments.

Conclusion

While both populations demonstrated high levels of food security, the dietary patterns in Grand Tunis align more closely with characteristics of a nutritional transition towards less healthy options. In contrast, Sidi Ali Ben Aoun appears to retain traditional dietary habits that contribute to better health outcomes, underscoring a notable divergence in the impact of the nutritional transition between these distinct Tunisian regions.
The exploration of food environments in Sidi Ali Ben Aoun and Grand Tunis offers insights into how regional specificities might influence dietary lifestyles amidst a national nutritional transition. Further research could build upon these observations to inform tailored public health initiatives designed to promote well-being across diverse Tunisian communities.



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