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ORIGINAL ARTICLE

Nutrition, Education and Dietetics

Nutritional Quality Assessment and Dietary Diversity of Food in Collective Catering: A Study in Al Hoceima Province, Morocco

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ABSTRACT

Background: The escalating prevalence of food consumption within collective catering establishments in Morocco has been associated with unbalanced dietary patterns, thereby contributing an increased risk of various chronic and degenerative diseases.

Aims: The study aimed to assess the overall nutritional quality of the food provided in selective collective catering establishments (CCEs) located in the province of Al Hoceima, Northern Morocco.

Subjects and Methods: A descriptive cross-sectional survey was conducted; Data regarding food offerings and management practices in six CCEs were collected using a structured questionnaire, observations, and interviews with kitchen staff. Dietary diversity and variety were assessed using the Food Diversity Score (FDS) and Food Variety Score (FVS), respectively, calculated based on an examination of menus and information collected during observations and discussion with chefs.

Results: The average daily FDS was 7.29 ± 0.80 food groups (FGs). For the majority of dietary days (78.6%), foods belonged to 7 to 8 FGs, with only 4.8% achieving the maximum FDS of 9 FGs. Significant differences in both FDS and FVS were observed based on the kitchen management method (p = 0.004 for FDS; p < 0.001 for FVS) and the involvement of health personnel (HP) in menu development (p = 0.004 for FDS; p < 0.001 for FVS). The highest average FVS and FDS were recorded for meals offered by CCEs employing external kitchen management and incorporating health personnel in menu development. Furthermore, the FDS varied significantly across the days of the week (p = 0.015), with a higher average observed on Friday (FDS = 8.33 ± 0.52). Conversely, FVS fluctuations across the days of the week were not statistically significant (p = 0.324).

Conclusion: The findings indicate that the diet provided by the assessed CCEs is moderately diversified but demonstrates a low representation of key micronutrient-rich food groups. The study suggests that outsourcing kitchen management, involving health professionals in menu planning, and increasing the inclusion of micronutrient-rich food groups are recommended strategies to enhance the nutritional quality of meals offered by the CCE.

Keywords: Collective Catering, Food Evaluation, Dietary Diversity Score, Dietary Variety Score, Al Hoceima Province, Morocco.

ARTICLE INFORMATION

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1 INTRODUCTION

The trend towards out-of-home catering has increased significantly in recent years, reflecting global shifts in lifestyles and dietary habits (Popkin, 2009; Sproesser *et al.*, 2019). In Europe, over 16.4 million meals are served daily in collective catering (CC) establishments (FoodService Europe, 2024). Previous studies have demonstrated that meals offered by CC can contribute up to half of the daily caloric intake of school-aged children and adolescents (Cohen *et al.*, 2021) and account for over than one-third of their daily caloric intake (Bell & Swinburn, 2004; Haynes *et al.*, 2020). In Morocco, statistics show that the number of meals served by university residences has increased from 5.8 million meals in the 2006–2007 academic year, to 11.3 million in the 2021-2022 academic year (MESRSFC, n.d). This development raises growing concerns about the nutritional quality of food offered in CC establishments. Indeed, studies consistently indicate that meals served in CC are usually characterized by suboptimal nutritional quality, unbalanced, high caloric density and a departure from healthy dietary patterns, such as the Mediterranean-type Moroccan diet (Colić Barić *et al.*, 2003; Lavall *et al.*, 2020; Marcotrigiano *et al.*, 2023; Mekhancha *et al.*, 2017; Šatalić *et al.*, 2004). For instance, as revealed by Bell and Swinburn (2004) study, over half of the

energy intake provided by meals served in school canteens was derived from five food groups, characterized by nutrient-poor and energy-dense items such as bread, fast foods, fruit juice and cordial drinks, biscuits and fat spreads. Similarly, analysis of canteen menus (Haynes *et al.* 2020) revealed that the menus of all the schools included in the study contain food items not recommended for inclusion due to their excessive content of energy, saturated fat, sugar, and/or sodium content, with a prevalence of 19.1% of all assessed items. Such dietary patterns are associated with an increased risk of numerous chronic diseases (Ness, 2004), including obesity (WHO, 2021), type 2 diabetes (O'Hearn *et al.*, 2023; WHO, 2023), cardiovascular diseases (WHO, 2013) and certain cancers (Anand *et al.*, 2008; Heller *et al.*, 2013; Schwingshackl *et al.*, 2017). Furthermore, the increasing adoption of these unhealthy dietary habits by young people is considered a factor in the early onset of non-communicable diseases, thereby contributing to future disease burdens and increasing the strain on national healthcare systems. Obesity, for instance, often caused by excessive consumption of calories, particularly from foods high in fat and added sugars, has become a major public health concern whose prevalence in adults more than doubling since 1990 worldwide (WHO, 2021). Additionally, five million deaths associated with a body mass index exceeding its optimal value were recorded in 2019 (Murray *et al.*, 2020). Moreover, studies have reported that an unbalanced diet, particularly one characterized by low intake in fruit, vegetables, and dietary fiber, and high consumption of red and processed meat, significantly increases the risk of several cancers (Anand *et al.*, 2008; Heller *et al.*, 2013; IARC, 2018; Schwingshackl *et al.*, 2017; Sharma *et al.*, 2022), notably colorectal cancer, which is the third leading cause of cancer death worldwide (Sharma *et al.*, 2022). In France, an unbalanced diet is responsible for 5.4% of cancer cases (IARC, 2018). Furthermore, beyond the prevention of numerous chronic diseases, a diet of optimal nutritional quality is concurrently integrated into major development projects, such as the Millennium Development Goals (MDGs) and the Sustainable Development Goals (SDGs) (Gérardin *et al.*, 2016; United Nations, 2022). Conversely, scholarly investigations have consistently indicated that collective meal contexts, including collective catering, possess a significant capacity to facilitate transitions toward healthier and more sustainable dietary patterns (Cohen *et al.*, 2021; Graça *et al.*, 2023).

Numerous studies within the extant literature have systematically assessed the nutritional quality of meals served in CC establishments across various countries (Cupertino *et al.*, 2021) including Italy (Menis *et al.*, 2024), Australia (Haynes *et al.* 2020), Croatia (Gajdoš Kljusurić *et al.*, 2016), Spain (Lavall *et al.*, 2020), and Algeria (Mekhancha *et al.*, 2017). However, there remains a noticeable scarcity of research specifically evaluating the quality of the food supply within CC establishments in Morocco. In addition, FAO and several studies consider dietary variety score and the dietary diversity score as robust tools to assess the quality of the individual and household diet (Kennedy *et al.*, 2013; Moustakim *et al.*, 2022; Ruel, 2003; VAM Resource Center, 2019).

In this context, the present study was undertaken to assess the overall quality of the diet offered by CC establishments through the application of food variety and diversity scores.

2 Material and Methods

2.1 Study Design and Population

This investigation employed a descriptive cross-sectional survey design, conducted between November 2022 and April 2023. The study encompassed six collective catering establishments (CCEs) situated within the province of Al Hoceima, Morocco. The selection of participating CCEs was based on feasibility considerations and the explicit consent of their respective management teams. Given the limited number of such establishments in the province, the inclusion of six establishments was considered representative of the local context. Access to these establishments for data collection necessitated adherence to established administrative procedures, and formal authorizations (reference #2123; 30/01/2023) were secured from their directors following a comprehensive explanation of the study's objectives. Subsequent to authorization, a structured schedule was developed to facilitate site visits.

2.2 Data Collection

Data were systematically collected from the managers of the selected CCEs via a structured questionnaire. The information gathered pertained to kitchen management methodologies and other details essential for assessing food quality. The evaluation of food quality was assessed based on dietary diversity and variety, as determined by a meticulous analysis of the dishes presented on the establishments' menus. Complementary data, including the precise composition of each dish, were additionally collected through direct observations and in-depth interviews with managers and chefs during the site visits. All collected data were entered into a Microsoft Excel spreadsheet and classified according to food groups for each observation day enabling the calculation of scores to quantify the diversity and variety of each establishment's offerings.

2.3 Definition of Food Groups

For the purpose of calculating the variety and diversity scores, the food groups for inclusion were rigorously predefined. It is recognized that, to date, no universal international consensus exists regarding the precise number

of food groups to be utilized for calculating scores that assess overall diversity, variety or general dietary quality (Kennedy *et al.,* 2013). Nevertheless, the latest revision of the FAO guide for measuring dietary diversity at both household and individual levels (Kennedy *et al.,* 2013), recommends the use of nine food groups, emphasizing the importance of adapting the questionnaire to the local context and the specific objectives of the study. In adherence to these recommendations and drawing upon existing literature, nine distinct food groups were considered and incorporated into this study, ensuring compatibility with the study's objectives and the prevalent dietary practices of the population under examination. These defined food groups are: starchy foods, legumes, green leafy vegetables, vegetables and fruits rich in vitamin A, other vegetables and fruits, meat-egg and fish, milk and dairy products, added fats and sweets.

2.4 Definition of Scores

Daily Food Variety Score (dFVS)

The dFVS quantifies the number of different food items served within a given day, irrespective of their categorization into specific food groups.

Food Diversity Score

Food diversity was assessed in a representative manner for the observed days (7 days), using the following two scores for each establishment:

- ***The Daily Food Diversity Score (dFDS):*** This metric corresponds to the number of distinct food groups present across the three meals served during a specific day. Its value is discrete, ranging from 0 to 9.
- ***The Overall Food Diversity Score (wFDS): This score*** provides an overall view of the establishment's food diversity over a full week. The wFDS is derived by calculating the average of the wFDS value recorded throughout week for a particular establishment. This value varies continuously between 0 and 9, thus representing the average food diversity of the meals presented by a given establishment over a complete week.

2.5 Statistical Analyses

Data collection and the initial calculation of scores were carried out using Microsoft Excel software. The subsequent statistical analysis of the data was conducted using IBM SPSS software for Windows, version 26. The general characteristics of the diet were expressed as means ± standard deviation (SD) for quantitative variables and as frequencies and percentages for categorical variables. The Kruskal-Wallis test was employed to assess for significant differences in the distributions of continuous variables across multiple groups, followed by Dunn's post hoc test to identify specific group differences. The Mann-Whitney U test was utilized for comparing means between two independent groups. Statistical significance was set at a p-value < 0.05.

In the absence of established reference threshold values for the scores, the analysis of the data on dietary diversity and variety was conducted according to wFDS tertiles (Kennedy *et al.*, 2013). Within the adopted classification, the first tertile (T1) corresponds to establishments where wFDS ≤ 7, indicating that the diet of these establishments was categorized as less diversified. Conversely, establishments whose diet is qualified as the most diversified were classified into the third tertile (T3), defined by the highest wFDS values (wFDS ≥ 8). Establishments exhibiting average dietary diversity were classified into the second tertile (T2; 7 < wFDS < 8).

3 RESULTS

3.1 Description of the Study Sample

The findings revealed 1296 meals served across six CCEs in the Al Hoceima Province of Morocco. During the study period, a total of 3,024 individuals were served the examined meals, based on a rate of three meals per day per person for seven days per establishment.

As presented in Table 1, two-thirds (66.7%) of the meals examined were served by establishments that delegate the management of their canteens to an external company. These establishments also involved at least one health professional (a physician, nurse, and/or dietitian) in their menu development process. The remaining one-third (33.3%) of the meals were served by establishments operating under internal management, overseen by administrative staff (the establishment's director and the bursar), who possessed foundational training in economics, management, or administration.

3.2 Diet Assessment

3.2.1 Dietary Diversity Score (DDS)

The results concerning the daily Food Diversity Score (dFDS) indicate the meals offered by the studied establishments comprised, on average, 7.29 ± 0.80 food groups, with a minimum of 6 food groups per day and a maximum of 9. The majority of the food days examined included foods belonging to either 7 groups (42.9%) or 8 food groups (35.7%). Conversely, 16.7% of food days featured only 6 food groups, while a mere 4.8% achieved the maximum of 9 food groups.

Table 1. Characteristics of the studied establishments

Establishments	Customer count/day	Number of meals served/day	Number of meals examined	Management method	Involvement of HS during menu development
CCE_1	20	60	21	External	Yes
CCE_2	75	225	21	Internal	No
CCE_3	55	165	21	Internal	No
CCE_4	120	360	21	External	Yes
CCE_5	137	411	21	External	Yes
CCE_6	25	75	21	External	Yes
TOTAL	**432**	**1296**	**126**	-	-

CCE: Collective catering establishments; HS: Health staff.

Based on the classification of dietary diversity according to weekly Food Diversity Score (wFDS) tertiles, the data reveal that half (3 out of 6) of the CCEs exhibited an average dietary diversity falling within the second tertile (7 < wFDS < 8; T2). One-third (1 out of 3) of the establishments demonstrated limited dietary diversity, corresponding to the first tertile (wFDS ≤ 7). Only one establishment out of the 6 achieved a high or optimal dietary diversity, classified within the third tertile (wFDS ≥8).

3.2.2 Food Group Frequency of Occurrence

Figure 1 illustrates the frequency of occurrence of food groups across the food days examined according to wFDS tertiles. Starchy foods, meat-eggs and fish, other vegetables and fruits, added fats, sweets, and milk and dairy products were universally present in all 42 food days examined (100%), irrespective of the establishment's dietary diversity level. In contrast, the legume group was present in 71% of food days in T1 and T3 establishments but in only 48% of food days in T2 establishments. The vitamin A-rich vegetables and fruits group was present in all food days offered by establishments classified as T3, yet it appeared in only 29% of food days offered by T1 establishments. Furthermore, nearly half (43%) of the food days offered by establishments in T3 included foods belonging to the green leafy vegetable group, whereas these food items were entirely absent from meals served by establishments classified as T1.

Figure 2 depicts the frequency of daily presence of food groups that were served daily by all establishments according to the wFDS tertiles. The groups comprising other vegetables and fruits, meat-egg and fish, milk and dairy products, and sweets were served at a frequency of two times per day in the establishments with high dietary diversity (T3). In contrast, these same groups were served only once per day in establishments classified possessing limited dietary diversity (T1). The starchy foods group, however, was consistently present at a frequency of three times per day across all examined food days, regardless of the establishment's diversity classification.

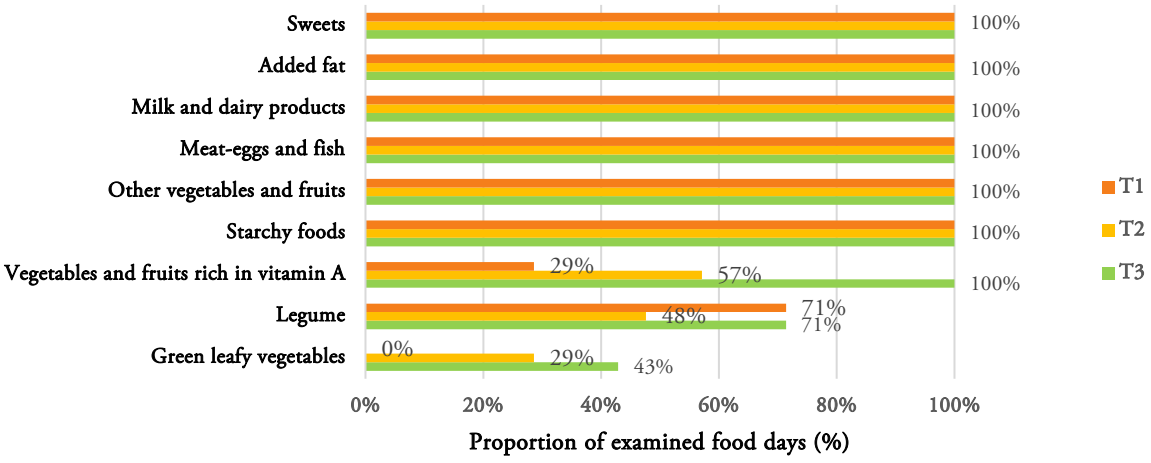

Figure 1. Frequency of presence of food groups in the examined food days

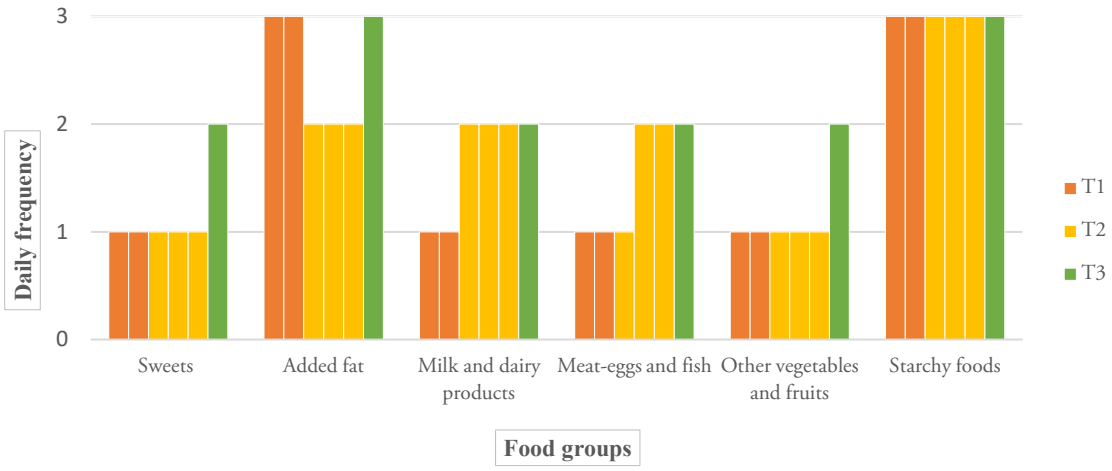

Figure 2. Daily frequency of presence of food groups whose foods are served daily according to the classes of dietary diversity

3.2.3 Food Scores and Influencing Factors

Table 2 presents the principal findings from the comparisons of the calculated variety and diversity scores, stratified by the explanatory variables investigated. As indicated in Table 2, a significant difference in these food scores was observed according to the restaurant management modality (for dFDS, $p = 0.004$; for dFVS, $p < 0.0001$).

As further illustrated in both Figures 3 and Figure 4, establishments that delegated their canteen management to an external company exhibited significantly higher food scores compared to those maintaining internal management (mean dFDS = 7.54 *versus* 6.79; mean dFVS = 16.36 *versus* 11.50). Similarly, the variety and diversity of food offerings differed significantly based on the involvement of health care staff member menu development. The mean food scores obtained in establishments that included at least one healthcare staff member in the development of their menus were higher compared to those found in establishments that did not involve any health care staff member (mean dFDS = 7.54 *versus* 6.79, $p = 0.004$; mean dFVS = 16.36 *versus* 11.50, $p < 0.0001$).

Table 2. The mean food diversity and variety scores according to the variables studied.

Variables	Mean dFDS	p-value	Mean dFVS	p-value
Management method				
- Internal	6.79 ± 0.69	$p = 0.004$	11.50 ±1.45	$p < 0.0001$
- External	7.54 ± 0.74		16.36 ±3.05	
Involvement of HS during menu development				
- No	6.79 ± 0.69	$p = 0.004$	11.50 ±1.45	$p < 0.0001$
- Yes	7.54 ± 0.74		16.36 ±3.05	
Days of the week				
- Monday	6.83 ± 0.75		14.83 ± 2.93	
- Tuesday	7.50 ± 0.84		14.17 ± 3.13	
- Wednesday	7.33 ± 0.82		14.17 ± 3.92	
- Thursday	6.67 ± 0.82	$p = 0.015$	13.83 ± 2.64	$p = 0.324$
- Friday	8.33 ±0.52		18.50 ±3.73	
- Saturday	7.17 ± 0.41		13.83 ± 3.97	
- Sunday	7.17 ±0.41		13.83 ± 2.99	

Note: HS: Health staff; dFDS: daily food diversity score; daily food variety score

Table 2 also illustrates a significant variation in dFDS across the days of the week ($p = 0.015$). This trend is further illustrated in Figure 5, which presents the distribution of dFDS values throughout the week with the highest values recorded on Friday (mean dFDS = 8.33 ± 0.52) and the

lowest on Thursday (mean dFDS = 6.67 ± 0.82). As presented in Table 3, pairwise comparisons of dFDS across days of the week, revealed that, with the exception of Tuesday (p = 0.115), Friday exhibited significantly higher dFDS values compared to all other days (p < 0.05). No statistically significant differences were observed between the other days of the week, suggesting that the increase in dFDS on Friday is particularly noteworthy. Regarding the variation of dFVS across the days of the week, although fluctuations were observed—with the highest mean recorded on Friday (18.50 ± 3.73) and values ranging between 13.83 and 14.83 on other days (Table 2),—this difference was not statistically significant (p = 0.324).

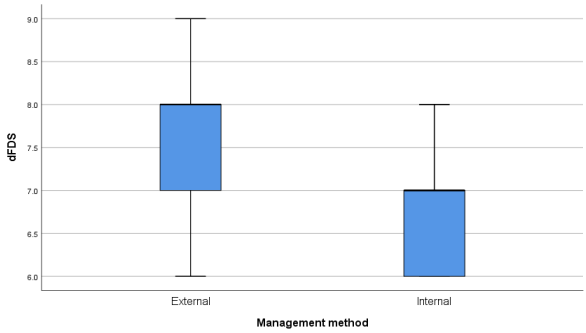

Figure 3. Distribution of the daily food diversity scores (dFDS) as a function of the management method (External *versus* Internal)

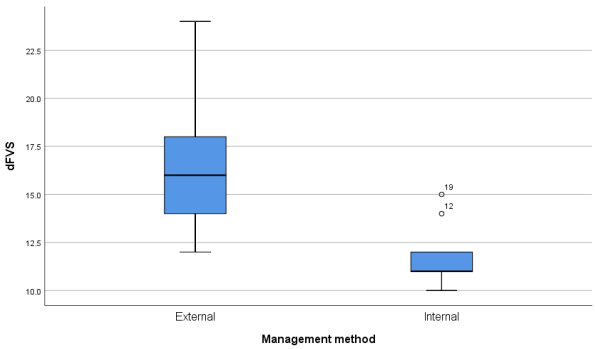

Figure 4. Distribution of the daily food variety scores (dFVS) as a function of the management method (External *versus* Internal)

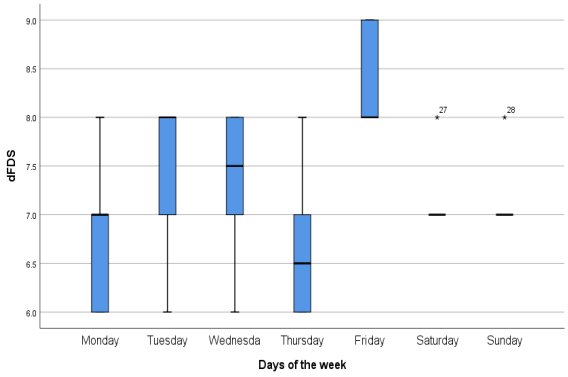

Figure 5. Distribution of daily food diversity scores (dFDS) throughout the days of the week

Table 3. Pairwise comparisons of daily food diversity scores (dFDS) across days of the week

Days of the week (mean dFDS)	Monday (6.83 ± 0.75)	Tuesday (7.50 ± 0.84)	Wednesday (7.33 ± 0.82)	Thursday (6.67 ± 0.82)	Friday (8.33 ±0.52)
Monday (6.83 ± 0.75)	–	h = -10.333 p = 0.118	h = -7.583 p = 0.251	h = -2.083 p = 0.753	h = -20.750 p = 0.002
Tuesday (7.50 ± 0.84)	–	–	h = 2.750 p = 0.677	h = 6.250 p = 0.345	h = -10.417 p = 0.115
Wednesday (7.33 ± 0.82)	–	–	–	h = -9.667 p = 0.144	h = -13.167 p = 0.046
Thursday (6.67 ± 0.82)	–	–	–	–	h = -22.833 p = 0.001
Friday (8.33 ±0.52)	–	–	–	–	–
Saturday (7.17 ± 0.41)	–	–	–	–	–
Sunday (7.17 ±0.41)	–	–	–	–	–

FDS: daily food diversity score

4 Discussion

The data obtained in this study provide valuable insights into the nutritional quality of food served in collective catering establishments within a country experiencing nutritional transition. Indeed, the reported data indicate that the food provided by the six CCEs is moderately diversified, as evidenced by the daily and weekly Food Variety Score (FVS) and Food Diversity Score (FDS). Specifically, the daily FDS (dFDS) for 78.6% of the examined food days ranged between 7 and 8, with an average dFDS of 7.29 ± 0.80. However, the maximum dFDS of 9 food groups per day, corresponding to optimal diversity, was achieved in only 2 of the 42 food days examined.

In addition, the diversity and variety of meals served by these establishments, determined by dFDS and dFVS, exhibited day-to-day variations and were influenced by specific determinants investigated in this study, including restaurant management modalities and the involvement of health personnel in menu development. On the other hand, across all food days examined during the study period, six food groups were included, irrespective of the food diversity category in which the establishment was classified or the other determining variables studied. These consistently present food groups are starchy foods, meat-eggs and fish, other vegetables and fruits, added fats, sweets and finally milk and dairy products. These food groups also largely align with the typical dietary patterns of the Moroccan population. Indeed, the food groups identified in this study have demonstrated consistency with those consumed by populations residing in other extensive regions of the country, namely the Rabat-Salé-Kenitra region (Barakat *et al.*, 2022) and the provinces of Sidi Bennour (Moustakim *et al.*, 2022) and El Jadida in the large region of Casa-Settat as well as in the province of Tetouan (Mziwira *et al.*, 2024), which shares geographical proximity with the current study province.

The consistent daily presence of foods from these food groups can be explained, on the one hand, by their fundamental role as dietary staples and preferred food choices within the Moroccan population (FAO, 2011). On the other hand, this pattern is influenced by the Mediterranean diet, given the study's conduct in a Mediterranean geographical area. Supporting this, a study conducted in boarding schools across two Croatian regions, —the Adriatic (coastal) and the continental—revealed that meals predominantly comprised six food groups: cereals, meat, fats, fruits, vegetables, and milk (Gajdoš Kljusurić *et al.*, 2016). Notably, significant regional variation in daily serving frequency was observed, with fruits, vegetables, and milk exhibiting greater prevalence in the coastal region. This disparity was attributed to the influence of the Mediterranean diet in the Adriatic region. These results by Gajdoš Kljusurić *et al.* (2016), reinforce the hypothesis that dietary habits within mass catering establishments may be influenced by regional food traditions and geographical location.

The food groups exhibiting the lowest prevalence in the meals served were vegetables and fruits rich in vitamin A followed by green leafy vegetables. These observations are consistent with those reported by Moustakim *et al.*, (2022), who also reported an extremely low consumption of green leafy vegetables accounting for merely 1.3% of those surveyed population. This outcome deviates from national nutritional guidelines, which recommend a minimum daily consumption of one green leafy vegetable (Ministère de la Santé, 2016). These particular vegetables are indeed recognized as high-quality sources of essential vitamins, minerals, and phenolic compounds (Aboukhalaf *et al.*, 2023; Kennedy *et al.*, 2013).

At the African continent level, a study conducted by Yagoubi-Benatallah *et al.* (2016) described the nutritional quality of meals served in Algerian school canteens by quantifying the contribution of each of the five food groups to the average daily ration. This investigation revealed that the daily average intake in these canteens was predominantly composed of the starch group, followed by animal protein products. However, fruits and vegetables ranked third in the daily ration. This finding aligns with the results of the present study, where identical patterns of food group distribution is observed, with starchy foods being the most prevalent, yet simultaneously underscoring a relative underrepresentation of fruits and vegetables, particularly those rich in vitamin A. The contrast between the predominance of starchy foods and the lower presence of nutrient-rich vegetables and fruits suggests potential avenues for improving the dietary diversity of meals offered by CCEs in both countries.

This study also highlighted the critical role of the management modality in influencing the nutritional quality of food served in CCEs. A comparison of the obtained data revealed a difference based on the management method of diversity and variety of food in the restaurants studied. By comparing the average daily scores obtained for food diversity (dFDS) and variety (dFVS) based on the management method of the establishment, it became evident that the meals served by CCEs which delegated the management of their canteens to an external company were more diversified and more varied compared to those served in CCEs whose restaurant management is internal. Meals provided by CCEs with subcontracted management included, on average, 0.75 more food groups and 4.86 more food items per day than those served by CCEs operating under an internal management. These results may primarily

be attributed to the presence, in the case of subcontracting, of a Special Requirements Book (SRB) between the administration and the subcontracting company. This SRB delineates technical clauses governing the structure of a food day, the composition of meals, the food plan, the quantity of food as well as the frequencies of food distribution. In addition, the administration often designates at least one individual to ensure continuous monitoring of meals, thereby confirming with the technical clauses of the SRB. This oversight further contributes to enhancing the quality of the meals served.

This work additionally emphasized the crucial impact of involving health personnel in menu development on the quality of the menus provided by the studied catering establishments. The findings demonstrated that all establishments employing the subcontracting management mode involve at least one person from the health personnel in the development of their menus. This can be explained by the imperative to ensure adequate implementation of the technical clauses of CPS, particularly concerning the nutritional aspect and dietary balance, for which the administration leverages individuals such as physicians, nutritionists, and nurses who possess the required knowledge and expertise. This staff contributes to enhancing the dietary diversity and variety of the menus.

Furthermore, the results of this study also indicated that the dietary quality of the CCEs varied significantly according to the days of the week. A statistically significant variation in the dFDS was revealed throughout the week with a notable increase in this score on Friday. This phenomenon is attributable to the traditional eating habits of Moroccans on Friday. All CCEs included in the study sample generally serve Couscous accompanied by fermented milk, locally known as *Lben* (Royaume du Maroc, 2000), for Friday lunch. This dish is widely prepared and consumed by the majority of the population in both households and restaurants (Merzouki, 2009). The typical composition of this dish includes foods belonging to at least seven distinct food groups identified in this study: (1) starchy foods (wheat semolina), (2) meat-egg-fish (beef, sheep, chicken or turkey), (3) legumes (chickpeas), (4) other vegetables and fruits, (5) vegetables and fruits rich in vitamin A (carrots and/or pumpkin), (6) added fats (butter, Smen [salted butter], and/or vegetable oil [olive or seed], and (7) green leafy vegetables (cabbage). Given that couscous is often accompanied by *Lben*, the dietary diversity of the day on which couscous is served would correspond to a minimum dFDS of 8 food groups, a value consistent with our findings. Moreover, some establishments also serve "Tfaya", a local couscous accompaniment primarily composed of onions, raisins, and either honey or sugar (Merzouki, 2009; Oubahli, 2008). Considering these additional ingredients, a food day featuring couscous with both accompaniments could reach a maximum dietary diversity score which is 9 food groups. These characteristics of diversity and variety pertaining to the couscous dish and its accompaniments thus warrant consideration during nutritional surveys, particularly in dietary assessment methodologies such as the 24-hour recall. The day on which couscous is served, while significant contributing to variety and dietary diversity, may not accurately represent the typical dietary patterns of individuals or households.

Limitations of the study

This study has yielded valuable information concerning the overall nutritional quality of meals served in CCEs and has identified key areas for potential improvement in meal composition to enhance dietary quality.

However, the present investigation is subject to several inherent limitations that should be acknowledged. Primarily, the relatively modest sample size employed in this study constrains the generalizability of the findings, as a larger sample would facilitate more robust statistical analyses and provide a more representative portrayal of dietary practices within collective catering establishments.

Furthermore, the assessment of nutritional quality was exclusively reliant upon the Dietary Diversity Score (FDS) and the Dietary Variety Score (FVS). While these scores are valuable indicators of dietary patterns, they do not afford a comprehensive assessment of precise nutrient adequacy or portion sizes. Consequently, the study did not incorporate direct nutrient analysis, which would have enabled an accurate quantification of the macro- and micronutrient content of the provided meals. A more detailed dietary assessment, integrating a rigorous analysis of nutrient intakes, would strengthen the findings of the present study.

5 Conclusions

The data reported in this study unequivocally demonstrate that the diet offered in most CCEs is moderately diversified. However, a critical finding is the scarcity of key micronutrient-rich food groups, specifically vegetables and fruits rich in vitamin A as well as green leafy vegetables, within the meals served by these establishments, particularly those classified in the first tertile (T1). The limited consumption of these food groups may contribute to micronutrient deficiencies within the consuming population. These results suggest the imperative to implement targeted measures to encourage both CCEs and the broader Moroccan population to include these essential foods in their diets.

The findings additionally highlight the considerable advantages of outsourcing restaurant management and

integrating health professionals into menu planning as strategic interventions for significantly improving the dietary diversity and variety of meals served by CCEs.

Moreover, extending this type of investigation to other regions of the country would prove instrumental in deepening the understanding of dietary practices and behaviors across diverse contexts. Furthermore, conducting comparable research in varied settings that feature distinct local food resources could provide a broader perspective on the factors influencing dietary diversity and meal variety provided by collective catering. Such a comprehensive approach could significantly assist policymakers and stakeholders in implementing more effective interventions aimed at enhancing the overall nutritional the quality of the food supply in CCEs.

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