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Functional and Quality Analysis of Nutrition-Related Mobile Apps Available in Poland Using the MARS Scale

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Abstract

Aim: The aim of this study was to evaluate the functionality and quality of nutrition-related mobile apps available on the Polish market through the App Store (Apple Inc.) using a standardised assessment tool, the Mobile App Rating Scale (MARS).

Methodology: The selection of apps was based on clearly defined inclusion and exclusion criteria, following the PRISMA (*Preferred Reporting Items for Systematic Reviews and Meta-Analyses*) framework. App quality was assessed using the MARS tool, known for its high reliability ($\alpha = 0.90$; $r = 0.79$). Evaluations were conducted by two independent teams, each consisting of two reviewers who evaluated every app over a two-week period. The final scores were established through consensus.

Results: The study revealed significant variability in the quality of the evaluated apps. MyFitnessPal received the highest overall quality rating, while Monitor Postu Przerywanego was given the lowest

rating. In terms of subjective quality, YAZIO, FatSecret, and MyFitnessPal achieved the highest scores, whereas Monitor Postu Przerywanego once again received the lowest rating. The most significant potential for user impact was found in YAZIO and MyFitnessPal, with Monitor Postu Przerywanego demonstrating the lowest potential in this sector.

Implications and recommendations: The findings underline the need for improvement in nutrition-related apps by integrating reliable, evidence-based content, personalised dietary recommendations, and advanced technological solutions. Collaboration with nutrition experts and the implementation of certification systems are also recommended to enhance user trust. Whilst these apps show potential in supporting healthy habits, further optimisation in terms of quality and functionality is essential.

Originality: This article offers a comprehensive evaluation of the quality and functionality of nutrition apps available on the Polish market, utilising the standardised MARS tool. Its originality lies in combining a systematic approach with hands-on user evaluation, taking into account the technical criteria and also the potential to influence health-related behaviour.

Keywords: mobile apps, dietary apps, nutrition, Mobile App Rating Scale (MARS), mHealth

1. Introduction

Information and Communication Technologies (ICT) refer to solutions that enable the electronic collection, processing, and sharing of data. In the healthcare sector, they support health promotion through tools such as electronic medical records, telemedicine, health information systems, professional tools for medical staff, and web-based clinical decision support services (Braz & Lopes, 2019).

The contemporary development of mobile technologies has significantly contributed to the widespread adoption of apps that support healthy lifestyles and nutrition education. Dietary apps provide personalised educational content and features that help monitor body weight, energy balance, physical activity, and sleep patterns, addressing the needs of diverse user groups, including individuals with overweight conditions, chronic illnesses, or a history of cancer. An additional advantage is the integration with extensive databases, which enables users to access reliable nutritional information and facilitates informed daily dietary decision-making, and graphic data presentation improves comprehension and enhances the effectiveness of health-promoting actions. Thus, mobile apps represent modern, flexible, and individualized tools for health promotion and dietary education (Nogueira-Rio et al., 2024; West et al., 2017).

Research indicates that mobile health apps can be a practical component of dietary interventions, particularly in supporting dietary monitoring and promoting change of behaviour. High user acceptance and ease of use, especially in out-of-home settings, make them a competitive alternative to traditional methods such as paper diaries or individual counseling. Although not all interventions have produced significant clinical outcomes, some studies have reported improvements in specific health indicators e.g. body weight, blood pressure, and fruit and vegetable intake. Moreover, combining apps with other intervention methods—including dietary counselling or multimedia communication—has been shown to enhance their overall effectiveness (Allen et al., 2013; Allman-Farinelli & Gemming, 2017; Samoggia & Riedel, 2020).

The nutrition app market is evolving rapidly, driven by increasing interest in healthy living and the need for accessible tools to support dietary control. It is projected to reach a value of USD 6.05 billion by 2025, and USD 9.15 billion by 2029, with an average annual growth rate of 10.89%. The number of users is also expected to increase, from 4.57% of the population in 2025 to 5.36% in 2029. Market growth is further influenced by local factors, including cultural preferences, culinary traditions, and specific dietary needs (e.g. gluten-free and vegetarian diets). On a global level, macroeconomic drivers—including rising incomes, widespread access to the Internet and smartphones, and increased health awareness—play a key role. As a result, nutrition apps are becoming increasingly attractive tools for everyday health management (Statista, 2025).

The dynamic development of mobile technologies is having a profound impact on the healthcare sector. Their role, referred to as mHealth, is particularly relevant in addressing obesity and promoting healthy dietary behaviour. Mobile apps are becoming key tools for individuals seeking to improve their lifestyle and maintain health, yet despite the rapid expansion of this market segment, many available apps have not yet undergone rigorous quality evaluation and require further improvement. The aim of the study was to conduct a systematic review of the App Store for nutrition-related applications and to evaluate their quality and functionality. The assessment was conducted using the Mobile App Rating Scale, which evaluates objective as well as subjective dimensions. The analysis enabled the identification of key areas requiring improvement, which may contribute to enhancing user experience and increasing the effectiveness of these applications in supporting healthy lifestyles.

2. Methodology

2.1. App Search Strategy

A systematic review of nutrition-related mobile apps available on the Polish version of the App Store (iOS), developed by Apple Inc., was conducted. The search was carried out between July and August 2023 within the "Health & Fitness" category. To maximise the comprehensiveness of the results, additional keywords were applied: *nutrition, diet, dietary, calories, obesity, weight loss, and body weight*.

2.2. App Selection Criteria

Application selection followed the PRISMA (*Preferred Reporting Items for Systematic Reviews and Meta-Analyses*) guidelines (Moher et al., 2009). Only apps meeting all of the following inclusion criteria were eligible for further analysis:

1. availability of a free version,
2. average user rating ≥4.5 (on a 5-point scale),
3. minimum of 1,000 user ratings,
4. availability in Polish or English,
5. last update released in 2021 or later.

Additionally, based on prior research (Franco et al., 2016; Gioia et al., 2023; Mandracchia et al., 2020) five key nutritional features were defined, the presence of which was required for app inclusion:

1. ability to search for food products and nutritional components,
2. daily intake tracking functionality (e.g., by weight, portion, or image),
3. access to personalised and detailed culinary recipes,
4. dietary analysis tools and advice (including energy and dietary structure analysis),
5. educational content related to principles of healthy eating.

Apps that did not meet any of the above criteria were excluded. For the apps qualified for in-depth analysis, the presence of the following additional functionalities was also evaluated:

1. option to register or log in,
2. interaction with other users or professionals (e.g. dietitians),
3. motivational mechanisms (e.g. points, badges, leaderboards),
4. smart recognition technologies (e.g. barcode, QR code, photo recognition),
5. integration with health-related devices (e.g. smartwatches, fitness bands).

2.3. Quality Assessment – MARS Scale

App quality was assessed using the standardised Mobile App Rating Scale, characterised by high internal consistency ($\alpha = 0.90$) and strong interrater reliability ($r = 0.79$) (Stoyanov et al., 2015). The evaluation process was conducted by two independent research teams, each comprising two

reviewers. Each reviewer tested the apps individually over a two-week period. The final app scores were established through consensus among team members.

The MARS tool includes two primary components:

1. descriptive classification – general app data (e.g. name, version, developer, cost, platform, purpose, target group, technical aspects) – not subject to scoring,
2. quality assessment – divided into objective quality components (engagement, functionality, aesthetics, and information quality) and subjective quality (4 items related to overall user impression). All assessments were performed using a 5-point Likert scale (1 = inadequate, 5 = excellent). Additionally, an optional module was included to assess the app's impact on the user (e.g. knowledge, attitudes, intentions of behavioural change).

2.4. Statistical Analysis

Descriptive statistics, including mean overall and subscale scores and standard deviations for each MARS component, were calculated. Subjective quality and perceived impact on the user were also analysed. The resulting data enabled a comparative evaluation of the strengths and weaknesses of the analysed apps and facilitated an assessment of their overall quality consistency.

3. Results

In this study, which aimed to evaluate the quality of mobile applications related to nutrition, the authors applied a selection process based on an elimination, in accordance with the PRISMA protocol. The search was conducted on one of the leading digital distribution platforms—the App Store—using a set of precisely selected keywords: *nutrition, diet, dietary, calories, obesity, weight loss, body weight*, and *weight reduction*. Data collection took place between July and August 2023. A detailed overview of the selection process, conducted in line with PRISMA guidelines, is presented in Figure 1.

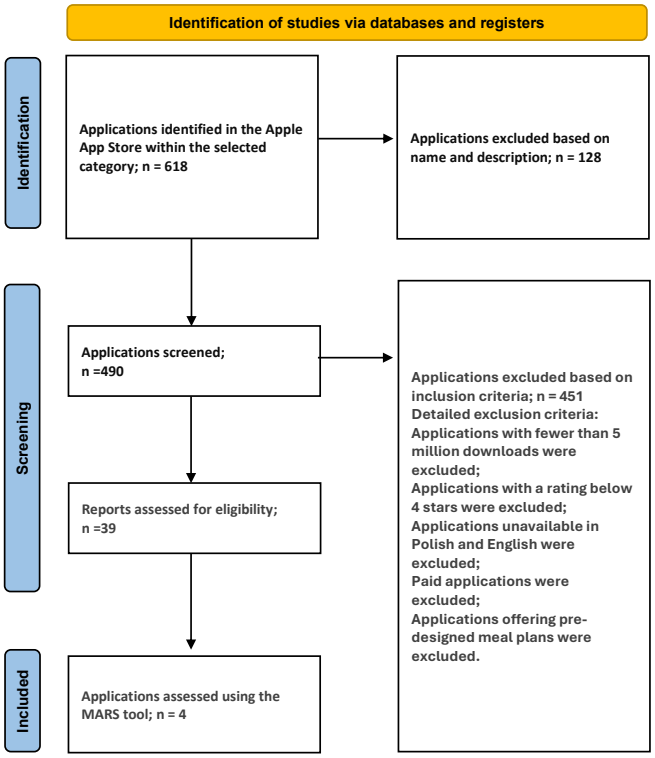

Fig. 1. Flow diagram for the selection process of the apps included in the study

Source: own work.

As part of the preliminary analysis, a systematic search of the App Store platform was conducted, resulting in the identification of 618 mobile apps. After an initial screening, 490 unique entries were selected for further evaluation, of which the majority were apps focused on dietary guidance (169/490, 34.5%) and supporting physical activity (161/490, 32.9%), as detailed in Table 1. Most of the analysed tools were developed by commercial entities (360/490; 73.5%), while apps created by individual users accounted for 26.5% (130/490). More than half of the apps (273/490; 55.7%) had an average rating below 4.5 stars, and nearly half (222/490, 45.3%) had been rated by fewer than 1,000 users. All apps had been updated after 2021, and the vast majority (472/490, 96.3%) were available free of charge.

In the next phase, the apps were verified against the previously defined methodological criteria, resulting in the selection of 39 tools that met the established inclusion criteria. Among these, only four apps (12.8%) were strictly diet-focused, while the others concentrated on physical activity (19/39, 48.7%) or general health management (6/39, 15.4%). All the apps included in the detailed analysis demonstrated high usability parameters, with a minimum rating of 4.5 stars and more than 1,000 user reviews (Table 1).

Table 1. Characteristics of mobile apps related to nutrition

Properties	Apps selected for initial screening (n=490), n (%)	Apps eligible for in-depth analysis (n=39), n (%)
Purpose:		
Dietary guidance	169 (34)	5 (13)
Fitness guidance	161 (33)	19 (49)
Dietary and fitness guidance	14 (3)	-
Cooking guidance	14 (3)	-
Health management	29 (6)	6 (15)
Other	103 (21)	9 (23)
Developer:		
Individual	130 (27)	3 (8)
Corporation	360 (73)	36 (92)
User rating (stars):		
Below 4.5	273 (56)	-
Above 4.5	217 (44)	39 (100)
Number of reviews:		
Below 1000	222 (45)	-
Above 1000	268 (55)	39 (100)
Available for free:		
Yes	472 (96)	39 (100)
No	18 (4)	-

Source: own work.

Table 2. Characteristics of mobile apps included in the in-depth analysis

Name	Icon	Description
YAZIO – Calorie Counter		The app enables comprehensive management of a daily nutrition diary and monitoring of physical activity. Its functionality is designed to support weight loss by allowing users to track their progress in real time.
FatSecret Calorie Counter		A mobile calorie counter designed for intuitive use, which—according to its developers—can serve as an effective tool for supporting weight loss.
Monitor Postu Przerywanego		An app promoting a healthy lifestyle through the implementation of beneficial habits. Its primary goal is to support users in reducing excess body weight and encourage them to engage in physical activity.
MyFitnessPal: Calorie Counter	- 	A tool offering progress tracking in nutrition, diet, physical activity, hydration, and weight control. It includes elements of virtual dietary guidance, a personalised meal plan, and a real-time food diary.

Source: own work.

Four apps containing content related to dietary guidance were included in the in-depth analysis (for a detailed description see Table 2).

As part of the in-depth analysis of four nutrition-related apps, it was found that the majority (75%) offered a food product information search function, allowing users to access data on nutritional values. In some cases, graphic visualizations (e.g. charts) were used to illustrate the content of specific nutrients. Regarding additional nutritional functionalities, 75% of the apps enabled users to log daily food intake, including portion weight or photographic documentation. Personalised recipes were available in 50% of the apps, with one requiring premium access. Similarly, 50% of the apps included dietary analysis and advisory components, such as assessments of dietary energy value, yet only one app (25%) provided educational content related to nutrition. Detailed data are presented in Table 3.

Table 3. Functionalities of nutrition-related apps included in the in-depth analysis

Feature	App count
Search for food and nutrient information	3 (75)
Items available in the database:	
– Individual food items	3 (75)
– Packaged food products	3 (75)
Available nutritional information:	
– Energy	3 (75)
– Nutrients	3 (75)
– Vitamins and minerals	2 (50)
– Fibre	2 (50)
Other information:	
– Glycemic index	-
– Graphical food rating	-
Daily food intake recording:	
– By weight	3 (75)
– By portion	2 (50)
– Use of charts to visualise intake	1 (25)
Personalised and detailed recipes:	1 (25)
– Based on energy requirements	-
– With specified food items	1 (25)
– With defined quantities	-
Dietary analysis and recommendations	2 (50)
Educational materials on nutrition	1 (25)

Source: own work.

Table 4 presents the results of a detailed evaluation of four nutrition-related mobile apps, conducted using the Mobile Application Rating Scale. The analysed apps were: YAZIO, FatSecret, Monitor Postu Przerywanego, and MyFitnessPal. The MARS scale includes five main sections: Engagement, Functionality, Aesthetics, Information Quality, and Subjective Quality, supplemented by an assessment of the perceived impact on health behaviour.

The overall mean MARS score reflects the general quality of each app, while domain-specific scores—engagement, functionality, aesthetics, and information quality—allow identification of specific strengths and weaknesses. All the analysed applications scored above 3.0 on the five-point scale, indicating a moderate to high level of quality. Consistent with earlier research, a total MARS score ≥3.0/5 was interpreted as acceptable overall quality. Several reviews explicitly treated ≥3.0 as the minimum acceptable threshold, and the instrument itself labelled "3" as *acceptable* on its 5-point Likert anchors (1–inadequate, 2–poor, 3–acceptable, 4–good, 5–excellent) (Geng et al., 2023). The overall mean scores ranged from 3.26 to 3.99. MyFitnessPal received the highest rating (3.99), while

Monitor Postu Przerywanego received the lowest (3.26). Notably, none of the evaluated apps exceeded a score of 4.0, which may suggest that the reviewed tools have limited optimization of their interface, content, or functionality.

In the engagement category, YAZIO achieved the highest score (3.80), distinguished by its high level of interactivity and relevance to the target group. A detailed analysis of the engagement component revealed that FatSecret scored the lowest (2.0) in the entertainment and interest subcategory. This may suggest that users perceive the app as insufficiently engaging and lacking elements that encourage regular use. A possible reason for this rating could be the absence of gamification features or interactive elements that enhance user enjoyment. In contrast, YAZIO received the maximum possible score (5.0) for interactivity, which may reflect a high degree of personalisation, responsiveness, and dynamic features supporting user engagement. MyFitnessPal was rated highest in target group relevance, indicating strong alignment with user needs and expectations.

Table 4. Variation in mean MARS scores among the analysed apps

Section	Item	YAZIO	FatSecret	Monitor Postu Przerywanego	MyFitnessPal
Engagement (A)	Entertainment	3	2	3	3
	Interest	4	4	3	4
	Personalisation	3	3	4	3
	Interactivity	5	3	4	3
	Target group	4	4	3	5
	Mean	**3.80**	**3.20**	**3.40**	**3.60**
Functionality (B)	Performance	5	4	2	5
	Ease of use	4	5	3	4
	Navigation	4	4	4	5
	Gesture control	4	4	4	4
	Mean	**4.25**	**4.25**	**3.25**	**4.50**
Aesthetics (C)	Layout	3	4	3	4
	Graphics	5	3	4	5
	Visual appeal	4	3	4	3
	Mean	**4.00**	**3.33**	**3.67**	**4.00**
Information (D)	Accuracy of app description	3	5	4	3
	Goals	4	5	2	4
	Quality of information	4	5	3	4
	Quantity of information	3	4	2	3
	Visual information	5	5	4	4
	Credibility of source	4	4	2	4
	Evidence base	2	3	2	5
	Mean	**3.57**	**4.43**	**2.71**	**3.86**
Subjective App Quality (E)	Would you recommend this app?	I would recommend this app to many people	I would recommend this app to many people	I would recommend this app to a few people	I would recommend this app to many people
	How many times do you think you would use this app?	>50	>50	1–2	>50
	Would you pay for this app?	Maybe	Maybe	No	Maybe
	Overall star rating	★★★★	★★★★	★★★	★★★★
Perceived Impact (F)	Awareness	5	3	2	4
	Knowledge	3	2	1	3
	Improvement of health behaviour	4	4	2	4
	Intention to change	3	4	3	4
	Help-seeking	3	4	2	4
	Behaviour change	4	4	1	3
	Mean	**3.44**	**4.50**	**4.36**	**2.31**
Overall Mean App Rating		**3.91**	**3.80**	**3.26**	**3.99**

Source: own work.

Regarding functionality, MyFitnessPal demonstrated the highest efficiency and ease of use (mean score: 4.50), while Monitor Postu Przerywanego received a significantly lower score (3.25). Its lowest sub-score (2.0) in performance suggests technical issues such as feature lag or system instability, which indicates a need for significant optimisation to improve usability. Conversely, FatSecret received the highest score (5.0) for ease of use, with reviewers highlighting its intuitive interface, enabling use without prior instruction or cognitive effort. MyFitnessPal also received the highest score (5.0) in the navigation subcategory, being the only app to achieve this, indicating a well-organized structure and a smooth user flow. All the apps received an identical score (4.0) for gesture-based control, suggesting consistent user-interface interaction with some room for minor improvements.

In terms of aesthetics, both YAZIO and MyFitnessPal scored highest (4.00), while FatSecret received a slightly lower rating (3.33). None of the apps obtained the maximum score in layout, indicating deficiencies in the placement of navigational elements such as buttons, icons, and text, which suggests a need for further interface optimisation to improve clarity and ergonomics. In the graphics subcategory, YAZIO and MyFitnessPal again led with perfect scores (5.0), with reviewers noting the high visual design quality and resolution, significantly contributing to a positive aesthetic experience. However, in terms of visual appeal, none of the apps stood out, implying a lack of particularly attention-catching or emotionally engaging visual elements.

In the information category, FatSecret dominated (4.43), distinguished for both the quality and quantity of its content, as well as its credibility as a source. Cross-sectional assessments of nutrition app quality consistently highlight insufficient referencing of scientific sources and infrequent reporting of effectiveness evidence, which lowered the scores in the MARS Information domain. To enhance credibility, transparent in-app citation of dietary guidelines and systematic reviews is recommended (Lee et al., 2023). Monitor Postu Przerywanego scored the lowest (2.71), mainly due to limited and low-quality content. FatSecret received the maximum score (5.0) in the accuracy of description subcategory, indicating high consistency between its App Store description and actual functionalities—an important value for users deciding to download the app. In contrast, Monitor Postu Przerywanego received a particularly low rating (2.0) for goal clarity and credibility, with reviewers expressing doubts about the realism and achievability of the declared outcomes. Meanwhile, FatSecret scored the highest possible rating in this subcategory, indicating greater trust in its claims. Once again, FatSecret was rated the highest (5.0) in information quality, reflecting high content accuracy, coherence, and relevance to nutritional topics. The information provided was described as precise, reliable, and not misleading. In terms of data visualisation, YAZIO and FatSecret were rated highest (5.0), indicating clarity, aesthetic appeal, and functional presentation of nutritional information. On the other hand, Monitor Postu Przerywanego scored lowest (2.0) in both information quantity and source credibility, with reviewers pointing to the limited scope of content and lack of references to verified scientific sources, which may raise user skepticism and undermine trust in the methods promoted by the app.

In addition to the four core MARS domains, the study also assessed subjective quality (Section E) and Perceived Impact on the User (Section F), covering knowledge, attitudes, intentions to change, and potential behaviour modification. In the subjective quality section, all apps—except for Monitor Postu Przerywanego—received positive reviews regarding the likelihood of future use, willingness to recommend, and overall satisfaction. The highest score for perceived impact on health behaviour was recorded for FatSecret (4.50), while the lowest was again attributed to Monitor Postu Przerywanego (2.31).

The final average scores indicate that MyFitnessPal demonstrated the highest overall quality (3.99), while Monitor Postu Przerywanego – the lowest (3.26).

The MARS evaluation results emphasise the importance of a comprehensive approach to designing health-related mobile apps which, if they are to support users effectively, must combine high content quality, intuitive usability, and strong user engagement. The MARS tool proved to be a valuable instrument for multidimensional quality assessment, allowing the identification of both strengths and areas requiring improvement.

4. Discussion

The analysis conducted using the MARS tool revealed substantial discrepancies between users' subjective ratings of nutrition-related applications and their actual quality as assessed using a standardised methodology. Despite high app store ratings (≥4.5 stars) and numerous user reviews, the evaluated apps did not fully meet quality criteria, particularly in terms of engagement and information quality. This is in line with previous findings by Mandracchia et al. (2020), who highlighted a clear divergence between subjective user evaluations and scores obtained through objective assessment tools.

This study showed that the discrepancy between high user star ratings and quality as measured by MARS was consistent with the literature, where correlations between app-store ratings and MARS are typically weak or very weak. In an analysis of popular nutrition apps in Spain, uMARS scores showed a very weak association with both star ratings and the number of reviews, underlining the limited value of app-store ratings as indicators of substantive quality. Similarly, across other mHealth categories, weak relationships were reported between user ratings and objective quality metrics (Fernandez-Lazaro et al., 2024).

The lowest scores in Section A (Engagement) indicated the limited capacity of the apps to sustain long-term user involvement. The lack of mechanisms fostering intrinsic motivation—such as personalised goals, reward systems, gamification features, or social interaction—reduces the apps' potential to drive meaningful health behaviour change. In light of the literature, these elements are considered critical for fostering sustained engagement (Chen et al., 2015; Li et al., 2019; Mandracchia et al., 2020).

In Section D (Information Quality), most apps were limited to calculating dietary energy values without incorporating qualitative recommendations regarding dietary diversity, the presence of critical nutrients (e.g. fats, sugar, salt), or the proportions of different food groups. These findings are consistent with Li et al. (2019) and Franco et al. (2016), who noted a general lack of educational and evidence-based content in diet-related apps available on both the Chinese and international markets. The findings of this study confirm the observations from markets outside Poland. In an analysis of free, popular apps supporting plant-based diets in Canada, mean MARS scores indicated moderate quality in content and functionality, with notable gaps in nutrition education and evidentiary underpinnings. A similar pattern—an attractive interface coupled with a paucity of diet-analysis tools and educational resources—was also reported in a study of nutrition apps conducted in Spain (Lee et al., 2023).

Apps with more advanced functionality and clear, appealing interfaces demonstrated higher usability, which is particularly important for users with limited technological literacy (Mandracchia et al., 2020). Notably, MyFitnessPal stood out among the apps analysed, consistently scoring high in both this study and previous evaluations (Alshathri et al., 2020; Kaiser et al., 2022; Szucs & Reicher, 2022), particularly in the areas of functionality and aesthetics. However, discrepancies in subjective and educational impact ratings were also observed in this case, potentially due to differences in sample populations, app versions, and user perceptions (Fernandez-Lazaro et al., 2024).

In the context of future development of dietary applications, the importance of deep personalisation of both content and interface should be emphasised. The implementation of artificial intelligence (AI) could enable adaptive dietary recommendations based on individual needs, medical history, taste preferences, and the presence of conditions or allergies (Hinojosa-Nogueira et al., 2024, 2025). From an implementation standpoint, two classes of solutions appear most promising "here and now": (1) rule-based personalisation (e.g. tailoring goals, thresholds, and educational content to the user's profile) and (2) image recognition for semi-automated meal logging, which has demonstrated utility in studies but still requires validation under real-world conditions (Lee et al., 2023). Image recognition algorithms may support automatic identification of food items via photographs (Sznajder, 2013), while virtual assistants could act as personalised dietary advisors, suggesting meals and generating tailored recipes (Kozłowska & Rodzik, 2018).

Another essential area is the enhancement of community-building features. User integration through cooperation, competition, and progress-sharing mechanisms can improve long-term engagement and support behaviour change. The application of gamification elements—such as rewards, point systems, challenges, and leaderboards – has been positively correlated with user motivation (Chen et al., 2015). It is also critical to identify barriers as well as facilitators of app use, where barriers include a lack of personalisation, unintuitive navigation, weak data security, and compatibility issues (Fernandez-Lazaro et al., 2024). Facilitators, on the other hand, include integration with other devices (e.g. smartwatches), configurable notifications, multi-platform availability, and user-friendly onboarding, all of which can enhance user satisfaction and application effectiveness (Gibney & Forde, 2022; Michie et al., 2011; Salazar et al., 2018). Given the importance of the 50+/65+ cohort, the design of nutrition apps should incorporate usability guidelines for older adults more rigorously (e.g. larger typography, high contrast, reduced navigational complexity, and clear status messaging). Systematic reviews stress that declines in visual and cognitive capacity, together with complex interfaces, limit the uptake of mHealth solutions in this population, whereas applying dedicated, age-informed design principles improves acceptance and effectiveness of use (Gomez-Hernandez et al., 2023).

The methodological limitations identified in this study, such as a lack of version standardisation, heterogeneity of reviewers, variation in professional background, and potential interpretative bias, stress the need for further validation of the MARS tool and standardisation of evaluation protocols (Lyzwinski et al., 2019; Stoyanov et al., 2015; Tonkin et al., 2017). Furthermore, MARS does not fully capture technical aspects such as data security, system performance, or energy consumption, which represent important areas for future investigation. It is worth emphasising that MARS does not include an in-depth assessment of privacy and security—areas in which mHealth apps often exhibit substantial deficiencies (e.g. opaque data-sharing practices, gaps in privacy policies). Augmenting evaluations with GDPR-aligned checklists and instruments that assess the rigour of privacy policies could improve the validity of conclusions regarding overall quality (Tangari et al., 2021).

To sum up, the findings highlight the need to redefine the design framework for dietary apps, integrating functional, educational, aesthetic, and psychosocial dimensions. Expanding existing evaluation tools to include technological components and conducting further research on real-world behavioural outcomes remain critical directions for future work.

5. Conclusion

The study revealed significant variation in the quality of mobile apps designed to support users in the area of nutrition. MyFitnessPal received the highest overall quality rating, whereas Monitor Postu Przerywanego the lowest. Regarding subjective quality and educational impact, YAZIO, FatSecret, and MyFitnessPal performed best, confirming their relatively high functionality and ability to influence users' awareness and behaviour. These findings indicate that nutrition-related apps should be enhanced with evidence-based dietary knowledge, advanced personalisation features, and modern technologies that support interaction and education.

Notably, an apparent discrepancy was observed between the user-generated star ratings in app stores and the objective quality assessment based on the MARS tool. This confirms that, while easily accessible, user star ratings are not a sufficient measure of app quality and may be misleading when making decisions about health-related tools. The MARS methodology proved to be a valuable and coherent tool for evaluating mobile apps, however its effectiveness should be continuously verified and refined in response to the dynamic development of the technology market. In particular, the tool would benefit from including components assessing data security and user privacy, which could enhance the comprehensiveness and validity of health app evaluations.

The outlook for the development of mobile nutrition apps is promising. The future of this sector will be driven by the integration of advanced technologies, including artificial intelligence (AI), the Internet

of Things (IoT), and machine learning, which will enable in-depth data analysis, personalised content, and adaptive user interfaces. The advancement of such features, supported by growing public awareness of healthy lifestyles, will facilitate the creation of more responsive, educational, and user-centred apps. In the coming years, mobile apps have the potential to become an integral component of health promotion and sustainable nutrition strategies in society.

References

Allen, J. K., Stephens, J., Dennison Himmelfarb, C. R., Stewart, K. J., & Hauck, S. (2013). Randomized Controlled Pilot Study Testing Use of Smartphone Technology for Obesity Treatment. *Journal of Obesity*, *2013*(1). https://doi.org/10.1155/2013/151597

Allman-Farinelli, M., & Gemming, L. (2017). Technology Interventions to Manage Food Intake: Where Are We Now? *Current Diabetes Reports*, *17*. https://doi.org/10.1007/S11892-017-0937-5

Alshathri, D. M., Alhumaimeedy, A. S., Al-Hudhud, G., Alsaleh, A., Al-Musharaf, S., & Aljuraiban, G. S. (2020). Weight Management Apps in Saudi Arabia: Evaluation of Features and Quality. *JMIR MHealth and UHealth*, *8*(10), e19844. https://doi.org/10.2196/19844

Braz, V. N., & Lopes, M. H. B. (2019). Evaluation of Mobile Applications Related to Nutrition. *Public Health Nutrition*, *22*(7), 1209-1214. https://doi.org/10.1017/S136898001800109X

Chen, J., Cade, J. E., & Allman-Farinelli, M. (2015). The Most Popular Smartphone Apps for Weight Loss: A Quality Assessment. *JMIR MHealth and UHealth*, *3*(4), e104. https://doi.org/10.2196/MHEALTH.4334

Fernandez-Lazaro, C. I., Santamaría, G., Fernandez Milano, A. F., Martin-Vergel, M. I., & Fernandez-Lazaro, D. (2024). Nutrition-Related Mobile Apps in the Spanish App Stores: Quality and Content Analysis. *JMIR MHealth and UHealth*, *12*, e52424. https://doi.org/10.2196/52424

Franco, R. Z., Fallaize, R., Lovegrove, J. A., & Hwang, F. (2016). Popular Nutrition-Related Mobile Apps: A Feature Assessment. *JMIR MHealth and UHealth*, *4*(3), e85. https://doi.org/10.2196/mhealth.5846

Geng, L., Jiang, G., Yu, L., Xu, Y., Huang, W., Chen, Z., Qi, X., Zhang, T., & Zhao, M. (2023). The Most Popular Commercial Weight Management Apps in the Chinese App Store: Analysis of Quality, Features, and Behavior Change Techniques. *JMIR MHealth and UHealth*, *11*, e50226. https://doi.org/10.2196/50226

Gibney, M. J., & Forde, C. G. (2022). Nutrition Research Challenges for Processed Food and Health. *Nature Food*, *3*(2), 104-109. https://doi.org/10.1038/s43016-021-00457-9

Gioia, S., Vlasac, I. M., Babazadeh, D., Fryou, N. L., Do, E., Love, J., Robbins, R., Dashti, H. S., & Lane, J. M. (2023). Mobile Apps for Dietary and Food Timing Assessment: Evaluation for Use in Clinical Research. *JMIR Formative Research*, *7*, e35858. https://doi.org/10.2196/35858

Gomez-Hernandez, M., Ferre, X., Moral, C., & Villalba-Mora, E. (2023). Design Guidelines of Mobile Apps for Older Adults: Systematic Review and Thematic Analysis. *JMIR MHealth and UHealth*, *11*, e43186. https://doi.org/10.2196/43186

Hinojosa-Nogueira, D., Navajas-Porras, B., Pastoriza, S., Delgado-Osorio, A., Toledano-Marín, Á., Rohn, S., Rufián-Henares, J. Á., & Quesada-Granados, J. J. (2025). Dietary Behavioural Preferences of Spanish and German Adults and Their Translation to the Dietary Recommendations of a Personalised Nutrition App in the Framework of the Stance4Health Project. *Nutrients, 17*(5), 912. https://doi.org/10.3390/NU17050912

Hinojosa-Nogueira, D., Subiri-Verdugo, A., Díaz-Perdigones, C. M., Rodríguez-Muñoz, A., Vilches-Pérez, A., Mela, V., Tinahones, F. J., & Moreno-Indias, I. (2024). Precision or Personalized Nutrition: A Bibliometric Analysis. *Nutrients*, *16*(17), 2922. https://doi.org/10.3390/NU16172922

Kaiser, B., Stelzl, T., Finglas, P., & Gedrich, K. (2022). The Assessment of a Personalized Nutrition Tool (eNutri) in Germany: Pilot Study on Usability Metrics and Users' Experiences. *JMIR Formative Research*, *6*(8), e34497. https://doi.org/10.2196/34497

Kozłowska, A., & Rodzik, A. (2018). Chatboty: perspektywy rozwoju technologii informatycznych w kontakcie z klientem. *Acta Universitatis Nicolai Copernici. Zarządzanie*, *45*(1), 7 -17. https://doi.org/10.12775/AUNC_ZARZ.2018.001

Lee, J. J., Ahmed, M., Mouhaffel, R., & L'Abbé, M. R. (2023). A Content and Quality Analysis of Free, Popular mHealth Apps Supporting 'Plant-based' Diets. *PLOS Digital Health*, *2*(10), e0000360. https://doi.org/10.1371/JOURNAL.PDIG.0000360

Li, Y., Ding, J., Wang, Y., Tang, C., & Zhang, P. (2019). Nutrition-Related Mobile Apps in the China App Store: Assessment of Functionality and Quality. *JMIR MHealth and UHealth*, *7*(7), e13261. https://doi.org/10.2196/13261

Lyzwinski, L. N., Edirippulige, S., Caffery, L., & Bambling, M. (2019). Mindful Eating Mobile Health Apps: Review and Appraisal. *JMIR Mental Health*, *6*(8), e12820. https://doi.org/10.2196/12820

Mandracchia, F., Llauradó, E., Tarro, L., Valls, R. M., & Solà, R. (2020). Mobile Phone Apps for Food Allergies or Intolerances in App Stores: Systematic Search and Quality Assessment Using the Mobile App Rating Scale (MARS). *JMIR MHealth and UHealth*, *8*(9), e18339. https://doi.org/10.2196/18339

Michie, S., Ashford, S., Sniehotta, F. F., Dombrowski, S. U., Bishop, A., & French, D. P. (2011). A Refined Taxonomy of Behaviour Change Techniques to Help People Change Their Physical Activity and Healthy Eating Behaviours: The CALO-RE Taxonomy. *Psychology & Health, 26*(11), 1479-1498. https://doi.org/10.1080/08870446.2010.540664

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., Antes, G., Atkins, D., Barbour, V., Barrowman, N., Berlin, J. A., Clark, J., Clarke, M., Cook, D., D'Amico, R., Deeks, J. J., Devereaux, P. J., Dickersin, K., Egger, M., Ernst, E., Gøtzsche, P. C., Tugwell, P. (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Medicine*, *6*(7), e1000097. https://doi.org/10.1371/JOURNAL.PMED.1000097

Nogueira-Rio, N., Varela Vazquez, L., Lopez-Santamarina, A., Mondragon-Portocarrero, A., Karav, S., & Miranda, J. M. (2024). Mobile Applications and Artificial Intelligence for Nutrition Education: A Narrative Review. *Dietetics*, *3*(4), 483-503. https://doi.org/10.3390/DIETETICS3040035

Salazar, A., de Sola, H., Failde, I., & Moral-Munoz, J. A. (2018). Measuring the Quality of Mobile Apps for the Management of Pain: Systematic Search and Evaluation Using the Mobile App Rating Scale. *JMIR MHealth and UHealth*, *6*(10). https://doi.org/10.2196/10718

Samoggia, A., & Riedel, B. (2020). Assessment of Nutrition-Focused Mobile Apps' Influence on Consumers' Healthy Food Behaviour and Nutrition Knowledge. *Food Research International*, *128*, 108766. https://doi.org/10.1016/J.FOODRES.2019.108766

Statista. (2025). *Nutrition Apps – Worldwide*. Retrieved July 9, 2025, from https://www.statista.com/outlook/dmo/digital-health/digital-fitness-well-being/digital-fitness-well-being-apps/nutrition-apps/united-states

Stoyanov, S. R., Hides, L., Kavanagh, D. J., Zelenko, O., Tjondronegoro, D., & Mani, M. (2015). Mobile App Rating Scale: A New Tool for Assessing the Quality of Health Mobile Apps. *JMIR MHealth and UHealth*, *3*(1), e27. https://doi.org/10.2196/mhealth.3422

Sznajder, A. (2013). Wpływ mobilnej technologii informacyjnej na działalność marketingową przedsiębiorstw. *Gospodarka Narodowa. The Polish Journal of Economics*, (7-8), 37-61. https://doi.org/10.22004/AG.ECON.358690

Szucs, K. R., & Reicher, R. Z. (2022). Mobile Health Application Evaluation Possibilities. *Zeszyty Naukowe Politechniki Śląskiej. Organizacja i Zarządzanie*, (160), 595-611. https://doi.org/10.29119/1641-3466.2022.160.38

Tangari, G., Ikram, M., Ijaz, K., Kaafar, M. A., & Berkovsky, S. (2021). Mobile Health and Privacy: Cross Sectional Study. *BMJ*, *373*. https://doi.org/10.1136/BMJ.N1248

Tonkin, E., Brimblecombe, J., & Wycherley, T. P. (2017). Characteristics of Smartphone Applications for Nutrition Improvement in Community Settings: A Scoping Review. *Advances in Nutrition*, *8*(2), 308-322. https://doi.org/10.3945/AN.116.013748

West, J. H., Belvedere, L. M., Andreasen, R., Frandsen, C., Hall, P. C., & Crookston, B. T. (2017). Controlling Your "App"etite: How Diet and Nutrition-Related Mobile Apps Lead to Behavior Change. *JMIR MHealth and UHealth*, *5*(7). https://doi.org/10.2196/MHEALTH.7410

Analiza funkcjonalna i jakościowa aplikacji mobilnych związanych z żywieniem dostępnych w Polsce z wykorzystaniem skali MARS (Mobile Application Rating Scale)

Streszczenie

Cel: Celem niniejszego badania była ocena funkcjonalności oraz jakości aplikacji mobilnych dotyczących odżywiania, dostępnych na polskim rynku za pośrednictwem platformy dystrybucji cyfrowej App Store (Apple Inc.), przy wykorzystaniu standaryzowanego narzędzia oceny – Skali Oceny Aplikacji Mobilnych (*Mobile App Rating Scale*, MARS).

Metodyka: Dobór aplikacji oparto na jasno określonych kryteriach włączenia i wyłączenia, zgodnie ze schematem PRISMA. Ich jakość oceniono za pomocą narzędzia MARS (*Mobile App Rating Scale*), cechującego się wysoką rzetelnością ($\alpha = 0{,}90$; $r = 0{,}79$). Oceny dokonały dwa niezależne, dwuosobowe zespoły, których członkowie testowali każdą aplikację przez dwa tygodnie. Ostateczne wyniki ustalono na podstawie konsensusu.

Wyniki: Wyniki badania wykazały istotne zróżnicowanie pod względem jakości ocenianych aplikacji. Najwyższą ogólną jakość uzyskała aplikacja MyFitnessPal, natomiast najniżej oceniona została aplikacja Monitor Postu Przerywanego. W zakresie jakości subiektywnej najwyższe wyniki osiągnęły aplikacje YAZIO, FatSecret oraz MyFitnessPal, podczas gdy najniższy wynik odnotowano ponownie dla aplikacji Monitor

Postu Przerywanego. Największy potencjał w zakresie oddziaływania na użytkownika zaobserwowano w aplikacjach YAZIO i MyFitnessPal, natomiast najmniejszy – w Monitorze Postu Przerywanego.

Implikacje i rekomendacje: Wyniki badania wskazują na potrzebę udoskonalenia aplikacji żywieniowych poprzez integrację rzetelnych, opartych na dowodach treści, spersonalizowanych zaleceń dietetycznych oraz nowoczesnych rozwiązań technologicznych. Rekomenduje się także współpracę z ekspertami ds. żywienia oraz wprowadzenie systemów certyfikacji zwiększających zaufanie użytkowników. Aplikacje te mają potencjał wspierania zdrowych nawyków, jednak wymagają dalszej optymalizacji pod kątem jakości i funkcjonalności.

Słowa kluczowe: aplikacje mobilne, aplikacje dietetyczne, żywienie, Skala Oceny Aplikacji Mobilnych (MARS), zdrowie mobilne (*m*-health)