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Article

Health-Related apps: Lifestyle application usability questionnaire (LAUQ)

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Abstract: Adult obesity is a significant health problem, with nearly a quarter of Hungarian citizens aged 15 years and older being obese in 2019 (KSH, 2019a). The use of mobile devices for health purposes is increasing, and many m-health apps target weight-related behaviours. This study uniquely examines the effectiveness and user satisfaction of health-oriented apps among Hungarian adults, with a focus on health improvement. Using a mixed-methods approach, the study identifies six key determinants of health improvement and refines measurement tools by modifying existing parameters and introducing new constructs. The principal objective was to develop a measurement instrument for the usability of nutrition, relaxation and health promotion applications. The research comprised three phases: (1) qualitative content analysis of 13 app reviews conducted in June 2022; (2) focus group interviews involving 32 students from the fields of business, economics and health management; and (3) an online survey (n = 348 users) conducted in December 2023 that included Strava (105 users), Yazio (109 users) and Calm (134 users). Six factors were identified as determinants of health improvement: physical activity, diet, weight loss, general well-being, progress, and body knowledge. The LAUQ (Lifestyle Application Usability Questionnaire) scale was validated, including 'ease of use' (5 items), 'interface and satisfaction' (7 items) and 'modified usefulness and effectiveness' (9 items), with modifications based on qualitative findings. This research offers valuable insights into the factors influencing health improvement and user satisfaction with healthy lifestyle-oriented applications. It also contributes to the refinement of measurement tools such as the LAUQ, which will inform future studies in health psychology, digital health, and behavioural economics.

Keywords: google play reviews; health improvement; lifestyle apps; mixed methods research; obesity; user satisfaction; MAUQ

1. Introduction

M-health apps can be defined as "software embedded in smartphones to improve health outcomes, health research and health services" (Nouri et al., 2018). With over 6 billion smartphone users worldwide (Statista, 2024a), the m-health market offers promising market potential. The amount of content accessed, downloaded and shared via mobile phones is creating a whole new situation in various industries, including healthcare (Happ, 2013).

Obesity is one of the most pressing public health problems of our time. It currently affects more than 2 billion people worldwide and the numbers are projected to rise further. Obesity in adults is one of the most common causes of diseases, with nearly a quarter of Hungarian citizens aged 15 and over being obese in 2019 (KSH, 2019a) and Hungary ranks below the EU average in life expectancy (Eurostat, 2023). The use of mobile phones and other smart devices for health purposes is becoming increasingly common, and most mobile health apps have a goal of weight-related

behaviours. Furthermore, mobile application-based interventions have been shown to improve dietary health outcomes (Villinger et al., 2019).

Thousands of apps are available for both consumers and health professionals. But successful apps also take advantage of the unique features of mobile devices (Happ and Keller, 2020). The most common health apps include lifestyle apps (LAs), namely fitness, nutrition, diet, and meditation apps, which account for half of all health apps on the market. Globally, the user penetration rate is 14.63%, compared to a usage rate of 24.65% for Hungarian users in this app category (Statista, 2024b). Krebs and Duncan (2015) found that nearly half of m-health app users have abandoned certain m-health apps for various reasons: high cost of data entry, usability issues, loss of interest, etc. These facts indicate the importance of good usability of mobile applications.

M-health apps are an effective form of health promotion, but there is little research in the national literature on how to scale up their use (Meskó et al., 2017). The primary aim of present research is to explore the criteria of satisfaction and to identify the perceived usefulness of LAs, which has an incremental role in the future intention to use. While previous studies have focused on m-health apps, we believe it is valuable to consider lifestyle apps as a distinct category. This is due to the fact that their core objective is to facilitate prevention and the advancement of physical and mental wellbeing.

Several measurement tools are commonly used to evaluate the usability of m-health apps. The System Usability Questionnaire (SUQ) is a frequently utilized method for general usability assessment, while the Mobile App Rating Scale (MARS) is another popular tool that evaluates apps across multiple dimensions, including engagement, functionality, aesthetics, and information quality (Stoyanov et al., 2016). A user-focused version, known as uMARS, was developed to provide more tailored feedback from the user's perspective (Stoyanov et al., 2016). Additionally, the m-health Application Usability Questionnaire (MAUQ) was created to assess the usability of different types of m-health apps, including interactive and standalone versions, for both patients and providers (Zhou et al., 2019). There have also been adaptations of the MAUQ, such as a modified version used specifically for an eye donation app, which allows for more context-specific usability assessments (Chumkasian et al., 2021). These tools, particularly MARS/uMARS and MAUQ, play a crucial role in quantifying the usability of m-health applications.

The principal aims of this study are twofold: firstly, to examine the criteria by which users evaluate the LA (fitness, diet, relaxation and other health promotion apps) and, secondly, to ascertain the impact of these apps on health outcomes. The authors defined the following research questions based on the literature review:

Q1: What criteria do users use to evaluate the different LAs in the Google Play store?

Q2: What factors do users use to evaluate lifestyle applications? What changes are needed in the adaptation of the MAUQ items?

Q3: Which items make up the LAUQ scale?

The study addresses a research gap by refining measurement tools for assessing the usability of health-oriented apps, with a particular focus on those designed for nutrition, relaxation, and health promotion. The development and validation of the Lifestyle Application Usability Questionnaire (LAUQ) scale addresses the need for

more precise and context-specific instruments that can evaluate user experience and app effectiveness, particularly in areas such as health psychology, digital health, and behavioural economics. This study is distinctive in its use of a mixed-methods approach and its emphasis on identifying the principal determinants of health improvement, which had not been adequately addressed in previous research.

2. Theoretical background

Lifestyle apps offer an excellent opportunity to promote preventive care (McKay et al., 2019). Research in the field of wearable health devices (such as fitness monitors and smart watches) has identified a number of reasons for the use, persistence, and abandonment of health devices, such as health status, health goals, (de)motivation, perceived utility, measurement inaccuracy, usability, convenience, accessibility, and privacy (Simblett et al., 2018). König et al. (2018) found that fitness apps are typically more popular than nutrition apps. This is supported by statistical data on the Hungarian market, with most users preferring free fitness apps (6.58%) over paid fitness apps (3.8%) and nutrition apps (1.47%) (Statista, 2024b). Relying on the data of Statista (2024b) considering digital fitness and wellbeing market Fitbit (7%), Strava (5%), Fitify (4%), Calm (3%), Daily Yoga (3%), Omron (3%) and Yazio Fasting and Food Tracker (3%) are the most popular apps.

In analyzing the use of m-health apps, 'use' encompasses three aspects (Shabir et al. 2022) that play an important role in the successful dissemination of apps: adoption, engagement, and retention. Zhang and Xu (2020) demonstrated that ease of use is one of the crucial factors that determine user retention. This ease-of-use can be facilitated by developing interfaces that allow users to access content more easily (Lieffers et al. 2018). The inclusion of visual aids and images can make it easier for users to understand the content of lifestyle apps (Régnier et al., 2018). Features that convey information in a more concise and understandable way have reduced the time and effort required to use lifestyle apps (Brewer et al., 2019). Studies have highlighted that attractive design can increase the likelihood of using an app (Tang et al., 2015).

The ease of use and the usefulness are the crucial factors affecting m-health adoption. The well-designed and easy to use apps can lead to more active user engagement (Lewis, 2018). Therefore, it is important to quantify the degree of the usability of an app. Hajesmaeel-Gohari et al. (2022) collected the measurement techniques in evaluating m-health apps in a systematic literature review of 247 scientific papers. They found that questionnaires were used for usability, quality, acceptance, and satisfaction outcomes, respectively. The system usability questionnaire and mobile application rating scale were the most frequently used tool for evaluating the usability of the m-health services. Stoyanov et al. (2016) developed the user version of Mobile App Rating Scale (uMARS) that includes four objective subscales – engagement, functionality, aesthetics, information quality and one subjective quality subscale. Later Zhou et al. (2019) developed a new m-health application usability questionnaire (MAUQ) that assesses the usability of different types of m-health apps by offering four different versions tailored to the type of app (interactive or standalone) and the target user (patient or provider). Interactive apps facilitate two-way communication between users and healthcare providers, while

standalone apps are used for self-monitoring without direct data exchange with providers. The strength of the MAUQ lies in its adaptability to different app-user combinations, although only the interactive and standalone versions have been empirically tested using Fitbit and iMHere (Muro-Culebras et al., 2021). Despite being designed to assess usability in various m-health applications, the MAUQ is rarely used, possibly due to its recent introduction.

The stand-alone patient version of the MAUQ was successfully adapted and validated in Malaysia, demonstrating its effectiveness with the MyFitnessPal app through positive user feedback (Mustafa et al., 2021). Similarly, Zhao et al. (2022) introduced a Chinese version of the MAUQ to evaluate the Good Doctor app, using a 21-item scale with 346 participants, facilitating cross-cultural usability evaluations in China. Recent research also includes the use of a modified MAUQ (m-MAUQ) for an eye donation app, consisting of 15 adapted items focused on eye donation and assessing various usability dimensions (Bertolini and Bevilacqua, 2010; Chumkasian et al., 2021).

The latest findings indicate that the integration of m-health can enhance health outcomes (Jaana et al., 2019). Individuals who utilize m-health applications are more likely to acknowledge the advantages of improved health behaviours and to initiate these practices (Ross et al., 2020). While perceived usefulness is not always linked to specific diseases, it has the potential to enhance physical condition and relaxation, improve overall condition, and improve sleep quality.

The advent of mobile app stores has prompted researchers to direct their attention toward user reviews and comments on apps. Prior studies have examined the relationship between the functionality of the health application and user feedback (Mendiola et al., 2015; Pagano and Maalej, 2013), as well as the relationship between features and user feedback (Franco et al., 2016). Some studies have concentrated on particular issues pertaining to applications, including the examination of user grievances (Fu et al., 2013), the investigation of errors and user feedback (Bavota et al., 2015), the analysis of comprehensive features associated with nutrition apps (Briggs et al., 2021), and the assessment of quality factors (Stoyanov et al., 2016).

3. Methodology

To investigate research questions, we used the mixed method research (**Table 1**), content analysis, qualitative and quantitative data was collected (**Figure 1**). In June 2022, we conducted an analysis of the quality of the content of 13 applications that were available for download from the Google Play Store. The selection of the apps was based on the findings of a previous exploratory study, in which undergraduate students enrolled in a semester-long academic program at Covid voluntarily chose a lifestyle app to test and share their experiences over the course of a 14-week study period. The comments from three apps were analysed (two sports apps, Garmin Connect and a 30-day fitness challenge, and one nutrition app, Yazio) between 1 January and 22 June 2022 due to the high number of reviews. In the content analysis (comment analysis on Google Play), a thematic analysis was employed to identify the data theme. Thematic analysis is a method that involves several systematic steps in order to ensure transparency and reproducibility in qualitative research. The process

commences with a comprehensive examination of the data through meticulous reading and note-taking. Subsequently, researchers generate preliminary codes by labelling significant text segments and then grouping these codes into potential themes. The themes are then subjected to further scrutiny and modification in order to guarantee that they accurately reflect the data and research questions. Subsequently, each theme is explicitly delineated and designated with a precise nomenclature, accompanied by a comprehensive explication. The final step is to write a report that integrates the themes with supporting data and ensures validity and reliability through systematic documentation and, if applicable, inter-coder reliability checks. This structured approach serves to enhance the credibility and reproducibility of the analysis (Braun and Clarke, 2006; Lincoln and Guba, 1985; Nowell et al., 2017).

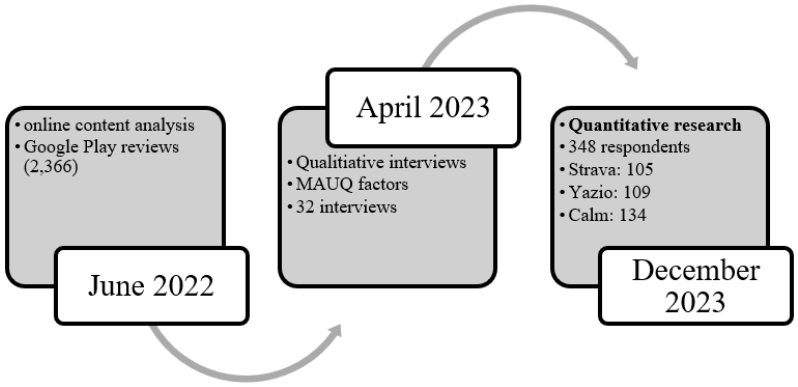

Figure 1. Timeline of the research.

Table 1. Research methods used to study lifestyle applications.

Lifestyle apps	Number of apps	Google play reviews	Qualitative research	Quantitative research
Sports and fitness activity measurement apps	6	765	16	105
Diet and nutrition apps	4	1275	11	109
Mindfulness apps	3	326	5	134
Count	13	366	32	348

The qualitative research was carried out with the participation of 32 bachelor students studying business and economics and health management. All of the students had been utilising lifestyle applications for a minimum of one year, with a considerable number having been doing so for a period exceeding this. The students were recruited during the course of seminars. Finally, 32 students participated in a qualitative interview, which aimed at discovering the experiences related to the usage of the apps. The focus group interviews allowed an in-depth insight into the lived experience and personal, social and environmental factors could be discovered. The analysis of qualitative data necessitates the implementation of a structured methodology to facilitate the interpretation of complex information. The process commences with data preparation, which encompasses transcription and organization of the data (Creswell, 2013). Subsequently, researchers code the data by identifying and labeling key themes and patterns (Braun and Clarke, 2006). Subsequently, thematic analysis is employed to consolidate the codes into overarching themes and extract meaningful insights (Nowell et al., 2017). It is of the utmost importance to ensure reliability and validity

at each stage of the process, with checks for consistency and consideration of alternative interpretations (Lincoln and Guba, 1985). Ultimately, researchers integrate the findings into a unified account that addresses the research questions (Guest et al., 2012).

In December 2023, an online survey was conducted among the users of the most popular fitness (Strava), nutrition (Yazio) and mindfulness (Calm) apps. The questionnaire was divided into three sections: (1) app usage habits; (2) MAUQ scale; and (3) basic demographics. Regarding app usage habits, the following aspects were analyzed: free or pro version, operating system (Android or iOS), smart watch, and use of health application on smartphone. MAUQ "Ease of use" (5 items), "Interface and satisfaction" (7 items) and "Modified usefulness and effectiveness" (9 items). In the case of usefulness, the original six items were changed based on previous qualitative study of the authors. One item ('The app improved my access to health care services.') was excluded and 4 new items (EFF2, EFF3, EFF4, EFF7, EFF8) were included. The original usefulness factor was renamed into modified usefulness and effectiveness. All items was measured on a 5 point Likert scale, with the end-points 1: totally disagree, 5: absolutely agree. A five-star rating was used to measure overall satisfaction. Sociodemographic characteristics included gender (male, female), age, place of residence (village, town, county center, capital city), and highest level of education (primary school, vocational education, high school graduation, higher education degree). Data analysis was conducted using SPSS 26.0 software, and multivariate statistical analysis (factor analysis) was used to answer the third research question. The method of extracting factors is the analysis of the main components. The number of factors is determined by a priori determination (1); and methods based on the eigenvalue (2); scree plot (3); and percentage of variance (4). The number of factors is determined by the eigenvalues. A 0.4-level factor loading benchmark was used as a standard for integrating elements into each factor.

In the context of this study, ethical considerations were of particular importance with regard to data privacy and informed consent, particularly in the field of health data. It is of the utmost importance to ensure the confidentiality of participants' personal and health information. All participants were furnished with comprehensive information regarding the objectives of the study, the characteristics of the data to be collected, and the planned utilization of their data. This procedure ensured that all participants had provided informed consent prior to their involvement in the study. The online survey is designed in such a way as to ensure anonymity, and the data are stored securely, with access limited to the research team. Moreover, the study adheres to the data protection regulations of the European Union and Hungary, including the General Data Protection Regulation (GDPR), which ensures that the processing of sensitive health data is conducted in accordance with the highest standards of privacy and security. By incorporating these ethical considerations, the study not only ensured the privacy of participants but also guaranteed the integrity and trustworthiness of the research findings.

4. Findings and discussion

4.1. First phase of the research

Users are generally satisfied with the applications. The negative comments were related to unreliable measurement ('The calorie is not the same as it is mentioned by producer.'), unreliable functions ('No warm-up and stretching.') technical aspects, namely the update problems ('It has not been working since the last update.'), the price of the pro version of the app ('Very expensive!'), or important functions that are available in the paid version ('Statistics and tracking work only in pro version.'), the number of ads in the free versions and language barriers ('The app is not available in Hungarian.'). Previous studies highlighted accuracy, stability, attractiveness (Fu et al., 2013) shortcomings, bug reports and feature requests (Pagano and Maalej, 2013), technical problems (Bavota et al., 2015) as major sources of complaints.

Most of the studies analyzed complaints or negative and positive ratings (Pagano and Maalej, 2013), but not the neutral ones. In present empirical research the neutral comments expressed some missing functions ('Counting calories should be included, that could raise motivation.'), or problems with the operation of the app and the communication clutter in the free version of the app ('Advertising is very annoying.'), Reviewers came up with some ideas ('More types of liquids should be included in the app.') on how to make a perfect app that would help their user friendliness and the achievement of their goals.

Pagano and Maalej (2013) found that helpfulness and feature information determine positive ratings. We also found similar results, positive reviews were related to the health improvement, the achievement of goals, overall satisfaction, positive bond and the willingness to recommend the app. Mendiola et al. (2015) came to the conclusion that plan or orders, export of data, usability, and cost contributed significantly and positively to the evaluation of the users of the applications (**Figure 2**).

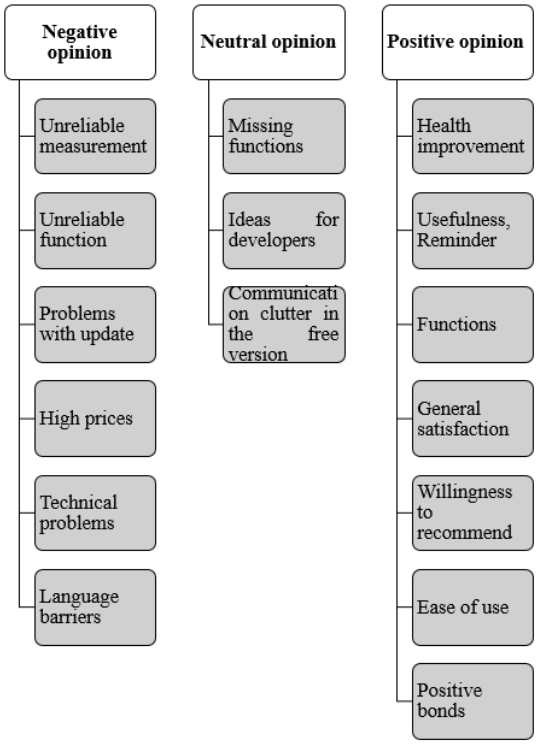

Figure 2. Factors determining satisfaction.

Taking into account the proportion of negative comments, other health apps and nutrition apps had the highest proportion of negative comments. Users expressed their overall satisfaction and positive experiences mainly in the case of mindfulness and fitness apps (**Table 2**).

Table 2. Reviews related to the lifestyle applications in the Google play store.

Lifestyle apps	**Proportion of negative reviews (★, ★★)**	**Proportion of neutral reviews (★★★)**	**Proportion of positive reviews (★★★★, ★★★★★)**
Sport and fitness activity measurement apps	14.1% (108*)	6.4% (49*)	79.5% (608*)
Diet and nutrition apps	18.8% (240*)	8.6% (109*)	72.6% (926*)
Stress reliever and relaxation apps	11.0% (36*)	4.6% (15*)	84.4% (275*)
Total	16.5% (467*)	7.1% (203*)	76.4% (2165*)

Information: * number of reviews, Source: Google play store data as of 22 June 2022.

4.2. Second phase of the research

A total of 32 students participated in the qualitative research, comprising 10 males and 22 females. The mean age of the participants was 21.11 years, with a standard deviation of 1.19 years (females: 21.77 years; SD: 0.90; males: 22.53; SD: 1.39). The youngest participant was 21 years old, while the oldest was 25 years old. The modal and median age for males and females was 22 years. Some students utilised multiple applications, with the majority employing fitness and nutrition apps, and only six instances of mindfulness apps.

The ease of use of lifestyle (LS) apps was identified as a crucial criterion in the evaluation of such apps, with all participants emphasising its importance in their app choices. This finding is consistent with those of previous studies (Cook et al., 2016; Chumkasian et al., 2021). The participants, who were primarily Generation Z digital natives with high levels of technological acceptance, found the lifestyle apps to be straightforward to use, requiring minimal effort to learn their functionality. While the learning phase for nutrition apps required slightly more time, other LS apps presented no significant learning challenges. As one participant observed, the app was intuitive and did not require significant time to learn. Another participant stated, “It took approximately 15 minutes to become proficient in the use of the application, even when searching for specific brands. The process was not arduous” (F8). The navigation of the apps was found to be consistent, with participants expressing satisfaction with the interfaces and available functions. One participant stated, “I believe this app is comprehensive,” while another added, “It incorporates not only calorie intake but also calorie expenditure. It is possible to ascertain data regarding physical activity, water intake and pedometer readings” (F9). Some issues were identified, including the presence of irritating reminder voices in the case of nutrition apps and the lack of certain features in free versions of fitness and nutrition apps. These issues could potentially be addressed by upgrading to pro versions. In general, the five items used to assess ease of use were considered to be relevant in evaluating the usability of these apps.

In their evaluation of app interfaces, students placed a greater emphasis on functionality than on aesthetics. As one participant observed, “For me, functionality is

of greater importance than the design" (M1), while another stated, "Simplicity is the most crucial factor for me" (M3, F4, F17). The organisation of information was also identified as a crucial factor, with students expressing appreciation for the ease of locating necessary details and the personalised challenges offered by fitness, nutrition, and mindfulness apps. For instance, one participant stated, "I am particularly interested in learning what is beneficial for my body" (F8, F9, F10). The majority of students found the apps to be convenient and time-efficient. One student commented, "It's a rapid process; it doesn't require a significant time commitment. I simply input my food intake while drinking my coffee" (F7, F10). Overall, participants expressed satisfaction with the apps, rating them 4 or 5 stars. However, two students provided lower ratings due to technical issues or unmet expectations. Although the majority of participants were reluctant to pay for the professional versions, several indicated a desire to continue utilising the apps and to recommend them to others. This suggests that measuring interface satisfaction, willingness to recommend, and willingness to pay are crucial constructs in app evaluation.

The findings indicate that the subjects expressed satisfaction with the lifestyle apps. Twenty-six of the participants reported positive effects, with the main ones being improvements in physical and mental health, well-being and activity. These findings align with those of previous studies (Ross et al., 2020). It is encouraging that 25 of the participants intend to continue utilising the apps. However, further investigation is required to ascertain the factors influencing the adoption and sustained use of these apps, as well as their integration into daily routines. Five students indicated that they had acquired sufficient knowledge from the diet apps and therefore saw no further need for continued use of the apps. In the domain of sports and fitness activity measurement apps, 22 students reported positive health changes, including improvements in fitness, health, energy levels, and dietary habits. Individuals who were previously unaware of the benefits of pedometers and other fitness apps had already adopted an active and healthy lifestyle prior to using the app. Similarly, ten students who used diet and nutrition apps reported positive outcomes, including weight loss, lower blood pressure, improved mood and energy levels, and an enhanced overall health status. With regard to mindfulness applications, some students demonstrated favourable outcomes, including a reduction in mobile phone usage, increased energy levels and enhanced menstrual tracking. The majority of students reported no difficulties when utilising the apps, including those pertaining to internet access. The majority of respondents expressed satisfaction with the content and additional features, although it should be noted that these are only available in paid versions. In general, five of the six measures of usefulness were relevant; however, the section on whether the app improved access to health services was not applicable to lifestyle apps (LS). It is recommended that this section be replaced with articles focusing on mental health, physical health, and well-being. Relying on the results of the exploratory research six factors determining health improvement were identified: (1) Physical activity; (2) Diet; (3) Losing weight; (4) General wellbeing; (5) Progress; (6) Body knowledge (**Figure 3**).

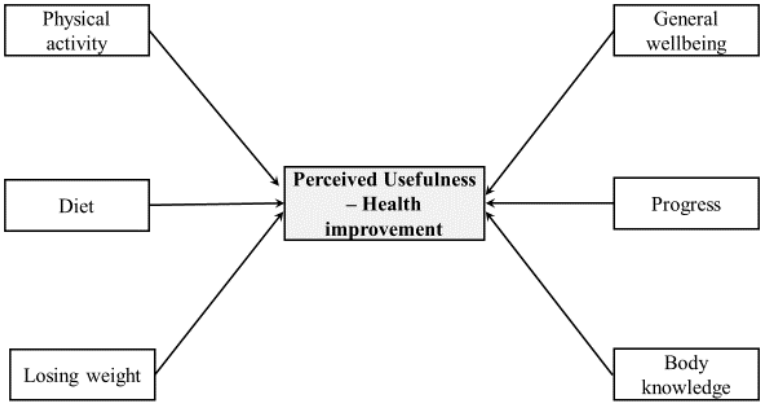

Figure 3. Factors determining health improvement.

The qualitative interviews revealed that not all of the original six items are relevant for lifestyle apps, e.g. "This app has helped me to use different health services". However, new items were identified in relation to the exploratory research history:

The app was useful for my wellbeing.
The app helped me improve my physical activity.
The app supported my healthy eating.
The app supported my personal growth.
The app helped me increase my knowledge about my body.

4.3. Third phase of the research Hungarian version of MAUQ

The data were collected via an online survey in Hungary using a pre-tested questionnaire to ensure consistency and facilitate comprehension. Convenience sampling, which is suitable for online surveys (Lehdonvirta et al., 2021), was employed to disseminate the survey via Facebook groups to users of Strava, Yazio, and Calm in December 2023.

These applications were selected for analysis due to their high level of usage and relevance in the domains of fitness, nutrition, and mindfulness. It should be noted that participation in the study was voluntary, which may have introduced a degree of self-selection bias.

The survey was concluded upon receipt of 100 completed responses for each application (Hair et al., 2019). Finally, 348 Hungarian users of various lifestyle applications: Strava (105; 30.2%), Yazio (109; 31.3%), and Calm (134; 38.5%) were reached. The majority of the sample is female, young (18–29 years old), lives in a town and has a high school education. The demographic distribution is shown in **Table 3**.

Table 3. The demographic composition of the sample.

Gender	**male**	**female**			
Strava (*n* = 105)	51.4%	48.6%			
Yazio (*n* = 109)	31.2%	68.8%			
Calm (*n* = 134)	59.0%	41.0%			
Age (years)	13–17	18–29	30–39	40–49	50+
Strava (*n* = 105)	7.6%	42.9%	19.0%	17.2%	13.3%
Yazio (*n* = 109)	8.2%	43.1%	12.9%	26.7%	9.1%
Calm (*n* = 134)	14.9%	43.3%	19.4%	10.4%	11.9%
Residence	**village**	**town**	**county centre**	**capital city**	
Strava (*n* = 105)	16.2%	31.4%	32.4%	20.0%	
Yazio (*n* = 109)	23.0%	33.0%	26.6%	17.4%	
Calm (*n* = 134)	26.1%	26.9%	23.1%	23.9%	
Highest level of education	**primary school**	**vocational education**	**graduation (high school)**	**higher education (degree)**	
Strava (*n* = 105)	9.5%	16.3%	55.2%	19.0%	
Yazio (*n* = 109)	21.1%	15.6%	34.0%	29.3%	
Calm (*n* = 134)	35.8%	21.6%	26.9%	15.7%	

In relation to MAUQ 21 statements were examined. In the case of Strava the value of Cronbach α was 0.968, which means that this scale is consistent. The values of the indicators that prove the adequacy of the factor analysis were adequate (KMO: 0.937, Bartlett's Test: 2118.482, Sig. 0.000). The number of factors was determined by Scree test that is the three factors could be distinguished explaining 73.70% of the total variance.

The MAUQ scale has been updated, and the Hungarian version of the LAUQ scale has been created and tested with 348 users. A total of 21 items were tested, and attitudes were measured on a 5-point Likert scale. The Cronbach's alpha value for the reliability of the scale is 0.968, indicating that the scale is consistent. The value of the indicators confirming the correctness of the factor analysis is adequate (KMO: 0.957, Bartlett: 7670.849, Sig. 0.000). The number of factors was determined in three using a Scree test, and the resulting three factors explain 74.8% of the total variance. The variance explained by the first factor is: The variance explained by the first factor is 32.2%, that of the second factor is 22.0%, and that of the third factor is 20.6%. The Cronbach's alphas for scale reliability are 0.918 (5 items), 0.949 (7 items), and 0.955 (9 items). The factor analysis identified three factors that were used to assess the usability of the lifestyle app: ease of use, satisfaction with the app interface, and effectiveness (**Table 4**). It is proposed that the term "efficiency" be used instead of the original term "usefulness."

Table 4. The items of the LAUQ questionnaire (n = 348).

	Statement	Average	SD
EU_1	It was easy to use the app.	3.85	1.23
EU_2	It was easy to learn how to use the app.	3.83	1.16
EU_3	Navigation was consistent as I switched screens.	3.75	1.14
EU_4	The interface of the app allowed me to use all of its features (entering information, responding to reminders, reviewing information).	3.83	1.09
EU_5	If I did something wrong while using the app, I could fix it quickly and easily.	3.97	1.05
SAT_1	I liked the interface of the app.	4.17	1.04
SAT_2	The information in the app is well organized, so I could easily find the information that was important to me.	4.00	1.04
SAT_3	The app kept me well informed about changes in my health status.	3.91	1.02
SAT_4	I felt comfortable using the app.	4.09	0.99
SAT_5	The time required to use the app was reasonable for me.	4.06	1.01
SAT_6	I will continue to use the app.	4.11	1.00
SAT_7	Overall, I am satisfied with the app.	4.17	0.99
EFF_1	The app has been useful for my well-being.	4.12	1.09
EFF_2	The app has helped me to increase my physical activity.	3.87	1.13
EFF_3	The app has helped me to eat healthier.	3.86	1.16
EFF_4	The app has helped me to stay healthy.	3.99	1.09
EFF_5	The app had all the features and options I expected.	3.96	1.08
EFF_6	The app worked well even when I had problems with Internet access.	3.78	1.14
EFF_7	The app helped me to lose weight.	3.88	1.21
EFF_8	The app has helped me with my personal development.	3.99	1.08
EFF_9	The app helped me to increase my knowledge about my body.	3.93	1.18

5. Discussion

In present research the authors have formulated three major research questions.

Q1: What criteria do users use to evaluate the different LAs in the Google play store?

The majority of users are generally satisfied with lifestyle applications. However, negative comments frequently mention unreliable measurements, missing features, technical issues, high prices for pro versions, excessive ads in free versions, and language barriers. Neutral comments typically highlight missing functions or operational problems. Conversely, positive reviews are related to health improvement, goal achievement, and overall satisfaction. However, our study also reveals a nuanced view of user experience, with frequent mentions of technical issues and high costs, which may not have been as prominent in previous studies. For example, while Fu et al. (2013) and Bavota et al. (2015) emphasised the importance of app features and usability, our findings suggest that economic factors and technical reliability have become more pressing concerns for users in the current landscape. This discrepancy

may reflect the evolving nature of app development and user expectations, where the proliferation of free and freemium models has increased awareness of cost-related issues and technical performance.

Q2: What factors do users use to evaluate lifestyle applications? What changes are needed in the adaptation of the MAUQ items?

Users evaluate lifestyle applications (LS apps) and prioritize several factors, including ease of use, functionality, and information organization. This aligns with previous research (Cook et al., 2016; Chumkasian et al., 2021) that has highlighted the importance of user satisfaction in m-health applications for ease of use. However, the current study shows some new insights. Previous researches have often concentrated on technical acceptance and usability (Régnier et al. 2018, Zhou et al., 2019). However, this study indicates a shift from functional value to aesthetics and the significance of personalised challenges within lifestyle applications. Users are more interested in the functionality of the app that supports their personal health goals than in its visual appeal. Furthermore, this study contributes to the existing literature by investigating specific health outcomes related to LAs. It was reported by users that significant improvements were made in a number of areas, including fitness, diet, health and body knowledge. Furthermore, the benefits of lifestyle applications were found to extend beyond mere functionality. This suggests a broader impact on the health and well-being of users.

Q3: Which items make up the LAUQ scale?

The research, based on an online survey of 348 Hungarian users of Strava, Yazio, and Calm, primarily involved young females from towns with high school education. Qualitative interviews indicated that some original items were irrelevant for lifestyle apps, leading to the identification of new items related to wellbeing, physical activity, healthy eating, personal growth, and body knowledge. The study also highlighted that some of the original MAUQ items, particularly those pertaining to access to health services, are no longer relevant for lifestyle applications. Consequently, LAUQ should be revised to include measures of the app's effectiveness in improving well-being, supporting physical activity, promoting healthy eating and increasing body knowledge. These amendments will render the LAUQ a more precise instrument for the assessment of lifestyle applications.The MAUQ scale (Zhou et al., 2019) was updated and tested, resulting in the Lifestyle Application Usability Questionnaire (LAUQ), which showed high reliability. Factor analysis identified three main factors that assess the usability of the app: ease of use, satisfaction with the app interface, and effectiveness. The study suggests that "efficiency" may be a more appropriate term than "usefulness" to describe the app's impact.

Our findings provide a comprehensive view of user evaluations of lifestyle applications and highlight the need for continuous adaptation of evaluation tools to reflect users' evolving needs and preferences. While our results are consistent with previous research on the importance of accuracy, stability, and helpfulness, they also reveal new concerns related to cost and technical reliability, as well as the limited long-term utility of some applications. The adaptation of the LAUQ scale further highlights the importance of cultural and contextual considerations in usability evaluation. By situating our work within the broader academic discourse, we

contribute to a deeper understanding of user experiences with lifestyle applications and provide actionable insights for future research and development in this area.

6. Conclusion, suggestion

Adult obesity represents a significant public health concern in Hungary, with an estimated 24% of adults aged 15 and above affected in 2019 (KSH, 2019b). In view of the increasing prevalence of mobile health apps designed to promote weight-related behaviours, this study assesses their efficacy and user satisfaction among Hungarian adults. A mixed-methods approach was employed for the purpose of identifying six key factors for health improvement and for the refinement of measurement tools. The data were collected from 32 students through app reviews in June 2022 and from users of fitness, nutrition, and mindfulness apps in December 2023. The latter group included users of Strava (105 users), Yazio (109 users), and Calm (134 users). Six determinants of health improvement were identified, namely physical activity, diet, weight loss, general well-being, progress, and body knowledge. The LAUQ scale was validated with modified parameters, including "ease of use," "interface and satisfaction," and "usefulness and effectiveness." The study offers valuable insights into the experiences of users of the LAs. While the identified determinants of health improvement, such as physical activity, diet, and general well-being, may be relevant for a diverse population, it is possible that cultural differences may influence their usability and adoption of such applications.

A number of studies have been conducted on m-health apps worldwide and the results show that well-designed m-health apps can empower patients to manage their health, improve medication management and reduce healthcare costs. By increasing participation in such preventive apps, public health could be greatly improved and fewer people would need to use health services for their treatment. Lifestyle apps contribute to a healthy, stress-free lifestyle, so their use can help to reduce the burden of prevention and, through this, the burden on the healthcare system. As previous studies highlighted the importance of usefulness, this study explored different dimensions of health benefits, that is physical activity, wellbeing, diet, progress and body knowledge. The persistent usage of such apps is a national interest, that is why educating people and social marketing campaigns could be effective and convince people to care about themselves. The focus of that campaigns can be the benefits (health improvement) of LAs.

This research provides valuable insights for the various interested parties, including users, app developers and healthcare providers. By identifying the determinants of health improvement and validating a measurement scale, the study provides guidance for the development and evaluation of lifestyle applications. Users can utilize this information to make informed choices about which apps to use based on their effectiveness in promoting health behaviour change.

App developers can use the results to improve the design and functionality of their apps, ultimately improving overall user satisfaction and health outcomes.

Healthcare providers can incorporate evidence-based digital interventions into their practice to complement traditional healthcare approaches and reduce the burden on the healthcare system. Overall, this research has the potential to improve the

effectiveness and accessibility of health promotion efforts, leading to better health outcomes for individuals and populations. Those engaged in the development of mobile health applications for weight-related purposes may utilise the findings of this study to enhance the efficacy and satisfaction of their products. The identification of six key factors for health improvement – namely, exercise, diet, weight loss, general well-being, progress, and body knowledge – provides a clear framework for developers to design functionality that is directly focused on these areas. To illustrate, applications can integrate personalised recommendations based on user data to enhance nutrition and exercise habits, provide progress tracking tools to highlight minor achievements, and offer educational content to improve users' body knowledge. Furthermore, the validation of the LAUQ scale, including the "use ease," "interface and satisfaction," and "modified usefulness and effectiveness" dimensions of the study, also provides a validated tool for developers to assess the usefulness and effectiveness of their apps. The incorporation of these parameters into the design and testing phases enables developers to create more user-friendly and effective apps that attract targeted users and, ultimately, improve user engagement and health outcomes.

As for healthcare, it can contribute to reducing the burden on the care system and to the integrated development of telemedicine and traditional healthcare. At the level of population, it has a key role in prevention. The findings of the study highlight the significance of recommending and utilising m-health applications that are not only widely used but also efficacious in facilitating health enhancement. The six key factors for improving health identified in the study can assist health professionals in guiding patients in the selection of apps that align with their specific health goals, such as weight loss or improved general health. For instance, experts may recommend particular apps that demonstrate efficacy in tracking physical activity and providing nutritional guidance, contingent on the patient's individual needs. Furthermore, the emphasis on user satisfaction underscores the necessity for healthcare professionals to consider patient preferences and ease of use when proposing m-health apps. Improved measurement tools, including LAUQ scale, can be employed by healthcare providers to assess the effectiveness and user experience of these applications and recommend them to patients. This approach guarantees that the tools employed encourage patients to utilise them, and that they are not only clinically beneficial, but also user-friendly and pleasant. This ultimately leads to improved compliance and health outcomes.

This research makes a theoretical contribution by providing a comprehensive analysis of the effectiveness and user satisfaction of health-oriented applications among the Hungarian adult population. It identifies six key determinants that influence health improvement, thereby enhancing the understanding of the factors that contribute to successful health behaviour change through digital interventions. In addition, the study contributes to the refinement of measurement tools, such as the Lifestyle Application Usability Questionnaire (LAUQ), by introducing new constructs and modifying existing parameters. These theoretical insights can shape future research in the fields of health psychology, digital health and behavioural economics.

In the future, researchers plan to conduct comparative studies between different types of lifestyle apps (e.g., fitness, diet, mindfulness) in order to gain insights into which features are most effective for specific health outcomes. The incorporation of more sophisticated analytics, such as machine learning techniques, could also help

predict user behaviour and optimize app functionalities. Finally, the exploration of the integration of lifestyle apps with other health services and technologies, such as wearable devices and telehealth platforms, could enhance their usefulness and effectiveness.

The study has several limitations. While the qualitative aspects of the study offer valuable insights, they may not fully capture the nuances of user experiences due to potential limitations in the depth of interviews and the subjective interpretation of responses. The study is limited in its scope, focusing on users of three market-leading lifestyle apps. It is possible that this does not fully represent the broader landscape of lifestyle applications. However, the limited sample size of the study and potential response bias may affect the generalizability of the findings. Future research should use more diverse samples and methods to reduce bias. While the current findings are insightful, the demographic composition of the sample is skewed, underscoring the need for research that includes a broader, more diverse population. This approach would enhance the representativeness and applicability of the results, thereby improving the overall relevance and utility of health apps across different user segments.

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