Current Trends in Natural Sciences
Vol. 13, Issue 25, pp. 191-199, 2024
https://doi.org/10.47068/ctns.2024.v13i25.023
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

DIGITAL SOLUTIONS FOR THE ASSESSMENT AND OPTIMIZATION OF PHYSICAL ACTIVITY: COMPUTATIONAL METHODS APPLIED IN PHYSIOTHERAPY

Elena Ioana Iconaru [1], Ana Catalina Tantu [2,3,*], Marilena Monica Tantu [1], Mariana Tudor [1], Constantin Ciucurel [1]

[1]Department of Medical Assistance and Physical Therapy, University Center of Pitesti, National University of Science and Technology Politehnica Bucharest, Targu din Vale 1, Pitesti, 110040, Romania
[2] University of Medicine and Pharmacy of Craiova, Petru Rares 2, Craiova 200349, Romania
[3] Craiova County Emergency Clinical Hospital, Tabaci 1, Craiova, 200642, Romania

Abstract
This study focuses on the development of a digital platform for the International Physical Activity Questionnaire (IPAQ), converting it into an interactive computational tool for assessing physical activity (PA). The digital version enhances the accessibility, and efficiency of PA assessments by enabling real-time data collection and potential synchronization with other health tools. Utilizing a cross-platform framework, the application ensures compatibility across various devices and offers a user-friendly interface. The computational model embedded in the platform automates PA calculations, including MET-minutes and energy expenditure, providing detailed and reliable insights into activity patterns. By transforming the IPAQ into a digital format, this study bridges the gap between traditional assessments and advanced technological solutions, improving physiotherapy practices and patient care. The tool demonstrates significant potential to optimize PA evaluation, offering healthcare professionals timely, accurate data to guide intervention strategies, with future research focusing on validating its reliability across diverse populations and clinical settings.

Keywords: digitalization, e-Health, monitoring, physiotherapy, rehabilitation.

1. INTRODUCTION

The rapid advancement of digital technologies has transformed healthcare, offering innovative tools to evaluate, monitor, and optimize various aspects of patient care. Practically, digital transformation provides patients with broader access to care options tailored to their needs (Stoumpos et al., 2023), reshaping the overall healthcare experience and improving outcomes across different medical domains. In physiotherapy, computational methods and digital solutions are increasingly employed to automate data collection, improve accuracy, and enhance patient outcomes. Recent advancements in algorithmic approaches, including data analytics, artificial intelligence (AI), machine learning, and motion-tracking technologies, are driving progress in patient-centered precision healthcare, enabling personalized treatment plans, predictive analytics, and the automated monitoring of rehabilitation progress (Liao et al., 2020). These advancements facilitate the creation of

*Corresponding author, E-mail address: catalina.tantu8@gmail.com

Current Trends in Natural Sciences
Vol. 13, Issue 25, pp. 191-199, 2024
https://doi.org/10.47068/ctns.2024.v13i25.023
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

personalised healthcare strategies, allowing for more precise tracking of patient progress and real-time adjustments to treatment plans, ultimately improving outcomes and efficiency in patient care.

Studies with varying levels of certainty indicate that digital physiotherapy assessments are generally valid and reliable across multiple components. Remote digital assessments could serve as a viable alternative to in-person evaluations, offering increased accessibility and convenience for patients who may benefit from such options (Bernhardsson et al., 2023). These methods allow patients to receive timely evaluations from the comfort of their homes, reducing barriers such as travel, time constraints, and geographical limitations, while maintaining the quality and accuracy of the assessments.

By leveraging algorithm-based systems, such as web and mobile applications, clinicians can efficiently assess various health variables, including physical activity (PA) levels, vital signs, sleep patterns, and cognitive function, while providing personalized recommendations and supporting rehabilitation programs.

Clinicians are increasingly interested in monitoring PA using digital tools, through activity trackers, as they offer valuable insights into patient behaviour and can play a key role in promoting PA, although the effectiveness of these interventions in improving physical functioning remains mixed (de Leeuwerk et al., 2022). To provide some examples, smartphone features including GPS, Bluetooth, and motion sensing, combined with applications or games for location tracking and social interaction in real life, virtual reality, or alternate reality, can offer valuable tools for health professionals (Kamel et al., 2021).

Beyond the growing interest in direct PA monitoring, the use of standardized digital questionnaires presents a valuable alternative. These tools, when integrated into mobile or web applications, allow for efficient and consistent data collection on PA levels, offering a more accessible option for both patients and healthcare providers. Standardized questionnaires can furnish a comprehensive overview of a patient's activity habits, enabling personalized interventions and tracking over time, while complementing real-time monitoring technologies (De Vera et al., 2010). Despite their potential, further exploration is needed to fully understand their effectiveness in clinical settings, particularly regarding user engagement and integration into healthcare workflows.

However, the use of Internet-based questionnaires offers clear advantages, such as the implementation of skip logic, which personalizes the respondent's experience, reduces their burden, minimizes missing data, and provides participants with greater control over time management during data collection (De Vera et al., 2010). The use of digital platforms has proven particularly valuable during situations like the COVID-19 pandemic, when access to PA facilities was restricted. Digital solutions are increasingly relevant for supporting PA engagement when traditional opportunities are limited, demonstrating their potential in maintaining health during challenging times (Parker et al., 2021).

Among the commonly used questionnaires in the field, the International Physical Activity Questionnaire (IPAQ) stands out for its reliability and validity, and, in addition, it is freely accessible (Craig et al., 2003). Its widespread adoption allows for standardized assessment of PA levels across diverse populations and settings, making it a valuable tool for research and clinical practice (Craig et al., 2003; Ekelund et al., 2006; Fogelholm et al., 2006). The IPAQ, through self-assessment, evaluates the frequency, duration, and intensity of PA across domains such as work, transportation, household tasks, and leisure time. Available in both short and long versions, and translated into numerous languages, it calculates MET-minutes and estimated calorie expenditure (kcal), categorizing individuals into low, moderate, or high PA levels (Guidelines for IPAQ, 2005).

*Corresponding author, E-mail address: catalina.tantu8@gmail.com

Current Trends in Natural Sciences
Vol. 13, Issue 25, pp. 191-199, 2024
https://doi.org/10.47068/ctns.2024.v13i25.023
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

This makes IPAQ a comprehensive and versatile tool for evaluating PA in both research and clinical settings (Craig et al., 2003; Macfarlane et al., 2006). The IPAQ is licensed under CC BY 4.0 (details: https://creativecommons.org/licenses/by/4.0/).

For this questionnaire, online versions have also been proposed, as they offer a user-friendly approach that leverages technological advancements in electronic and internet-based survey distribution. This method allows for automated delivery and data collection, making the process more efficient and less prone to errors (Kurth and Klenosky, 2020). Researchers are particularly interested in these online formats because they simplify assessment procedures, enhance accessibility for participants, and ensure that data collection is streamlined and accurate, addressing common challenges associated with traditional paper-based surveys.

In general, such questionnaires are administered through dedicated platforms or specialized software that streamline the process of survey distribution and data collection (Iconaru et al., 2023). However, developing a custom-coded program within a specific operating system offers several advantages. This approach allows for the creation of cross-platform applications with a single codebase, simplifying both the development and deployment processes. It ensures high accessibility across various devices and provides greater flexibility in tailoring the user experience. Additionally, custom-coded programs enable rapid updates and adjustments, making it easier to modify the questionnaire as the study evolve.

The feasibility of this approach lies in its ability to support real-time data collection, automatic synchronization, and seamless integration with other digital health tools, all of which are essential for conducting effective and reliable assessments in health studies. By utilizing this method, a modern, scalable solution is created for developing applications that are both functional and user-friendly. In a connected environment, the creation of multi-platform applications for physiotherapy guarantees a smooth user experience, enhances operational efficiency, and lowers costs by providing uniform functionality across different devices and systems, thus improving accessibility and ensuring continuous care (Osinachi et al., 2024). This integration not only strengthens the overall system but also aligns with the demands of modern healthcare delivery.

This paper aims to design and implement a coded program for the IPAQ, transforming it into a digital tool for measuring and analysing PA. The objective is to bridge the gap between traditional assessment methods and advanced technological solutions by developing a customized software application. This approach is intended to enhance the precision, accessibility, and efficiency of PA assessments, ultimately improving patient care and enabling more effective physiotherapy practices.

2. MATERIALS AND METHODS

The methodology focused on creating a digital application to transform the IPAQ into an interactive software tool. The development began with defining user requirements and designing an interface optimized for usability. A cross-platform framework ensured compatibility across various devices, while dynamic logic within the questionnaire enabled personalized pathways for participants, minimizing irrelevant questions.

Secure data storage was implemented for real-time synchronization and potential integration with other health tools. Rigorous testing validated the tool's functionality, reliability, and user experience. Post-deployment, usability testing was conducted, and participant data was collected to assess activity levels, ensuring accuracy and accessibility.

The development utilized an integrated environment leveraging an open-source, cross-platform framework and a concise programming language, optimized for creating dynamic and responsive

*Corresponding author, E-mail address: catalina.tantu8@gmail.com

Current Trends in Natural Sciences
Vol. 13, Issue 25, pp. 191-199, 2024
https://doi.org/10.47068/ctns.2024.v13i25.023
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

digital tools. With robust tools for real-time editing and cross-platform optimization, the application was successfully adapted into a digital format, enhancing physiotherapy assessments through innovative computational methods.

The methodology integrated the IPAQ scoring system, employing both continuous and categorical methods to evaluate PA. Continuous scoring equations, derived from the IPAQ scoring manual, were implemented to estimate total energy expenditure by calculating MET-minutes based on the intensity, duration, and frequency of activities. The categorical scoring system was also incorporated to classify participants into low, moderate, or high activity levels (Guidelines for IPAQ, 2005).

By embedding these standardized equations into the application, the tool ensures consistent and accurate quantification of physical activity levels, aligning with established frameworks (Craig et al., 2003; Guidelines for IPAQ, 2005). This integration enhances the reliability and utility of the digital tool for physiotherapy assessments.

In Figure 1, we presented the methodological workflow outlining the key steps involved in developing the IPAQ digital application over a timeline of approximately six months. This process began with a detailed requirement analysis and interface design, which spanned the first two months. This was followed by a three-month development phase, during which the questionnaire was digitized and integrated with secure data storage and synchronization features. The final month was dedicated to extensive testing, usability evaluations, and deployment across multiple platforms, ensuring functionality, reliability, and accessibility for participants.

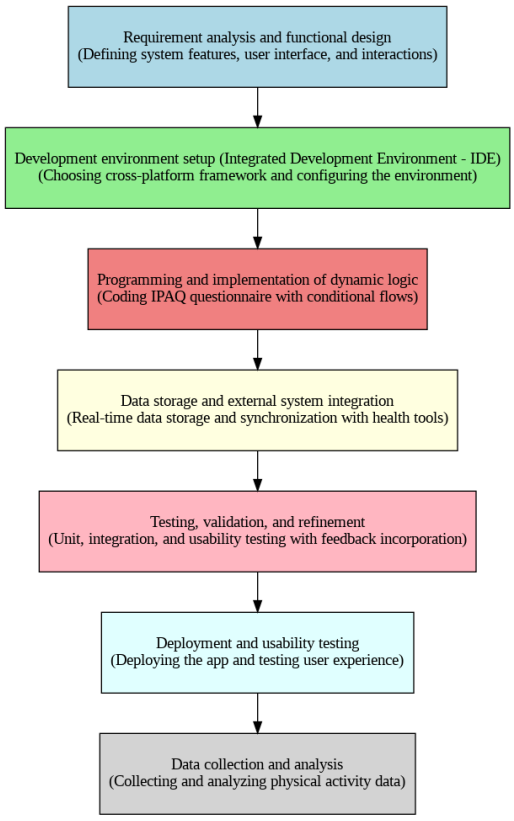

Figure 1 - Methodological workflow for developing the IPAQ digital application

*Corresponding author, E-mail address: catalina.tantu8@gmail.com

Current Trends in Natural Sciences
Vol. 13, Issue 25, pp. 191-199, 2024
https://doi.org/10.47068/ctns.2024.v13i25.023
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

To transition from the traditional IPAQ version to the digital format, we utilized a modern programming language, applying its syntax and logic to develop an interactive application that faithfully replicates the structure and functionality of the original questionnaire. The computational model for calculations was implemented through algorithms that process user input and apply standardized formulas for MET-minutes and calorie expenditure, using individualized parameters such as weight and activity duration. In this way, we transformed a manual process, based on filling out a paper form, into an automated, rapid, and accurate assessment of PA, integrating these calculations into a seamless digital workflow.

To minimize additional costs and ensure accessibility, we leveraged free resources available on the web, such as open-source libraries and frameworks. This approach allowed us to build the application without incurring significant expenses while still maintaining high functionality. By utilizing these free tools, we ensured that the digital IPAQ tool could be widely accessible to users across various platforms, making it an affordable solution for healthcare providers and individuals alike.

Additionally, we focused on creating an interface that would be easy to understand and use, even for individuals without advanced digital skills. The design of the application prioritized simplicity and clarity, ensuring that users could easily navigate through the questionnaire and understand the steps involved in inputting their PA data.

To achieve this, we opted for a clean and minimalistic user interface, avoiding complex menus or overwhelming visuals. The graphics were kept simple yet effective, using intuitive icons and clear labels to guide users through the process. This approach aimed to eliminate any confusion or frustration, particularly for older adults or individuals who might not be as familiar with digital tools.

We also implemented a straightforward layout, where each section of the questionnaire was clearly defined and visually distinct, making it easier for users to focus on one task at a time. The results screen, for example, presented the output in large, readable fonts, with color-coded indicators to represent different levels of PA. This not only enhanced accessibility but also helped users interpret their activity levels at a glance, without requiring advanced knowledge of the underlying metrics.

Overall, the design was built with the user experience in mind, ensuring that the tool was accessible to a broad audience, including those with limited technological expertise. The goal was to create a functional, user-friendly platform that encourages engagement and helps users take actionable steps toward improving their PA levels.

3. RESULTS AND DISCUSSIONS

This study aimed to design and implement a custom-coded application that digitizes the IPAQ, transforming it into an interactive tool for assessing and analysing PA. The objectives included enhancing the precision, accessibility, and efficiency of traditional IPAQ assessments, providing a user-friendly digital interface, and ensuring robust data management for seamless integration with existing healthcare tools. By addressing these goals, the study sought to bridge the gap between conventional paper-based assessments and modern technological solutions, ultimately supporting improved physiotherapy practices and patient care.

The application provides a streamlined, computational solution for assessing PA levels through a questionnaire-based tool. Users input details about their activity patterns, and the application instantly calculates key metrics, including MET-minutes, calorie expenditure, and overall, PA level. The digital questionnaire is divided into three main sections:

*Corresponding author, E-mail address: catalina.tantu8@gmail.com

Current Trends in Natural Sciences
Vol. 13, Issue 25, pp. 191-199, 2024
https://doi.org/10.47068/ctns.2024.v13i25.023
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

1. User information: collects personal data, such as sex, age and weight, essential for tailoring calorie calculations to individual physiological parameters.
2. Activity details: covers three activity categories (vigorous, moderate, and walking), where users specify the frequency (days per week) and duration (hours and minutes) of each activity. These inputs serve as the basis for calculating energy expenditure and intensity.
3. Results: upon completing the questionnaire, users press "Calculate" to trigger an automated process that computes total weekly MET-minutes, calories burned, and activity levels. The results are presented clearly on-screen, offering actionable insights into activity patterns.

From a technical perspective, the application is developed using a cross-platform framework and a modern programming language, ensuring efficient development and responsive performance across different devices and operating systems. The user interface includes input fields managed by controllers that validate and restrict entries to numerical values, ensuring data integrity while maintaining ease of use.

Core calculations are based on standardized MET values for vigorous, moderate, and walking activities, combined with user-specific parameters like weight and activity duration. The activity levels are categorized as low, moderate, or high, based on predefined MET-minute thresholds and activity frequency.

The application employs a responsive design to accommodate various screen sizes, ensuring accessibility across devices. Its modular codebase supports future adaptations for other questionnaires or additional features.

By automating PA calculations and providing instant feedback, the application eliminates the manual effort traditionally required for activity assessment. It offers a robust and user-friendly tool for physiotherapy professionals and individuals aiming to monitor and optimize their PA levels.

This study does not seek to evaluate the reliability of the IPAQ, as its reliability has been well-established in previous research. Instead, the primary objective is to adapt the IPAQ into a computational format, emphasizing its optimization and integration within a digital framework to enhance efficiency and accessibility for physiotherapy applications. Future investigations may address reliability testing, particularly in the context of integrating the tool with other health assessment platforms.

Notably, prior research have validated the reliability of some online version of the IPAQ-SF, confirming its capacity to accurately reflect the original construct of PA. For instance, studies have shown that the online version of the IPAQ-SF exhibits reliable results, even among specific populations such as college students from low-income regions (Nascimento-Ferreira et al., 2022). In practice, the present study focuses on adapting the IPAQ for digital platforms, incorporating real-time data collection, and enhancing user accessibility.

A new direction for the development of our digital version of the IPAQ tool focuses on shifting the approach from simple assessment to personalized feedback that encourages actionable steps for improving PA. Moreover, other authors emphasize the importance of understanding how older adults allocate their time across activities, including PA, sitting, and lying down during waking hours (Cleland et al., 2018), highlighting that constructive feedback could foster awareness and improve comprehension of these patterns. While the current version of the tool primarily measures PA levels, future developments aim to guide users toward healthier behaviour by providing tailored recommendations for interventions designed to enhance PA outcomes.

This potential transition is based on a computational model integrated within the tool, which processes data in real-time and could adapt feedback according to individual activity patterns. By

*Corresponding author, E-mail address: catalina.tantu8@gmail.com

Current Trends in Natural Sciences
Vol. 13, Issue 25, pp. 191-199, 2024
https://doi.org/10.47068/ctns.2024.v13i25.023
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

offering specific recommendations based on the user's input, the tool could not only assess PA but also provide practical suggestions for increasing activity, such as personalized exercise routines, lifestyle adjustments, or dietary tips.

This innovative approach could ensure that the tool does more than just collect data; it could actively engage users in improving their PA levels. The inclusion of feedback-driven recommendations may help users understand their current activity patterns, identify areas for improvement, and adopt healthier habits. This model leverages the power of computational methods to offer a dynamic and responsive user experience, enhancing the effectiveness of the IPAQ tool in promoting long-term health and well-being.

Ultimately, the goal of our digital IPAQ tool is to bridge the gap between assessment and intervention, supporting users in making positive changes to their PA habits and, consequently, improving their overall health outcomes. However, these developments are still in progress and will require further testing to evaluate their utility and effectiveness in real-world settings.

Although some authors argue that face-to-face interactions enhance adherence to PA programs (Peng et al., 2022), societal trends and the ongoing digitalization present new frameworks for such interventions. The growing shift towards digital solutions provides alternative ways to engage patients and support PA adoption, overcoming some of the barriers associated with in-person sessions. As technology continues to evolve, digital platforms are becoming increasingly capable of delivering personalized interventions (Gao and Lee, 2019), which may offer comparable or even enhanced opportunities for sustained PA engagement, especially when combined with tailored feedback and real-time tracking.

Our research aligns with current trends in advanced digital health tools, which enable the collection of comprehensive data on daily life factors such as individual preferences and interactions, facilitating personalized care and strengthening long-term partnerships between patients and care teams to promote healthy behaviours (Abernethy et al., 2022).

Our study has some limitations. Firstly, the reliability of the digital version of the IPAQ was not directly tested. As such, future studies should address this gap by conducting reliability assessments to confirm its validity in different populations and settings. Additionally, the current version of the tool primarily focuses on PA assessments, and while there are plans to incorporate personalized feedback and interventions, these features have not yet been fully realized. Another limitation is the potential challenge of sustaining user engagement over time, particularly without features like gamification or reminders to encourage continued use.

In contrast, the strengths of our study are substantial. One of the key strengths is the successful adaptation of the IPAQ into a digital tool, significantly improving the precision, accessibility, and efficiency of PA assessments. The tool allows for real-time data collection and synchronization, enabling seamless integration with other health tools and offering clinicians up-to-date information for timely interventions. Furthermore, the application was designed with the user in mind, ensuring a simple and intuitive interface that enhances accessibility across various devices. The use of a cross-platform framework guarantees that the tool can be accessed on smartphones, tablets, and computers, broadening its potential applications in healthcare settings. Finally, the automation of PA calculations streamlines the assessment process, reducing the potential for errors and improving the overall efficiency of data collection and analysis. These strengths collectively demonstrate the potential of our digital IPAQ tool to enhance physiotherapy practices and improve patient care.

*Corresponding author, E-mail address: catalina.tantu8@gmail.com

Current Trends in Natural Sciences
Vol. 13, Issue 25, pp. 191-199, 2024
https://doi.org/10.47068/ctns.2024.v13i25.023
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

4. CONCLUSIONS

This study demonstrates the successful conversion of the IPAQ into a digital platform, enhancing the efficiency and accessibility of PA assessments. The integration of real-time data collection and secure synchronization positions the tool as a valuable asset in data-driven healthcare applications. This computational model facilitates a more accurate and automated assessment of PA, providing enhanced flexibility and scalability for integration into diverse healthcare environments and enabling efficient adaptation to various clinical needs. However, further research is essential to validate its reliability in various settings and refine its functionality, particularly in the realm of personalized interventions. Further developments should also focus on sustaining user engagement and ensuring seamless integration with other health platforms.

5. REFERENCES

Abernethy, A., Adams, L., Barrett, M., Bechtel, C., Brennan, P., Butte, A., Faulkner, J., Fontaine, E., Friedhoff, S., Halamka, J., et al. (2022). The Promise of Digital Health: Then, Now, and the Future. *NAM Perspect*, *2022*, 10.31478/202206e. doi: 10.31478/202206e.

Bernhardsson, S., Larsson, A., Bergenheim, A., Ho-Henriksson, C.M., Ekhammar, A., Lange, E., Larsson, M.E.H., Nordeman, L., Samsson, K.S., Bornhöft. L. (2023). Digital physiotherapy assessment vs conventional face-to-face physiotherapy assessment of patients with musculoskeletal disorders: A systematic review. *PLoS One*, *18*(3), e0283013. doi: 10.1371/journal.pone.0283013.

Cleland, C., Ferguson, S., Ellis, G., Hunter, R.F. (2018). Validity of the International Physical Activity Questionnaire (IPAQ) for assessing moderate-to-vigorous physical activity and sedentary behaviour of older adults in the United Kingdom. *BMC Med Res Methodol*, *18*(1), 176. doi: 10.1186/s12874-018-0642-3.

Craig, C.L., Marshall, A.L., Sjöström, M., Bauman, A.E., Booth, M.L., Ainsworth, B.E., Pratt, M., Ekelund, U., Yngve, A., Sallis, J.F., et al. (2003). International physical activity questionnaire: 12-country reliability and validity. *Med Sci Sports Exerc*, *35*, 1381–1395. doi: 10.1249/01.MSS.0000078924.61453.FB.

de Leeuwerk, M.E., Bor, P., van der Ploeg, H.P., de Groot, V., van der Schaaf, M., van der Leeden, M. (2022). OPRAH consortium. The effectiveness of physical activity interventions using activity trackers during or after inpatient care: a systematic review and meta-analysis of randomized controlled trials. *Int J Behav Nutr Phys Act*, *19*(1), 59. doi: 10.1186/s12966-022-01261-9.

De Vera, M.A., Ratzlaff, C., Doerfling, P., Kopec, J. (2010). Reliability and validity of an internet-based questionnaire measuring lifetime physical activity. *Am J Epidemiol*, *172*(10), 1190–1198. doi: 10.1093/aje/kwq273.

Ekelund, U., Sepp, H., Brage, S., Becker, W., Jakes, R., Hennings, M., Wareham, N.J. (2006). Criterion-related validity of the last 7-day, short form of the International Physical Activity Questionnaire in Swedish adults. *Public Health Nutr*, *9*(2), 258–265. doi: 10.1079/phn2005840.

Fogelholm, M., Malmberg, J., Suni, J., Santtila, M., Kyröläinen, H., Mäntysaari, M., Oja, P. (2006). International Physical Activity Questionnaire: Validity against fitness. *Med Sci Sports Exerc*, *38*(4), 753–760. doi: 10.1249/01.mss.0000194075.16960.20.

Gao, Z., Lee, J.E. (2019). Emerging Technology in Promoting Physical Activity and Health: Challenges and Opportunities. *J Clin Med*, *8*(11), 1830. doi: 10.3390/jcm8111830.

Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire (IPAQ) (2005). Retrieved September 16, 2024, from https://sites.google.com/view/ipaq/score

Iconaru, E.I., Tarcau, E., Ciucurel, M.M., Draghici, L., Ciucurel, C. (2023). The Relationship between Physical Activity Level and Sociodemographic Factors in Romanian Adults in the Post-COVID-19 Pandemic Period. *Sustainability*, *15*, 13488. doi: 10.3390/su151813488.

Kamel Boulos, M.N., Yang, S.P. (2021). Mobile physical activity planning and tracking: a brief overview of current options and desiderata for future solutions. *Mhealth*, *7*, 13. doi: 10.21037/mhealth.2020.01.01.

Kurth, J.D., Klenosky, D.B. (2020). Validity Evidence for a Daily, Online-delivered, Adapted Version of the International Physical Activity Questionnaire Short Form (IPAQ-SF). *Meas Phys Educ Exerc Sci*, *25*(2), 127–136. doi: 10.1080/1091367X.2020.1847721.

Liao, Y., Vakanski, A., Xian, M., Paul, D., Baker, R. (2020). A review of computational approaches for evaluation of rehabilitation exercises. *Comput Biol Med*, *119*, 103687. doi: 10.1016/j.compbiomed.2020.103687.

*Corresponding author, E-mail address: catalina.tantu8@gmail.com

Current Trends in Natural Sciences
Vol. 13, Issue 25, pp. 191-199, 2024
https://doi.org/10.47068/ctns.2024.v13i25.023
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

Macfarlane, D.J. Lee, C.C.Y., Ho, E.Y.K., Chan, K.L., Chan, D. (2006). Convergent validity of six methods to assess physical activity in daily life. *J Appl Physiol*, *101*(5), 1328–1334.

Nascimento-Ferreira, M.V., Rosa, A.C.A., Azevedo, J.C., Santos, A.R.A., De Araujo-Moura, K., Ferreira, K.A. (2022). Psychometric Properties of the Online International Physical Activity Questionnaire in College Students. *Int J Environ Res Public Health*, *19*(22), 15380. doi: 10.3390/ijerph192215380.

Parker, K., Uddin, R., Ridgers, N.D., Brown, H., Veitch, J., Salmon, J., Timperio, A., Sahlqvist, S., Cassar, S., Toffoletti, K., Maddison, R., Arundell, L. (2021). The Use of Digital Platforms for Adults' and Adolescents' Physical Activity During the COVID-19 Pandemic (Our Life at Home): Survey Study. *J Med Internet Res*, *23*(2), e23389. doi: 10.2196/23389.

Peng, S., Othman, A.T., Yuan, F., Liang, J. (2022). The Effectiveness of Planning Interventions for Improving Physical Activity in the General Population: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *Int J Environ Res Public Health*, *19*(12), 7337. doi: 10.3390/ijerph19127337.

Segun-Falade, O.D., Osundare, O.S., Kedi, W.E., Okeleke, P.A., Ijomah,T.I., Abdul-Azeez, O.Y. (2024). Developing crossplatform software applications to enhance compatibility across devices and systems. *Comput Sci IT Res J*, *5*(8), 2040–2061. doi: 10.51594/csitrj.v5i8.1491.

Stoumpos, A.I., Kitsios, F., Talias, M.A. (2023). Digital Transformation in Healthcare: Technology Acceptance and Its Applications. *Int J Environ Res Public Health*, *20*(4), 3407. doi: 10.3390/ijerph20043407.

*Corresponding author, E-mail address: catalina.tantu8@gmail.com