

Article

A Sustainable mHealth Intervention to Promote Physical Activity for Healthy Aging: A Pilot Study of the “Every Walk You Take” Citizen Science Initiative

Preet Naik ^{1,2}, Dolores Álamo-Junquera ^{2,3} , Laura Igual ⁴, Marc Serrajordi ⁴, Albert Pérez ⁴, Carles Pericas ^{2,5}, Constança Pagès-Fernández ⁶ , Tarun Reddy Katapally ^{7,8,9}  and María Grau ^{2,10,11,*} 

¹ School of Pharmacy, University College London (UCL), London WC1N 1AX, UK; preet.naik.20@ucl.ac.uk

² Department of Medicine, School of Medicine and Health Sciences, University of Barcelona, 08036 Barcelona, Spain; lola.alamo@gmail.com (D.Á.-J.); cpericas@aspb.cat (C.P.)

³ Catalan Institute of Health, 08908 Sabadell, Spain

⁴ Department of Computer Science, School of Mathematics and Computer Science, University of Barcelona, 08007 Barcelona, Spain; ligual@ub.edu (L.I.); marcserajordidomenech@gmail.com (M.S.); albertperezcosta99@gmail.com (A.P.)

⁵ Public Health Agency of Barcelona, 08023 Barcelona, Spain

⁶ School of Pharmacy, University of Barcelona, 08028 Barcelona, Spain; constancapages@gmail.com

⁷ Digital Epidemiology and Population Health Laboratory (DEPth Lab), School of Health Studies, Faculty of Health Sciences, Western University, London, ON N6A 3K7, Canada; tarun.katapally@uwo.ca

⁸ Department of Epidemiology and Biostatistics, Schulich School of Medicine, Western University, London, ON N6A 3K7, Canada

⁹ Lawson Health Research Institute, London, ON N6A 3K7, Canada

¹⁰ Biomedical Research Consortium in Epidemiology and Public Health (CIBERESP), 28029 Madrid, Spain

¹¹ Cardiovascular Risk, Nutrition and Aging, August Pi I Sunyer Biomedical Research Institute (IDIBAPS), 08036 Barcelona, Spain

* Correspondence: mariagrau@ub.edu



Citation: Naik, P.; Álamo-Junquera, D.; Igual, L.; Serrajordi, M.; Pérez, A.; Pericas, C.; Pagès-Fernández, C.; Katapally, T.R.; Grau, M. A Sustainable mHealth Intervention to Promote Physical Activity for Healthy Aging: A Pilot Study of the “Every Walk You Take” Citizen Science Initiative. *Sustainability* **2024**, *16*, 5338. <https://doi.org/10.3390/su16135338>

Academic Editors: Giuseppe Battaglia and Andreas Ihle

Received: 15 April 2024

Revised: 17 June 2024

Accepted: 19 June 2024

Published: 23 June 2024



Copyright: © 2024 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Abstract: The objective of the Every Walk You Take initiative was to co-design and test, in a pilot study, a sustainable mHealth intervention prototype (mobile app) to promote physical activity. This prototype would help to identify the barriers to and facilitators of active living in individuals older than 55 years. A prototype of the intervention was co-designed by a community of stakeholders in Barcelona who were familiar with the social and economic burden of aging in high-income societies. The app’s functionalities included recommendations for healthy routes in the city (parks, pedestrian lanes, and streets) according to environmental variables (air quality and climate) and personal preferences (route difficulty, distance, and geolocation), and ecological momentary assessments (pictures and voice notes) were collected to identify the barriers to and facilitators of performing these routes. To test the app, a pilot study was conducted over two 7-day cycles with citizen scientists recruited at the life-long learning centers of two deprived neighborhoods in Barcelona. A total of 21 citizen scientists (mean age = 67 (standard deviation = 7)), 86% of them female, collected 112 comments and 48 pictures describing their perceived barriers to and facilitators of active living. Every Walk You Take is a new, validated, and sustainable mHealth intervention that is directly involved in health promotion, as it empowers the citizens of Barcelona to play an active role in their own healthcare. This intervention has the potential to be implemented in different cities around the world to collect information on the community determinants of health and health assets.

Keywords: active living; citizen science; healthy aging; physical activity; smart city; sustainability

1. Introduction

The term “sustainable development” is used to describe projects, policies, and initiatives that provide benefits without sacrificing environmental, social, or personal health in the future [1]. In a context in which the effects of the climate crisis are becoming increasingly

evident, approaches that simultaneously ensure health improvements and cost reductions would prove beneficial from both the healthcare and sustainability standpoints. mHealth initiatives focusing on the prevention of non-communicable diseases and the promotion of healthy behaviors fall into this category, as they have the potential to greatly diminish the load on healthcare systems, thus reducing costs and resource expenditure in the long term.

Currently, more than 20% of the EU-27 population is 65 years of age and over, and projections suggest an increase to 31.3% by 2100 [2]. An aging population comes with increased risks of non-communicable diseases that have the potential to precipitate healthcare crises [3]. Physical inactivity, the fourth leading cause of death worldwide, which costs healthcare systems approximately USD 67.5 billion per year globally [4], will further perpetuate this health crisis, making it imperative to promote healthy, active aging. The World Health Organization defined a global action plan on physical activity (2018–2030) that responds to the need for a whole-of-society response to achieve a paradigm shift in both supporting and valuing all people being regularly active according to ability and across the life course [5]. Indeed, physical activity has multiplicative health, social, and economic benefits, and investment in policy actions to increase physical activity can contribute to achieving the Sustainable Development Goals (SDGs) [6].

The promotion of active lifestyles and healthy aging is contingent on social and community networks; general socioeconomic, cultural, and environmental conditions; and individuals [7]. Previous studies have provided insights into the barriers to and facilitators of an active life [8–11] and their effects on aging [12–14]. The domains that these studies identified included personal, environmental, ecological, socio-cultural, economic, and political issues. The integration of this information included in several of the previously identified domains (i.e., community health assets and individual and environmental data) [14] is important for designing feasible interventions to promote physical activity.

Citizen science can play a key role in capturing the influences of these domains by enabling active participation of the general population in research projects. This could be through engagement with the steering committees/advisory councils of active living projects [15] or by providing data via ecological momentary assessments (EMAs) that capture active living prospectively [16,17]. The implementation of such citizen science methodologies will help to provide more insights into strategies to promote healthy living considering smart city infrastructure [18,19]. The use of digital technologies, especially mobile applications, allows for the integration of instant feedback from users, making them powerful tools through which to implement citizen science initiatives. For instance, training programs combining supervised outdoor exercise with telecoaching have been shown to be effective for improving balance and strength in older populations [19]. Nevertheless, the lack of digital literacy among certain demographics has been mentioned as a main obstacle for digital health initiatives [20]. Therefore, close collaboration with these demographics to include them in the design process is intended to prevent inequities and ensure their access to mHealth tools. Low adoption and long-term sustainability are also current challenges regarding mHealth apps [21]. In both cases, the involvement of patients or citizens in the development process has been proposed as the preferred solution. A previous analysis of other health interventions in low-income settings also highlighted the importance of involving all stakeholders, especially end-users, in the design process [22] as a way of ensuring the sustainability and effectiveness of a project [21]. Existing research agrees that an open dialog between all involved parties (developers and stakeholders) facilitates the accessibility, affordability, and acceptability of an intervention [19,22].

The World Health Organization has recognized digital health as a tool to increase access to timely, trustworthy, and actionable information for patients [23]. Thus, socially sustainable mHealth, understood as an intervention that is used regularly over the long term by patients, is expected to improve health outcomes [21]. In addition, these interventions have significant potential to promote healthy aging through enhanced access, monitoring, and self-care.

The objectives of this study were as follows: (1) to co-design and prototype, in a community of stakeholders, an mHealth intervention to promote active living and identify the barriers to and facilitators of active living in individuals older than 55 years and (2) to test the performance of the intervention in a pilot study. Thus, Every Walk You Take, a co-designed mHealth intervention that recommends personalized healthy routes with real-time information on air quality and climate, could be a valid method for identifying the barriers to and facilitators of active living among individuals older than 55 years, with the goal of promoting physical activity.

2. Materials and Methods

2.1. Community of Stakeholders

Every Walk You Take started with the constitution of a community of stakeholders that acted as the steering committee of the project. Citizens, researchers, health professionals, health planners, policymakers, and teachers who were familiar with the social and economic burden of aging in high-income societies took part in this community, which had representatives from both economically deprived and privileged areas of the city. The publicly owned life-long learning centers of two deprived neighborhoods in Barcelona (Trinitat Vella and Bon Pastor) were the executive offices of the project and meeting points for the community of stakeholders with the following responsibilities: (a) project planning, co-designing, and prototyping the Every Walk You Take mHealth intervention intended to promote active living; (b) interpretation and awareness (discussion and interpretation of the data collected in the pilot study); (c) reflection (remembering what worked properly during the study and the points that need improvement); and (d) legacy (co-designing and implementing the communication strategy of the project) (Figure 1, cells 2, 4, 5, and 6).



Figure 1. Flow chart of the design process and pilot analysis of the Every Walk You Take initiative.

2.2. Intervention Prototype

An iterative process was implemented to validate the mHealth intervention. The starting point was an evaluation of the first prototype of the app designed by the research team, which recommended healthy routes according to weather predictions and real-time data on air quality. At the first meeting (June 2023), the community of stakeholders suggested enhancements and modifications, which were promptly incorporated by the research team to develop a refined second prototype. This iteration was followed by a second meeting (September 2023) where the stakeholders evaluated and endorsed the latest prototype (Figure 1, cell 2).

2.3. Pilot Study

The mHealth intervention co-designed and prototyped by the community of stakeholders was tested in a pilot study conducted over two 7-day cycles, one in each neighborhood (Bon Pastor and Trinitat Vella) (Figure 1, cell 3). To qualify as a citizen scientist, participants needed to meet the following inclusion criteria established by the community of stakeholders: being 55 or older, owning a smartphone, and attending literacy courses at a life-long learning center. The sample size was defined considering previous usability studies that recruited from 10 to 20 participants [24–29]. All citizen scientists were duly informed and signed their informed consent to be involved in the study. The protocol of this study was approved by the Bioethics Committee of the University of Barcelona (#IRB00003099).

2.3.1. Formative Session

All citizen scientists attended a 2 h formative session at their own life-long learning center. During that session, the citizen scientists learned how to download, register, and use the mobile app and how to register EMAs to capture the barriers to and facilitators of active living. All questions that arose during the sessions regarding the functioning of the app were answered.

2.3.2. Data Collection

Once the app was installed on their smartphones, the citizen scientists answered the project questionnaires on socio-demographic data embedded in the app. Additionally, they were encouraged to (1) follow the personalized recommendations according to their individual preferences and environmental data and (2) register EMAs using the app. The citizen scientists were prompted to take pictures and describe, via audio recordings, if they perceived their environment (indoor or outdoor) to be either a barrier to or a facilitator of active living. These images and audio recordings were automatically geo-coded to exact latitude–longitude locations measured via smartphone-based location services. To help the citizen scientists become familiar with the app's functionalities, some members of the community of stakeholders accompanied them on walks during the first day of each 7-day cycle. Afterwards, the citizen scientists had 6 more days to collect data on their own.

2.4. Statistical Analysis

To describe the sample, the means and standard deviations of the continuous variables and the proportions of the categorical variables were estimated as appropriate. The EMAs (pictures and voice notes) were analyzed to reveal patterns of the perceptions (i.e., barriers and facilitators) of active living in the community of stakeholders. Moreover, intrinsic motivations at the individual level and key factors at the environmental level were identified.

3. Results

The Every Walk You Take study was conducted between June and December of 2023 in Trinitat Vella and Bon Pastor, two neighborhoods in the city of Barcelona.

3.1. Co-Design and Validation of the mHealth Intervention

The mHealth intervention to promote physical activity in individuals older than 55 years was co-designed with 10 community leaders familiar with the social and economic burden of aging in high-income societies (e.g., two citizen scientists, one researcher, one health professional, one policymaker, two teachers, and three community agents).

At a meeting held in June 2023, this community agreed that a mobile app was the best channel for the co-designed mHealth intervention, and the functionalities of such an app were discussed. The enhancements proposed by the stakeholders primarily focused on improving the interactions between the application and its users. Consequently, features such as the collection of barriers and facilitators through images and voice notes, along with a route-rating functionality, were seamlessly integrated into the second prototype.

In September 2023, the second prototype of the mobile app was presented to the community of stakeholders. This app was designed with a user experience adapted to the target population (i.e., people older than 55 years). The app recommended healthy routes in the city, defined as routes that maximized passage through pedestrian-friendly areas (parks, pedestrian lanes, and streets). The recommendations considered environmental variables in the current global context of the climate crisis (i.e., air quality and climate), personal preferences (i.e., route difficulty and distance), and geolocalization, as well as the barriers to and facilitators of performing the routes, which were previously identified through EMAs (collected via pictures and voice notes) considering the material and emotional perceptions captured by all citizen scientists. The application was multilingual (English, Spanish, and Catalan) (Figure 2), and the prototype was validated by the community of stakeholders.

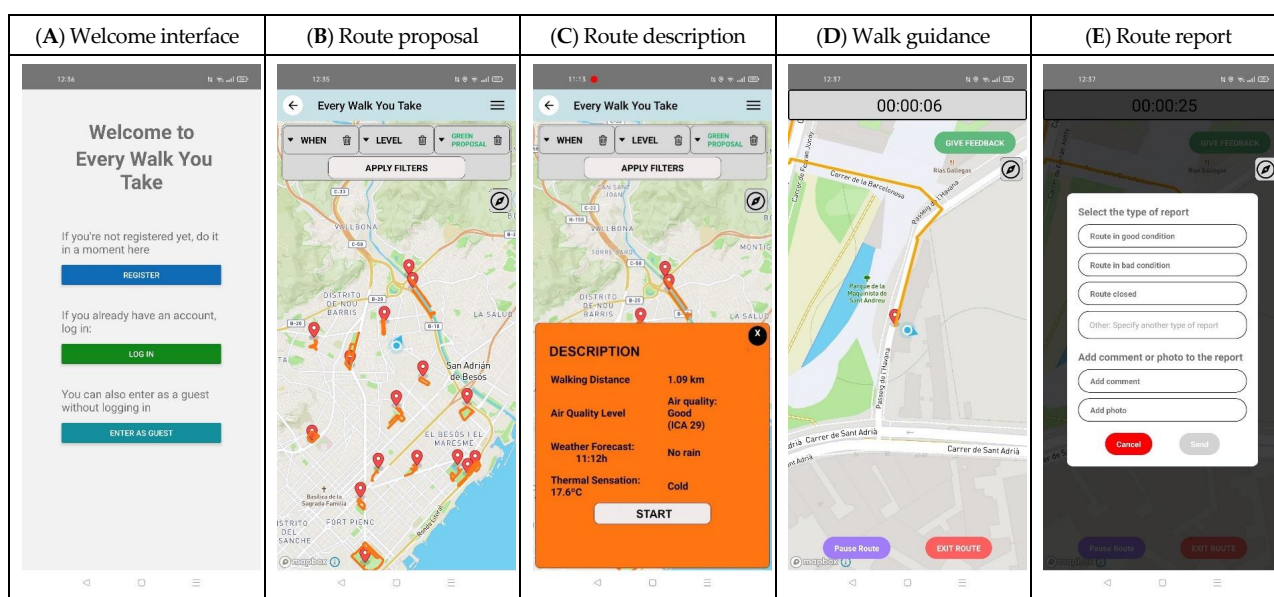


Figure 2. Interface of Every Walk You Take mobile app.

3.2. Pilot Study

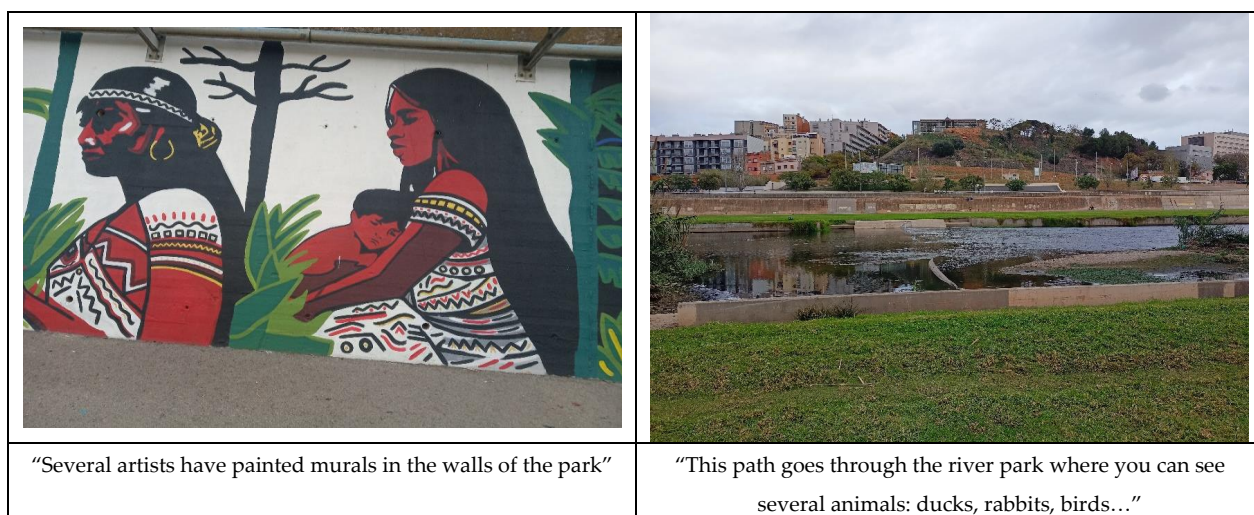
The research team held a formative session at each life-long learning center to familiarize the citizen scientists with the application and data collection (EMAs). This study included 21 citizen scientists with a mean age of 67 (standard deviation: 7), 86% of which were female. The most common education level was primary studies (76%), followed by university studies (14%) and secondary studies (10%) (Table 1).

Table 1. Summary of the socio-demographic characteristics of the citizen scientists.

	All (<i>n</i> = 21)	Female (<i>n</i> = 18)	Male (<i>n</i> = 3)
Age (years), mean (SD)	67 (7)	68 (7)	65 (8)
Education attainment, <i>n</i> (%)			
Primary studies	16 (76)	13 (72)	3 (100)
Secondary studies	2 (10)	2 (11)	0 (0)
University studies	3 (14)	3 (17)	0 (0)

SD: standard deviation, as a measure of variation.

During the pilot study, a total of 112 EMAs were collected. In particular, 64 reports were sent, and 92% of them pointed out that the routes were in good condition. In addition, the citizen scientists sent 48 pictures of barriers and facilitators they identified for active living. The metadata of all images and audio recordings were reviewed to ensure reliability. Figures 3 and 4 include examples of the images and the associated reports of barriers and facilitators, respectively. The most commonly described barriers were related to dirtiness and damaged roads, whereas the facilitators included murals on the roads and urban green spaces.

**Figure 3.** Pictures and comments about the barriers to active living captured by citizen scientists.**Figure 4.** Pictures and comments about the facilitators of active living captured by citizen scientists.

4. Discussion

The results of the co-design process performed by the community of stakeholders produced a sustainable mHealth intervention that aimed to increase physical activity by recommending healthy routes in the city. This tool helped to identify the barriers to and facilitators of active living in individuals older than 55 years. The pilot study, which was conducted after testing the intervention through life-long learning centers located in two deprived areas in Barcelona, showed a high degree of interaction between the citizen scientists and the app's functionalities. By showing that the development and implementation of this app were feasible among the targeted population, the current results set the basis for the next steps of the "Every Walk You Take" project, which ultimately aims to promote physical activity in order to improve quality of life among older individuals. This initiative tackles three core objectives of public health policy: prevention, protection, and health promotion. The project is directly involved in health promotion, as it increases health literacy among the citizens of Barcelona, empowering them to play an active role in their own healthcare. Citizen involvement is key to ensuring social sustainability and accessibility to all patients who could potentially benefit from this intervention. Furthermore, this project provides a foundation for the development of novel sustainable models of health surveillance to address gaps in the current research landscape of active living.

4.1. *Every Walk You Take: An Innovative Approach*

This initiative takes advantage of the current urban environment, known as the smart city, with many sensors gathering real-time data from multiple sources. This ecosystem has huge potential for experimentation with new interventions, deploying new technologies at scale, and aggregating and integrating large volumes of data. Three mid- and long-term effects of this approach are expected: (1) increases in health literacy and population empowerment, leading to reductions in health inequities; (2) a direct impact on the socio-cultural and technological transformation of Barcelona; and (3) the city landscape will become more livable and resilient due to the identification of the barriers to and facilitators of active living. Several projects have considered physical inactivity with citizen science methodologies and individual perspectives [16,30,31]. However, Every Walk You Take recognizes that successful healthy aging through active living depends not only on individuals, but also general socioeconomic, cultural, and environmental conditions and strong social and community networks. Thus, the Every Walk You Take approach includes interactions with several determinants of health, particularly community ones (e.g., urbanism and the environment).

4.2. *Citizen Science as a Tool to Improve Health Literacy*

The lack of diversity among citizen science participants has scientific and societal implications [32]. For Every Walk You Take, to tackle the issue of the underrepresentation of people from deprived areas, we focused our efforts within the economically disadvantaged neighborhoods of Trinitat Vella and Bon Pastor in Barcelona. In this context, community engagement strategies are crucial [33], as indicated in the Smart Framework, which integrates citizen science with community-based participatory research [15]. Through the inclusion of community leaders in our stakeholder community, we could increase the effectiveness of health interventions [34].

We established a scientific collaboration with the public network of life-long learning centers in the neighborhoods. These centers offer a set of learning activities that, within the framework of life-long learning, allow for adults to develop their capabilities, enrich their knowledge, and improve their technical and professional skills. The executive offices of this citizen science project were the life-long learning centers. Thus, the meetings of the community of stakeholders, the formative sessions, and the pilot study were conducted at these centers. Most of the citizen scientists were students attending an alphabetization course that also covered basic computer skills. Every Walk You Take significantly contributed to these learnings in the following ways: firstly, the citizen scientists put the theoretical content

acquired in the life-long learning center classes into practice by validating a new mobile app designed for individuals older than 55 [35]. Since we aimed to follow an approach guided by end-user requirements, two citizen scientists took part in the community of stakeholders and actively participated in the community's tasks [36].

Secondly, strategies for improving healthy behavior and reducing health inequalities may benefit from adopting a stronger focus on health literacy within prevention and public health interventions [37]. Thus, our citizen scientists, most of whom completed primary studies, may have benefited from the relationship between educational attainment and healthy behavior. Indeed, the World Health Organization, in the conceptual framework for action considering the social determinants of health, identified education as an inequality axis [38]. Concurring with this, Wister et al. highlighted that programs and policies that encourage life-long and life-wide educational resources and practices for older persons are needed [39]. In consequence, the existence of a public network of life-long learning centers, like the centers involved in Every Walk You Take, has important benefits for the most vulnerable groups.

4.3. Barriers to and Facilitators of Active Living

Using EMAs, images of the barriers to active living captured and uploaded by the citizen scientists revealed noteworthy insights into their perceptions, as well as significant patterns within the barriers they encountered. Concurring with previous publications, the most common observation regarded the bad state of the roads, which acted as a deterrent by reducing their inclinations towards walking and partaking in physical activities [40,41]. This observation highlights a key point of consideration for policymakers and urban planners. The negative impact of dirty or damaged roads on citizen scientists' motivations to engage in physical activity proves that the city infrastructure influences the public's inclinations toward adopting active lifestyles. This relationship is particularly important in low-income neighborhoods, where walkability (defined as the extent to which the built environment is friendly to the presence of people living, shopping, visiting, enjoying, or spending time in an area) is related to a healthier weight status [42]. By addressing these issues, policymakers possess the ability to support healthier lifestyle choices, ultimately benefiting the overall well-being of communities. Conversely, the images of facilitators uploaded and described by the citizen scientists were varied. Some people were impressed by murals on the roads, which made their walks more enjoyable and stimulating, while others were pleased by being surrounded by nature and found this to be a serene experience that motivated them to engage in more physical activity. Thus, there are general public benefits from investments in art, culture, and green spaces, as they are aesthetically attractive to see and pleasurable to be around. Concurring with this observation, Balci et al. also pointed out that neighborhoods with visually engaging and eye-catching objects and locations increase the frequency, duration, and vigorousness of residents' and visitors' exercise [43]. New possibilities for the development of urban spaces could be derived from co-design practices. In fact, the implications that city infrastructure has on health requires the diversification of the group of stakeholders involved. The aim is to reconfigure urban spaces and to translate the diverse user perspectives on urban life into planning practices, since these interventions can impact the socio-technical development of a city [44,45].

4.4. The "Every Walk You Take" Initiative and the Sustainable Development Goals

There are multiple direct and indirect pathways by which this health initiative supports the SDGs. Firstly, SDG#3 is enhanced, particularly the part that addresses reducing premature mortality from non-communicable diseases by one-third through prevention and treatment to promote mental health and well-being. Increased participation in physical activity contributes to the prevention and treatment of non-communicable diseases in the general population and at-risk individuals. Increased rates of physical activity reduce the subsequent disease burden and overall mortality, promoting well-being and mental health for all [46]. Secondly, overweight and obesity are forms of malnutrition. Physical

activity can assist with maintaining a healthy weight and can contribute to weight loss [47], addressing SDG#2 (end all forms of malnutrition). Thirdly, our initiative was carried out through life-long learning centers. The importance of such places is huge for ensuring that all learners (regardless of age) acquire the knowledge and skills needed to promote sustainable development, including education for sustainable development and sustainable lifestyles (SDG#4) and, consequently, for reducing inequalities (SDG#10). Finally, climate change is intensely addressed through our initiative (SDG#13) and is deeply linked with the enhancement of inclusive and sustainable urbanization and the capacity for participatory, integrated, and sustainable human settlement planning and management (SDG#11). Thus, through the promotion of active living in older adults, Every Walk You Take greatly contributes to the sustainable development of our societies.

4.5. Strengths and Limitations

This study has several limitations. On the one hand, there was unbalanced gender representation within the sample, with the majority of the participants being women. This may have introduced gender-based biases, which could impact the generalizability of the findings. The overrepresentation of women may have skewed the perspectives and insights that were gathered from this study, which would limit a comprehensive understanding of active living barriers and facilitators among diverse gender demographics. This gender imbalance might reflect a propensity among women to more readily participate in health-related initiatives compared to men. Therefore, to address this limitation in future studies, efforts should be made to ensure that recruitment strategies are inclusive and balanced; this could be carried out by emphasizing the benefits of participation [18]. On the other hand, we used educational attainment as a proxy of socioeconomic level. Although socioeconomic status and education may not correlate well in some instances, the neighborhoods where this study was conducted are among the most deprived areas in the city of Barcelona. Thus, educational attainment may have been a good proxy for socioeconomic status in this study. Finally, this project aimed to validate a prototype of the Every Walk You Take mHealth intervention, but no information was collected on its effect on the citizen scientists' health status (e.g., quality of life). Further randomized controlled trials should be performed to evaluate the effectiveness of such an intervention, particularly by considering the compliance of citizen scientists in using EMAs to report data and the cost-effectiveness of the intervention [36,48,49].

5. Conclusions

Every Walk You Take is a new, validated, and sustainable mHealth intervention that was co-designed by a community of stakeholders in Barcelona. It promotes physical activity through the recommendation of healthy routes in the city. It helps to identify the barriers to and facilitators of active living for individuals older than 55 years. This comprehensive mHealth intervention provides the best choices of healthy routes (i.e., community health assets) by considering information on the determinants of health from an individual perspective (e.g., age, physical condition, and geolocation) and from the community perspective (e.g., environmental variables (air quality and climate) and city infrastructure (parks, pedestrian streets, and lanes)). This mHealth intervention allows for the evaluation of barriers and facilitators when following the proposed routes, considering material and emotional perceptions. Thus, this intervention has the potential to be implemented in different cities around the world that collect information on the community determinants of health and community health assets. As the accessibility of this application was ensured through a co-design process involving the target population of the intervention, Every Walk You Take supports the inclusion of demographics who may lack digital literacy in this mHealth intervention.

Author Contributions: Substantial contributions to the conception or design of this work: M.G. and T.R.K. Acquisition and analysis of data: L.I., M.S., A.P. and M.G. Interpretation of data: P.N., D.Á.-J., C.P., C.P.-F., T.R.K. and M.G. Drafting this work or critically revising important intellectual content: all authors. All authors have read and agreed to the published version of the manuscript.

Funding: This work was funded by IMPETUS, the European Union’s Horizon Europe research and innovation program, under grant agreement number 101058677.

Institutional Review Board Statement: The protocol of this study was approved by the Bioethics Committee of the University of Barcelona (#IRB00003099).

Informed Consent Statement: Informed consent was obtained from all subjects involved in this study.

Data Availability Statement: All research data can be downloaded at Zenodo [<https://zenodo.org/records/10259746> (accessed 20 January 2024)].

Acknowledgments: The authors wish to thank the management teams and students at the life-long learning centers in Trinitat Vella and Bon Pastor in Barcelona as well as Laura Lopez Crespo for her contribution to the dissemination of this project.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. World Health Organization. Sustainable Development. 2024. Available online: https://www.who.int/health-topics/sustainable-development#tab=tab_1 (accessed on 31 March 2024).
2. Eurostat. The Home of High-Quality Statistics and Data on Europe. 2024. Available online: <https://ec.europa.eu/eurostat> (accessed on 31 March 2024).
3. World Health Organization. Noncommunicable Diseases. 2024. Available online: <https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases> (accessed on 31 March 2024).
4. Ding, D.; Lawson, K.D.; Kolbe-Alexander, T.L.; Finkelstein, E.A.; Katzmarzyk, P.T.; van Mechelen, W.; Pratt, M.; Lancet Physical Activity Series 2 Executive Committee. The economic burden of physical inactivity: A global analysis of major non-communicable diseases. *Lancet* **2016**, *388*, 1311–1324. [[CrossRef](#)] [[PubMed](#)]
5. World Health Organization. *Global Action Plan on Physical Activity 2018–2030: More Active People for a Healthier World*; World Health Organization: Geneva, Switzerland, 2018; Available online: <https://www.who.int/publications/i/item/9789241514187> (accessed on 31 March 2024).
6. United Nations. The 17 Goals—Sustainable Development Goals 2024. Available online: <https://sdgs.un.org/es/goals> (accessed on 31 March 2024).
7. Dahlgren, G.; Whitehead, M. European Strategies for Tackling Social Inequities in Health: Levelling Up Part 2. 2006. Available online: <https://iris.who.int/handle/10665/107791> (accessed on 31 March 2024).
8. Odunitan-Wayas, F.A.; Hamann, N.; Sinyanya, N.A.; King, A.C.; Banchoff, A.; Winter, S.J.; Hendricks, S.; Okop, K.J.; Lambert, E.V. A citizen science approach to determine perceived barriers and promoters of physical activity in a low-income South African community. *Glob. Public Health* **2020**, *15*, 749–762. [[CrossRef](#)] [[PubMed](#)]
9. Winter, S.J.; Goldman Rosas, L.; Padilla Romero, P.; Sheats, J.L.; Buman, M.P.; Baker, C.; King, A.C. Using Citizen Scientists to Gather, Analyze, and Disseminate Information About Neighborhood Features That Affect Active Living. *J. Immigr. Minor. Health* **2016**, *18*, 1126–1138. [[CrossRef](#)] [[PubMed](#)]
10. Katapally, T.R.; Rainham, D.; Muhajarine, N. Factoring in weather variation to capture the influence of urban design and built environment on globally recommended levels of moderate to vigorous physical activity in children. *BMJ Open* **2015**, *5*, e009045. [[CrossRef](#)] [[PubMed](#)]
11. Katapally, T.R.; Bhawra, J.; Leatherdale, S.T.; Ferguson, L.; Longo, J.; Rainham, D.; Larouche, R.; Osgood, N. The SMART Study, a Mobile Health and Citizen Science Methodological Platform for Active Living Surveillance, Integrated Knowledge Translation, and Policy Interventions: Longitudinal Study. *JMIR Public Health Surveill.* **2018**, *4*, e31. [[CrossRef](#)] [[PubMed](#)]
12. Patti, A.; Bianco, A.; Karsten, B.; Montalto, M.A.; Battaglia, G.; Bellafore, M.; Cassata, D.; Scoppa, F.; Paoli, A.; Iovane, A.; et al. The effects of physical training without equipment on pain perception and balance in the elderly: A randomized controlled trial. *Work Read. Mass.* **2017**, *57*, 23–30. [[CrossRef](#)] [[PubMed](#)]
13. Barrie, H.; Soebarto, V.; Lange, J.; Mc Corry-Breen, F.; Walker, L. Using Citizen Science to Explore Neighbourhood Influences on Ageing Well: Pilot Project. *Healthcare* **2019**, *7*, 126. [[CrossRef](#)]
14. Wood, G.E.R.; Pykett, J.; Daw, P.; Agyapong-Badu, S.; Banchoff, A.; King, A.C.; Stathi, A. The Role of Urban Environments in Promoting Active and Healthy Aging: A Systematic Scoping Review of Citizen Science Approaches. *J. Urban Health* **2022**, *99*, 427–456. [[CrossRef](#)] [[PubMed](#)]
15. Katapally, T.R. The SMART Framework: Integration of Citizen Science, Community-Based Participatory Research, and Systems Science for Population Health Science in the Digital Age. *JMIR mHealth uHealth* **2019**, *7*, e14056. [[CrossRef](#)] [[PubMed](#)]

16. Katapally, T.R.; Chu, L.M. Digital epidemiological and citizen science methodology to capture prospective physical activity in free-living conditions: A SMART Platform study. *BMJ Open* **2020**, *10*, e036787. [CrossRef]
17. Hognogi, G.G.; Meltzer, M.; Alexandrescu, F.; Ștefănescu, L. The role of citizen science mobile apps in facilitating a contemporary digital agora. *Humanit. Soc. Sci. Commun.* **2023**, *10*, 863. [CrossRef]
18. Leale, I.; Figlioli, F.; Giustino, V.; Brusa, J.; Barcellona, M.; Nocera, V.; Canzone, A.; Patti, A.; Messina, G.; Barbagallo, M.; et al. Telecoaching as a new training method for elderly people: A systematic review. *Aging Clin. Exp. Res.* **2024**, *36*, 18. [CrossRef] [PubMed]
19. Leale, I.; Giustino, V.; Brusa, J.; Barcellona, M.; Barbagallo, M.; Palma, A.; Messina, G.; Dominguez, L.J.; Battaglia, G. Effectiveness of a Sustainable Training Program Combining Supervised Outdoor Exercise with Telecoaching on Physical Performance in Elderly People. *Sustainability* **2024**, *16*, 3254. [CrossRef]
20. Smith, B.; Magnani, J.W. New technologies, new disparities: The intersection of electronic health and digital health literacy. *Int. J. Cardiol.* **2019**, *292*, 280–282. [CrossRef] [PubMed]
21. An, Q.; Kelley, M.M.; Hanners, A.; Yen, P.Y. Sustainable Development for Mobile Health Apps Using the Human-Centered Design Process. *JMIR Form. Res.* **2023**, *7*, e45694. [CrossRef] [PubMed]
22. McCool, J.; Dobson, R.; Muinga, N.; Paton, C.; Pagliari, C.; Agawal, S.; Labrique, A.; Tanielu, H.; Whittaker, R. Factors influencing the sustainability of digital health interventions in low-resource settings: Lessons from five countries. *J. Glob. Health* **2020**, *10*, 020396. [CrossRef] [PubMed]
23. World Health Organization. *Classification of Digital Interventions, Services and Applications in Health: A Shared Language to Describe the Uses of Digital Technology for Health*, 2nd ed.; World Health Organization: Geneva, Switzerland, 2023.
24. Díaz, J.L.; Codern-Bové, N.; Zomeño, M.D.; Lassale, C.; Schröder, H.; Grau, M. Quantitative and qualitative evaluation of the COMPASS mobile app: A citizen science project. *Inf. Health Soc. Care* **2021**, *46*, 412–424. [CrossRef] [PubMed]
25. Kuhns, L.M.; Hereth, J.; Garofalo, R.; Hidalgo, M.; Johnson, A.K.; Schnall, R.; Reisner, S.L.; Belzer, M.; Mimiaga, M.J. A Uniquely Targeted, Mobile App-Based HIV Prevention Intervention for Young Transgender Women: Adaptation and Usability Study. *J. Med. Internet Res.* **2021**, *23*, e21839. [CrossRef] [PubMed]
26. O'Malley, G.; Dowdall, G.; Burls, A.; Perry, I.J.; Curran, N. Exploring the usability of a mobile app for adolescent obesity management. *J. Med. Internet Res.* **2014**, *16*, e29. [CrossRef] [PubMed]
27. Landman, A.; Emani, S.; Carlile, N.; Rosenthal, D.I.; Semakov, S.; Pallin, D.J.; Poon, E.G. A mobile app for securely capturing and transferring clinical images to the electronic health record: Description and Preliminary Usability Study. *JMIR mHealth uHealth* **2015**, *3*, e1. [CrossRef] [PubMed]
28. Al Ayubi, S.U.; Parmanto, B.; Branch, R.; Ding, D. A persuasive and social mHealth application for physical activity: A Usability and Feasibility Study. *JMIR mHealth uHealth* **2014**, *2*, e25. [CrossRef] [PubMed]
29. Gunter, R.; Fernandes-Taylor, S.; Mahnke, A.; Awoyinka, L.; Schroeder, C.; Wiseman, J.; Sullivan, S.; Bennett, K.; Greenberg, C.; Kent, K.C. Evaluating patient usability of an image-based mobile health platform for postoperative wound monitoring. *JMIR mHealth uHealth* **2016**, *4*, e113. [CrossRef] [PubMed]
30. Joensuu, L.; Csányi, T.; Huhtiniemi, M.; Kälbi, K.; Magalhães, J.; Milanović, I.; Morrison, S.A.; Ortega, F.B.; Sardinha, L.B.; Starc, G.; et al. How to design and establish a national school-based physical fitness monitoring and surveillance system for children and adolescents: A 10-step approach recommended by the FitBack network. *Scand. J. Med. Sci. Sports* **2024**, *34*, e14593. [CrossRef] [PubMed]
31. Buli, B.G.; Tillander, A.; Fell, T.; Bälter, K. Active Commuting and Healthy Behavior among Adolescents in Neighborhoods with Varying Socioeconomic Status: The NESLA Study. *Int. J. Environ. Res. Public Health* **2022**, *19*, 3784. [CrossRef] [PubMed]
32. Pateman, R.M.; Dyke, A.; West, S.E. The Diversity of Participants in Environmental Citizen Science. *Citiz. Sci. Theory Pract.* **2021**, *6*, 9. [CrossRef]
33. Duea, S.R.; Zimmerman, E.B.; Vaughn, L.M.; Dias, S.; Harris, J. A Guide to Selecting Participatory Research Methods Based on Project and Partnership Goals. *J. Particip. Res. Methods* **2022**, *3*. [CrossRef] [PubMed]
34. Phillips, T.B.; Ballard, H.L.; Lewenstein, B.V.; Bonney, R. Engagement in science through citizen science: Moving beyond data collection. *Sci. Educ.* **2019**, *103*, 665–690. [CrossRef]
35. Iancu, I.; Iancu, B. Designing mobile technology for elderly. A theoretical overview. *Technol. Forecast. Soc. Chang.* **2020**, *155*, 119977. [CrossRef]
36. Alruwaili, M.M.; Shaban, M.; Elsayed Ramadan, O.M. Digital Health Interventions for Promoting Healthy Aging: A System-atic Review of Adoption Patterns, Efficacy, and User Experience. *Sustainability* **2023**, *15*, 16503. [CrossRef]
37. Friis, K.; Lasgaard, M.; Rowlands, G.; Osborne, R.H.; Maindal, H.T. Health Literacy Mediates the Relationship Between Educational Attainment and Health Behavior: A Danish Population-Based Study. *J. Health Commun.* **2016**, *21* (Suppl. S2), 54–60. [CrossRef] [PubMed]
38. Solar, O.; Irwin, A. A Conceptual Framework for Action on the Social Determinants of Health. Social Determinants of Health Discussion. Paper 2 (Policy and Practice). 2010. Available online: <https://www.who.int/publications/i/item/9789241500852> (accessed on 31 March 2024).
39. Wister, A.V.; Malloy-Weir, L.J.; Rootman, I.; Desjardins, R. Lifelong educational practices and resources in enabling health literacy among older adults. *J. Aging Health* **2010**, *22*, 827–854. [CrossRef] [PubMed]

40. Weiss, R.L.; Maantay, J.A.; Fahs, M. Promoting Active Urban Aging: A Measurement Approach to Neighborhood Walk-ability for Older Adults. *Cities Environ.* **2010**, *3*, 12. [[CrossRef](#)] [[PubMed](#)]
41. Gkavra, R.; Nalmpantis, D.; Genitsaris, E.; Naniopoulos, A. The walkability of Thessaloniki: Citizens' perceptions. In Proceedings of the 4th Conference on Sustainable Urban Mobility (CSUM2018), Skiathos Island, Greece, 24–25 May 2018; Springer International Publishing: Cham, Switzerland, 2018; pp. 191–198.
42. Van Cauwenberg, J.; Van Holle, V.; De Bourdeaudhuij, I.; Van Dyck, D.; Deforche, B. Neighborhood walkability and health outcomes among older adults: The mediating role of physical activity. *Health Place* **2016**, *37*, 16–25. [[CrossRef](#)] [[PubMed](#)]
43. Balcetis, E.; Cole, S.; Duncan, D.T. How Walkable Neighborhoods Promote Physical Activity: Policy Implications for Development and Renewal. *Policy Insights Behav. Brain Sci.* **2020**, *7*, 173–180. [[CrossRef](#)]
44. Munthe-Kaas, P. Agonism and co-design of urban spaces. *Urban Res. Pract.* **2015**, *8*, 218–237. [[CrossRef](#)]
45. Bácsné-Bába, É.; Ráthonyi, G.; Pfau, C.; Müller, A.; Szabados, G.N.; Harangi-Rákos, M. Sustainability-Sport-Physical Activity. *Int. J. Environ. Res. Public Health* **2021**, *18*, 1455. [[CrossRef](#)] [[PubMed](#)]
46. Li, Y.; Pan, A.; Wang, D.D.; Liu, X.; Dhana, K.; Franco, O.H.; Kaptoge, S.; Di Angelantonio, E.; Stampfer, M.; Willett, W.C.; et al. Impact of Healthy Lifestyle Factors on Life Expectancies in the US Population. *Circulation* **2018**, *138*, 345–355. [[CrossRef](#)] [[PubMed](#)]
47. Barroso, M.; Zomeño, M.D.; Díaz, J.L.; Pérez, S.; Martí-Lluch, R.; Cerdón, F.; Ramos, R.; Cabezas, C.; Salvador, G.; Castell, C.; et al. Efficacy of tailored recommendations to promote healthy lifestyles: A post hoc analysis of a randomized controlled trial. *Transl. Behav. Med.* **2021**, *11*, 1548–1557. [[CrossRef](#)] [[PubMed](#)]
48. Katapally, T.R.; Hammami, N.; Chu, L.M. A randomized community trial to advance digital epidemiological and mHealth citizen scientist compliance: A smart platform study. *PLoS ONE* **2021**, *16*, e0259486. [[CrossRef](#)]
49. Mathews, S.C.; McShea, M.J.; Hanley, C.L.; Ravitz, A.; Labrique, A.B.; Cohen, A.B. Digital health: A path to validation. *NPJ Digit. Med.* **2019**, *2*, 38. [[CrossRef](#)]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.