

Online Communities for Promoting Physical Activity: A Scoping Review of Use, Characteristics and Research Gaps

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Keywords: Digital Platforms, Physical Activity, Health Communities, Health Promotion, User Engagement.

Abstract: The objective of this scoping review was to identify, characterise, and synthesise existing literature on the use of online communities (OC) to promote physical activity (PA) and identify gaps to direct future research. Systematic searches were conducted in Science Direct, PubMed, Scopus, and Institute of Electrical and Electronics Engineers Xplore for studies published up to August 2020. The search terms included a combination of the following keywords: physical activity, sedentary, exercise, health, sport, brand, and online community. No limits were used. Studies were included if they encompassed a full publication containing enough details on characteristics and described any feature primarily aiming at PA promotion. A total of 21 different OC were found in the total of 25 selected studies. Of those studies, all reported on at least one behaviour change technique, 68.2% (n=15) used websites to support the OC, 36% (n=9) reported on strategies to keep users engaged, 16% (n=4) comprised information related to the design process, and 16% (n=4) reported on OC effectiveness. Existing reports do not provide evident detailed information on the design process or user engagement strategies related to OC, and only a few studies assess its effectiveness in improving PA. Further research is needed.


1 INTRODUCTION

Global levels of physical activity (PA) have not been improving, despite evidence pointing out that PA is the cornerstone of a healthy lifestyle. Evidence has shown PA to be associated with lower rates of all-cause mortality (Zhao et al., 2020), chronic diseases such as cardiovascular diseases and hypertension (Carnethon, 2009; Hegde & Solomon, 2017; Lanier et al., 2016; O'Donovan et al., 2017), type-2 diabetes (Hamasaki, 2016), cancer (Brown et al., 2014), mental health problems (Biddle, 1992, 2016), and better cognitive health and sleep (Swirski et al., 2019).

OC refers to “a group of people with a common purpose whose interaction is mediated and supported by computer systems and governed by formal and informal policies” (Preece, 2000). Generally, it involves a dispersed group of people who share interest and expertise in a specific topic (Hagel & Armstrong, 1997) and who engage in public discussions long enough, and with sufficient human feeling (Rheingold, 1993), to create a sense

of community (Blanchard & Lynne Markus, 2004). This sense of community “exists in the minds of its members and is constructed symbolically through shared meanings, norms and culture” (Cohen, 1985; Malinen, 2015).

The interest in OC to promote PA has been receiving more attention in the past few years. Research has explored OC users' interaction and sharing behaviours (Phan et al., 2014; Andrade et al., 2018; Stragier et al., 2015; Zeng et al., 2018), how sharing experiences in OC can motivate users to increase PA (Boratto et al., 2017; Groenewegen et al., 2012), possible barriers to PA (Malinen & Nurkka, 2015; Sanders et al., 2019), and the effectiveness of OC in promoting PA (Ba & Wang, 2013; Groenewegen et al., 2012; Richardson et al., 2010). This growing body of diverse research raises the need to conduct a scoping review with the aim of synthesizing and comprehensively characterizing existing evidence on how OC has been used to promote PA and identifying potential gaps that deserve further research.

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2 MATERIALS AND METHODS

The scoping review methodology was considered the appropriate approach as it aims to map key concepts and summarise a range of evidence, especially in complex fields, and identify gaps in the existing literature (Arksey & O'Malley, 2005; Levac et al., 2010). This review design is based on the methodological framework proposed by Arksey and O'Malley (2005) and Levac, Colquhoun and O'Brien (2010), which is divided into five different stages: (1) identifying the research question, (2) identifying relevant studies, (3) study selection, (4) charting the data and (5) collating, summarising, and reporting results.

2.1 Research Questions

The research question guides the scoping review and, particularly, informs on what authors believe the review should target. This scoping review's overall research question is: "What is the existing evidence on the use and characteristics of OC to promote PA?". This general question was operationalized in more specific research questions:

- (1) How has the design process of the platforms that support OC been described?
- (2) What type of digital platforms (DP) are used to support OC?
- (3) What are the existing OC features?
- (4) What are the existing OC contents?
- (5) What strategies are suggested to keep users engaged in OC?
- (6) Which behaviour change techniques are used in OC?
- (7) What is the effectiveness of OC in promoting PA?

2.2 Identification of Relevant Studies

To find relevant studies, a comprehensive literature search on five online databases was conducted: Science Direct, PubMed, Scopus, and Institute of Electrical and Electronics Engineers Xplore (IEEE) using a combination of the following keywords: (Physical Activity OR Sedentary OR Exercise OR Health OR Sport) AND (Brand OR Online AND Community) AND (Communication OR Participation). The search covered the period between the date of database inception and August 4th, 2020. No limits on date, language, subject, or type were used.

2.3 Study Selection

The search results from each database were exported into Mendeley, merged and duplicates were removed. Then, titles and abstracts were screened against inclusion and exclusion criteria by one author. Full texts of selected references were retrieved and independently checked against inclusion criteria.

The operational definition for OC used for the scoping review was, as referred to in the introduction, "a group of people with a common purpose whose interaction is mediated and supported by computer systems and governed by formal and informal policies" (Preece, 2004).

Studies were included if they encompassed a full publication containing enough details on OC characteristics and described any feature of an OC aiming primarily at promoting PA. Studies were excluded if PA was not the focus of the study, there was an online intervention without reporting on an OC, or if the study was a review or a study protocol.

In addition to author details and year, specific information was extracted to answer each specific question of this scoping review.

3 RESULTS

A total of 10,574 references were found, of which 5,923 were duplicates and were removed. Of the 4,651 remaining manuscripts, 4,548 were removed after title and abstract screening, leaving 103 manuscripts for full-text screening. Of these, we were unable to retrieve 4, and 25 manuscripts entered this scoping review. The flowchart for this review can be found in Figure 1 (Appendix A).

The 25 included manuscripts report on a total of 21 (84%) different OC, of which 2 (9.52%) were categorized as Online SBC (Lopez-Gonzalez et al., 2014; Malinen & Nurkka, 2015; Malinen & Ojala, 2011).

3.1 Platform Design Process

From the 25 included manuscripts, only 4 studies (16%) comprised information related to the design process of 4 different platforms that support the respective OC (Boratto et al., 2017; Elloumi et al., 2017; Kolt et al., 2020; Malinen & Ojala, 2011).

These studies are related to different subjects, such as identifying the main issues associated with the platform usability (Boratto et al., 2017; Kolt et al., 2020; Malinen & Ojala, 2011), and introducing requirement elicitation processes to motivate for

practice of PA (Elloumi et al., 2017). The information extracted from these four studies can be found in Table 1 (Appendix A).

3.2 Types of DP Used to Support OC

Within the 25 selected manuscripts, there is a total of 21 (95.5%) OC in 22 (88%) different platforms. Of the 22 different platforms, 10 (45.5%) were purposely developed to accommodate the OC, and the remaining 12 (55.5%) OC used pre-existing platforms (i.e., commercial platforms). Fifteen (68.2%) platforms of the 22 platforms supported on website format (Elloumi et al., 2017; Feldvari et al., 2020; Greene et al., 2013; Groenewegen et al., 2012; Kolt et al., 2020; Lopez-Gonzalez et al., 2014; Mailey et al., 2019; Malinen & Nurkka, 2015; Malinen & Ojala, 2011; Manzoor et al., 2016; Resnick et al., 2010; Richardson et al., 2010; Toscos et al., 2010; Yu, 2018); 5 (22.7%) were supported on both website and app formats (Andrade et al., 2018; Ba & Wang, 2013; Boratto et al., 2017; Fan et al., 2019; Li & Yan, 2020; Stragier et al., 2015, 2017; Tague et al., 2014; Zeng et al., 2018); and 2 (9.10%) were supported only on app format (Phan et al., 2014; Sanders et al., 2019). Details can be found in Table 2 (Appendix A).

3.3 Existing OC Features

All the 25 included studies reported on OC features and a total of 20 different features were reported across them, and their reporting frequency is presented in Figure 2. Details on the OC features' presence in each study can be consulted in Table 3 (Appendix A).

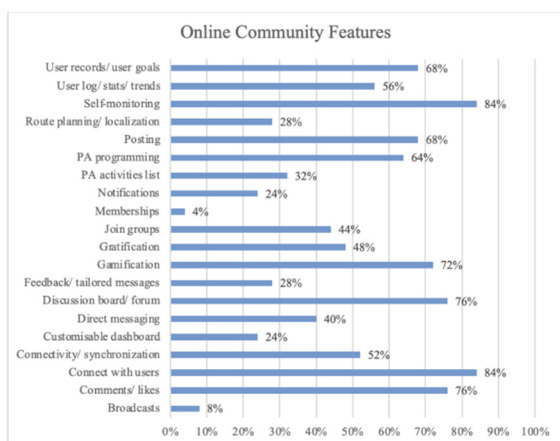


Figure 2: OC Features in the included manuscripts.

The most reported OC features (with a reporting frequency between 50 and 100%) were: gamification, user records/ user goals, user log/ stats/ trends, posting, PA programming, discussion boards/ forums, comments/ likes, connectivity/ synchronization, self-monitoring, and the possibility to connect with other users. The least reported OC Features (with a reporting frequency between 0 and 49%) were: memberships, broadcasts, feedback/tailored messages, route planning/localization, notifications, customizable dashboard, join groups, direct messaging, PA activities list and gratification.

3.4 Existing OC Contents

All the 25 included studies reported on the OC contents and a total of 10 different categories were defined based on the data collected from the included manuscripts, which are described in Table 4 and their frequency presented in Figure 3. Details about OC contents' presence in each study can be consulted in Table 4 (Appendix A).

The most reported OC contents (with a reporting frequency between 50 and 100%) were: skills training, posting, contests/ challenges, support group discussions. The least reported OC contents (with a reporting frequency between 0 and 49%) were: offline events, audio content, audio-visual content, maps, interviews/ surveys/ writing prompts, articles/ other resources.

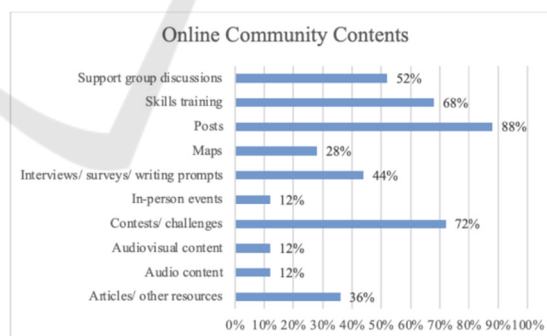


Figure 3: Frequency of reporting of OC Contents.

3.5 Strategies to Support Users Engagement

A total of 9 (36%) out of the 25 manuscripts included in this scoping review report on strategies to keep users engaged (Andrade et al., 2018; Ba & Wang, 2013; Boratto et al., 2017; Kolt et al., 2020; Lopez-Gonzalez et al., 2014; Mailey et al., 2019; Malinen & Ojala, 2011; Resnick et al., 2010; Richardson et al.,

2010). The user engagement strategies retrieved from the analysis of the included manuscript can be found in Table 5 (Appendix A).

3.6 Behaviour Change Techniques

We found reference to at least one BCT in the 25 included manuscripts, being referred to 20 (76.9%) out of the 26 BCT listed in Abraham and Michie's framework (2008). Only two BCT were reported in all the 25 manuscripts (plan social support or social change and provide opportunities for social comparison). An additional four BCT were reported in at least 50% of the included manuscripts. The remaining 14 BCT were reported in 40% or less of the included manuscripts. The BCT and their respective frequency of reporting can be found in Figure 4 (Appendix A).

3.7 Effectiveness of OC in Promoting PA

From the 25 selected manuscripts, only 4 (16%) reported on the effectiveness of OC in promoting PA (Greene et al., 2013; Mailey et al., 2019; Manzoor et al., 2016; Richardson et al., 2010), comparisons reported in these four studies, varied in aim, study design, and target group (i.e., study participants, OC members).

One study (Richardson et al., 2010) measured the impact on PA behaviour change of adding an OC to Stepping Up to Health, an automated lifestyle change intervention, using pedometers to detect possible changes in average daily step count. Participants had a body mass index of 25 or higher, type 2 diabetes or coronary artery disease. By the end of the intervention, average daily steps increased in both study arms. Manzoor et al. (2016) assessed PA changes between members and non-members of an OC by analysing a dataset of participants in a PA intervention. Participants were employees of a non-profit healthcare system company and their family members.

Study results conclude that OC members have higher PA levels at the start of the program and compared to users who are not in the OC, the increase in PA is also significantly higher. Mailey et al. (2019) compared the effects of a standard educational intervention and an interactive, theory-based intervention (based on Self-Determination Theory delivered through podcast content and weekly challenges in military spouses). Study results indicated no between-group differences in PA. Greene et al. (2013) examined whether the intervention group that used the iWell OSN had

greater increases in PA when compared to a group that received traditional education. Study results suggest that both groups increased PA with no overall difference in PA between groups.

4 DISCUSSION

This scoping review aimed to characterise and synthesise existing literature on the use of OC to promote PA and identify gaps to direct future research.

Results suggest that the number of manuscripts on OC has been increasing over the last few years. Most OC are supported in website-only format and close to half of the OC platforms used in the studies were purposely developed to accommodate the OC.

However, information related to their design process is scarce and OC features and contents are not comprehensively detailed. Furthermore, studies exploring strategies to keep users engaged in OC and studies assessing the effectiveness of PA promotion using OC are also lacking.

4.1 OC Platform Support and Usability

The majority of OC reported in the studies are supported in website format, and almost half of them were purposely developed to accommodate the OC. Considering that, nowadays, 56% of internet traffic comes from smartphones (GlobalStats, 2021) and 88% of mobile time is spent on apps (Wurmser, 2020), OC might benefit from being harboured in apps, and it might help explain users' current high attrition rates in OC and unlikeliness for long-term use of OC related to PA (Manzoor et al., 2016).

However, the fact that websites allow for higher compatibility, cost-effectiveness, and broader accessibility (i.e., according to the W3C Accessibility Standards Overview) might explain why OC continue to be mostly harboured in a website format (Cao & Loiacono, 2021; Henry, 2021). This is a very important point to explore considering that user retention has been reported as one of the biggest concerns in OC maintenance, even in OC which reports positive and promising results in behaviour change (Manzoor et al., 2016; Resnick et al., 2010).

Despite the high number of new platforms, there was a small number of studies related to their design process (16%; 4). Furthermore, the studies provided scarce details on aspects of usability assessment and involvement of users, and the data presented was scattered and insufficient to understand the design process of the OC platforms and to allow for

comparisons between the development process of different OC platforms.

These results suggest that developers of platforms might not be employing a user-centred approach, which might also contribute to low user-retention rates reported in some studies (Edney et al., 2017; Kolt et al., 2020). It is important to develop the platforms that support OC employing a user-centred approach so that their functional requirements allow the OC to function in a way that meets the users' needs and preferences, which is essential for the success of an OC (Preece, 2004).

4.2 OC Features, Contents, and User Engagement Strategies

Regarding OC features, self-monitoring (84%), connect with users (84%), comment/likes (76%), and gamification (72%) are among the most reported ones. This is important to acknowledge, especially because these features are associated with user participation consistency and relationship-building in the OC (Ba & Wang, 2013; Greene et al., 2013; Manzoor et al., 2016), which might contribute to increased user retention. It has been reported that emotional support has a stronger effect on health behaviour changes than informational support (Li & Yan, 2020). Two other highly reported features which include displaying users' records and goals (68%), and PA log, stats, and trends (56%) are also relevant as they can leverage user interaction and relationship building between users in the OC (Li & Yan, 2020), fostering social and emotional support. However, these strategies might need to be personalized. For example, gamification features such as leaderboards, point attribution and levelling up might negatively impact some users as they find the challenge unattainable (Werbach & Hunter, 2012) it might be more beneficial to invest in more gratification features prioritizing OC participation over PA.

Among the least reported OC features were several that give users a sense of autonomy (i.e., customizable dashboard, route planning/localization, direct messaging, logging PA from activities list) and/or feed onto the sense of relatedness (i.e., memberships, join groups, broadcasts, notifications, feedback/tailored messages). Considering the importance of users' sense of autonomy and relatedness needs to encourage user engagement (Malinen & Ojala, 2011; Tague et al., 2014), the fact that these OC features are narrowly present in studies might also contribute to decreased retention rates.

Information about OC content is scarce among study reports. Contests and challenges, and skills

training were the most reported features, with the first being aligned with the number of studies that report gamification features. However, support group discussions, which are crucial for higher user engagement in OC (Andrade et al., 2018; Kolt et al., 2020; Mailey et al., 2019; Malinen & Ojala, 2011; Resnick et al., 2010) were reported in only around half of the included studies. Included in the pool of least reported OC contents are in-person events, maps, and interviews/surveys/writing prompts. Considering that these contents create a greater amount of physical interaction and/or level of immersion with the shared community (Blazquez Cano et al., 2017; Oh et al., 2018), it might be beneficial to incorporate them more often in OC.

Overall, there is not much information regarding platform development and OC dynamics, hence it is difficult to understand how choices were made and if they are adjusted to users' needs and preferences. Therefore, although these contents were likely not present in the OC, it is also possible that these contents exist in the OC of included studies but were not detailed in the manuscript. User engagement strategies are a crucial part of OC because they contribute to building awareness and promoting the growth of collaborative knowledge, thus facilitating learning (Lopez-Gonzalez et al., 2014). Considering that retention is a main problem in OC (Kolt et al., 2020), it was surprising that only 9 (36%) of these reported specific user engagement strategies (Andrade et al., 2018; Ba & Wang, 2013; Boratto et al., 2017; Kolt et al., 2020; Lopez-Gonzalez et al., 2014; Mailey et al., 2019; Malinen & Ojala, 2011; Resnick et al., 2010; Richardson et al., 2010).

OC might benefit from using user engagement strategies more often to create a higher sense of community which could potentially contribute to solving an identified challenge of preserving long-term user engagement (Kolt et al., 2020; Manzoor et al., 2016). Keeping OC closed and accessible only to OC users might help clarify if some users aren't as actively engaged in OC due to hesitance to be potentially viewable by a public audience (Andrade et al., 2018).

Moreover, paid memberships might affect users' participation level in OC due to the level of personal investment in the OC (Ba & Wang, 2013). Future qualitative studies aiming at understanding what are the features, contents and user engagement strategies that are valued by users and more likely to positively affect retention are needed. These are likely to differ among target groups and personal aims, highlighting the need to develop OC and supporting platforms in a user-centred approach as previously referred.

4.3 Behaviour Change Techniques and Effectiveness of OC in Promoting PA

Practicing more PA, generally, involves changing previous behaviours and adopting new ones. Facilitating this change requires appropriate BCT. Included studies report on 20 of the 26 BCT described by Abraham and Michie (2008).

Furthermore, 14 of these 20 BCT are reported in 40% or less of the included manuscripts, suggesting that BCT are not receiving adequate attention when building an OC and respective supporting platform. This is likely to impact the effectiveness of OC in terms of PA promotion. For example, OC might benefit from time management and stress management strategies, prompting specific goal setting, or providing useful prompts or cues as the lack of resources associated with these BCT have been reported as constituting barriers for PA (Toscos et al., 2010), or facilitators of PA (Mailey et al., 2019; Rose et al., 2018). In line with the low attention given to BCT, there are also only a few studies ($n=4;16\%$) on the effectiveness of OC to increase PA. The reduced number of studies and their high heterogeneity in terms of procedures and comparisons prevent any firm conclusions. However, taken together, they suggest that OC are not superior to other forms of promoting PA. Further high-quality studies comparing OC to other more traditional interventions are required and these should also include a cost-effectiveness analysis as one of the potentially attractive aspects of OC is their ability to reach a high number of individuals at lower costs.

5 LIMITATIONS AND FUTURE DIRECTIONS

The categorisation of contents, features and user engagement strategies was based on the authors' knowledge of the subject rather than on validated models, which we were unable to find. We also acknowledge that the included manuscripts might not comprehensively describe OC and the respective support platforms.

6 CONCLUSION

Existing reports do not provide evident detailed information on the design process, or user engagement strategies, nor comprehensive and specific data on OC features and contents. Only a few

studies were found that assess the effectiveness of OC in promoting PA. Further research is required.

ACKNOWLEDGMENTS

This work was supported by Fundação para a Ciência e Tecnologia (FCT) under the PhD grant SFRH/BD/144296/2019.

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