

PEER REVIEW HISTORY

BMJ Open publishes all reviews undertaken for accepted manuscripts. Reviewers are asked to complete a checklist review form (<http://bmjopen.bmj.com/site/about/resources/checklist.pdf>) and are provided with free text boxes to elaborate on their assessment. These free text comments are reproduced below.

ARTICLE DETAILS

TITLE (PROVISIONAL)	Use of geofencing interventions in population health research: a scoping review
AUTHORS	Tobin, Karin; Heidari, Omeid; Volpi, Connor; Sodder, Shereen; Duncan, Dustin

VERSION 1 – REVIEW

REVIEWER	Nghiem, Nhung University of Otago
REVIEW RETURNED	14-Mar-2023

GENERAL COMMENTS	<p>Thank you for the opportunity to review this interesting and important work. I have the following comments for the authors.</p> <p>Major comments:</p> <p>While this work is important, I am concerned that with only nine studies included in the final analysis, this would be biased on the study's findings, conclusions and recommendations. As most studies were published in the last five years, I would suggest the authors to collect more observations (such as extending the timeframe to March 2023) and rerun the analyses. In my perspective, the total of nine studies was a small number to be able to conclude that "geofencing to be an emerging technology that is an acceptable and feasible intervention".</p> <p>In addition, the study concluded that "geofencing interventions have been applied to various populations and health outcomes.", but the majority of the included studies (nine studies) were in the US with lack of representation from the minority populations. Will this conclusion work (or be fair) for countries in other parts of the world, especially in countries with high prevalence in infectious diseases such as HIV or malaria?</p> <p>Minor comments:</p> <ul style="list-style-type: none">- Line 113 (p8): change "an individua" to "an individual"- Line 206 (p12): please check this sentence "Sample sizes ranged from 4-3,443"- P29: Table 1, it is clearer to also include reference number as per the reference list for each of the nine studies in this Table, such as change "Connor & Herzig, 2016 Stat!" to "Connor & Herzig, 2016 Stat!45"
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REVIEWER	Gruebner, Oliver University of Zurich, Geography
REVIEW RETURNED	12-Apr-2023

GENERAL COMMENTS	Thank you for inviting me to review this manuscript. The authors provided a scoping review of the available literature on geofencing as an intervention and found that it is increasingly
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	<p>used in public health research. Please find my comments and suggestions below.</p> <p>In general: Please better align research aims with your results and discussion section. This would dramatically increase the readability of the manuscript.</p> <p>ABSTRACT It would be good to reformulate the passage on the exclusion criteria. Maybe better mention what you included instead of excluded to improve readability.</p> <p>Line 113: ...needs of an individua*I*..., last letter missing.</p> <p>Line 117 I like the definition of geofencing. However, can you discuss a bit more on how it is conceptualised as an intervention? Especially in public health research? As this is the central question of this manuscript, it would be worth elaborating on this a bit more or better link it to your framework.</p> <p>Figure 1 is actually a table. Would it be possible to make it a graphic to better illustrate your framework? I think this would also improve the readability.</p> <p>Lines 193-201 Can you also provide % for the included studies?</p> <p>RESULTS /DISCUSSION I can't find the results section. Where does it start and how does it relate to the research aims (with regard to design, feasibility, and impact)? Please consider restructuring your result and also discussion sections to help the reader better navigate through the text. Maybe by introducing sub-headlines for easier recognition?</p> <p>Lines 233-245 A-CHESS, UBESafe, LowSalt4Life etc. what are they? Maybe introduce each one of them briefly in the text or provide an info box for overview of these abbreviations and studies?</p> <p>Lines 313-323 The whole paragraph on cueing is not entirely clear to me. Maybe you can extend your example a bit more to further clarify what is meant also for non-experts in the cognitive field (like me).</p> <p>Line 348 I am still not sure whether geofencing should be termed/ considered an intervention or whether it is rather used to deliver interventions (as a geospatial and digital method). Maybe you can elaborate on this also a bit more in the intro section and come back to this here in the discussion again.</p>
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VERSION 1 – AUTHOR RESPONSE

Reviewer: 1

Dr. Nhung Nghiem, University of Otago

Concern about the review including articles published through 2021.

We acknowledge this as a limitation in the method, which we listed in the revised manuscript (pages 6 and 18). Unfortunately, we are not able re-do the search to include more recent studies for this publication but plan to update the review in the future to assess whether this intervention methodology has been implemented with more populations and settings. However, we believe this review, as is, is a contribution to the field because it is to our knowledge the first manuscript to do so and includes a conceptual model and focus on mechanisms of action.

In addition, the study concluded that “geofencing interventions have been applied to various populations and health outcomes.”, but the majority of the included studies (nine studies) were in the US with lack of representation from the minority populations. Will this conclusion work (or be fair) for countries in other parts of the world, especially in countries with high prevalence in infectious diseases such as HIV or malaria?

This is an excellent point, which we have seriously considered. Based on this comment we have changed the word “various” to “a variety” (page 18). We also comment in the conclusion that “There is a need for future research that includes sexual and gender minority and BIPOC populations and populations from non-Western contexts to achieve the Health People Framework objectives...” (page 18).

Minor comments:

- Line 113 (p8): change “an individua” to “an individual”

We have revised this typo

- Line 206 (p12): please check this sentence “Sample sizes ranged from 4-3,443”

We have checked this and confirm that the Sample sizes ranged from 4 to 3,443. We have revised the sentence to be more precise.

- P29: Table 1, it is clearer to also include reference number as per the reference list for each of the nine studies in this Table, such as change “Connor & Herzig, 2016 Stat!” to “Connor & Herzig, 2016 Stat!45”

We have added the reference numbers to the Table 1.

Reviewer: 2

Dr. Oliver Gruebner, University of Zurich

Comments to the Author: Please better align research aims with results and discussion.

We have revised results and discussion to align with the study aims: assess design, acceptability, feasibility and impact of geofencing interventions and believe this improves the readability.

ABSTRACT

It would be good to reformulate the passage on the exclusion criteria. Maybe better mention what you included instead of excluded to improve readability.

We have added the exclusion criteria to the abstract. Thank you for this great suggestion.

Line 113:

...needs of an individua*I*..., last letter missing.

As suggested, we have corrected the typo.

Line 117

I like the definition of geofencing. However, can you discuss a bit more on how it is conceptualised as an intervention? Especially in public health research? As this is the central question of this manuscript, it would be worth elaborating on this a bit more or better link it to your framework.

Thank you for this important comment. In the revised manuscript (page 8), we provide further discussion on geofencing can be used as an intervention tool in public health research. We agree that this addition improved our manuscript.

Geofencing interventions are a subset of JITAI where there is continuous monitoring of the participant's location using GPS and delivery of an intervention such as text messages or links to health information or information about health services that are in the area based on a spatial context trigger. Another example of this in the public health setting is the use of geofencing to monitor movements of individuals who tested positive for COVID-19 virus.

Figure 1 is actually a table. Would it be possible to make it a graphic to better illustrate your framework? I think this would also improve the readability.

We appreciate this comment and agree that the figure is a table. We chose this format to depict multiple concepts including three types of mechanisms that operate in both protective and risk dimensions at numerous scales..

Lines 193-201

Can you also provide % for the included studies?

As suggested, we added percentages on the studies (page x). We believe this improves the rigor of our manuscript.

RESULTS /DISCUSSION

I can't find the results section. Where does it start and how does it relate to the research aims (with regard to design, feasibility, and impact)? Please consider restructuring your result and also discussion sections to help the reader better navigate through the text. Maybe by introducing sub-headlines for easier recognition?

Thank you for this suggestion. In the revised manuscript, we have added a sub-title to indicate where the results section starts.

Lines 233-245

A-CHESS, UBESafe, LowSalt4Life etc. what are they? Maybe introduce each one of them briefly in the text or provide an info box for overview of these abbreviations and studies?

We have added a text that directs the reader to the Supplemental Table 1 which is where detailed descriptions of the table can be found.

Lines 313-323

The whole paragraph on cueing is not entirely clear to me. Maybe you can extend your example a bit more to further clarify what is meant also for non-experts in the cognitive field (like me).

Thank you for these important comments. We have revised this paragraph to be more specific about what cueing is and provide examples of how this would be used in a geofencing intervention. "Cueing is a significant component of many effective interventions as they serve as reminders to engage in behaviors of interest."⁴⁹⁻⁵¹ For example, wearing a bracelet that has a phrase as a reminder to take medication. Cues can focus on both the protective and risk dimensions of the mechanism. For example, if an individual triggers a geofence of a place they have identified as associated with a sense of control, a geofencing intervention could send a text

message that reminds the individual to engage in self-care. In places where stigma is anticipated a geofencing intervention can send a text message that reminds the individual about adaptive coping behaviors. “ We believe that these revisions have improved our manuscript.

Line 348

I am still not sure whether geofencing should be termed/ considered an intervention or whether it is rather used to deliver interventions (as a geospatial and digital method). Maybe you can elaborate on this also a bit more in the intro section and come back to this here in the discussion again.

Thank you. In the revised manuscript, we made this important clarification (page 8): “A geofence involves creating virtual predefined set of boundaries or “fences” around a geographic location, including using GPS technology. Geofencing methodology can be used in public health research – both in observational and intervention studies. Thus, geofencing can be a valuable tool in intervention research, enabling researchers to study and implement interventions in specific geographic areas. For example, geofencing allows researchers to precisely target specific areas for intervention. In addition, geofencing allows researchers to send location-based notifications (an intervention) to participants, including on their mobile devices.” One example of this in the public health setting is the use of geofencing to monitor movements of individuals who tested positive for COVID-19 virus.

VERSION 2 – REVIEW

REVIEWER	Gruebner, Oliver University of Zurich, Geography
REVIEW RETURNED	30-Jun-2023
GENERAL COMMENTS	Thank you, all my comments have been addressed.