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Role of Social Determinants of Health in building an mHealth application

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Role of Social Determinants of Health in building an mHealth application

Completed Research Full Paper

Abstract

The pandemic has shown that the health of those with the least resources affects the rest of the population. Social determinants of health effect health disparities leading to greater inequities between those with and those without the resources needed to stay healthy. In order to help people, find resources they need to stay healthy, an mHealth application was created. Data was collected through this mobile application to investigate: what are the social determinants of health resources (SDOH) that are needed to address health inequities? Using this data, an mHealth prototype was developed to help understand whether the application can be useful in addressing the health inequities in a local community. Following a design science approach, the analysis suggests that resources for some social determinants of health are more useful than others. The contribution of this paper is in uncovering the SDOH resources that are needed to address the health inequities.

Keywords (Required)

Health Equity, Social Determinants of Health

Introduction

Social determinants of health, according to the CDC, “are conditions in the places where people live, learn, work, and play that affect a wide range of health and quality-of-life risks and outcomes” (CDC, 2021). It has been well documented that socio-economic status impacts an individual’s health (Marmot, 2007; Marmot, 2003; Stansfeld & Marmot, 1998; Singh-Manoux et al., 2003; Phelan, 2004; Pamuk et al., 1998; Pampel et al., 2010; Clarke et al. 2021). It has been documented that health of an individual impacts community health and thus impacts the economy in a cyclical manner (Kahn et al., 2010). Much of the healthcare research is also focused on patient-centered care and patient-empowerment (James, 2013) Patient-empowerment is the idea that if a patient is empowered to seek medical answers for themselves, then they will have better health outcomes (Clarke et al., 2020; Clarke et al., 2021). Due to everyday stressors, this may be difficult for some people to do. However, mobile health applications are making it much easier to access the tools someone might need to live healthier lives.

Kiemde et al (2021) found at the national US level that ICTs can help people access resources to assist with poverty, insurance, education, physical distress, and people who live in rural populations can take advantage of ICTs to help them lead the lives they choose to live. Kiemde and Qureshi (2021)’s analysis at the global level, uncovered the social determinants of health that are related to human development and how mhealth access is related to social determinants of health and the Human Development Index. This has implications for how inequalities may be addressed through mobile health applications to bring about human development.

While there is evidence to suggest that the use of mobile applications can bring about better health outcomes, it is still not clear what social determinants of health can be overcome using mhealth applications. This paper contributes to this body of knowledge, by asking the question: what are the social determinants of health resources (SDOH) that are needed to address health inequities? To do so, a deductive design science approach is employed to create a mhealth prototype. The prototype uses location-based functionality to offer socio-economic resources. It shows the distance between a given location and the resource as well as gives information based on eligibility, cost, and other relevant information. The backend is designed to filter out all high cost resources. To organize the information about each place in a relevant manner, the categories were designed to group the organizations into like-resources. For example, all dentists were grouped together into a group called “Dental Services”. Data was collected on the resources and the way they were organized in relation to groups of people that would find these resources relevant to their own health issues. The following sections offer the theoretical basis of this research, methods used for

data collection, and analysis are offered. Then finally, sections offer the results and contributions of this research.

Theoretical Background

Social Determinants of Health

According to the World Health Organization (WHO), health is largely determined by a person's "circumstance and environment" (World Health Organization, n.d.). This refers to the factors which are called social determinants of health (SDOH). These are not only the socio-economic factors such as education, income, and occupation (Adler, 2002; CDC, 2018; APA, 2020; Clarke et al. 2021). They also include factors such as race, religious affiliations, gender, geographic location, age, disability, and sexual orientation (Georgsson & Mattias, 2016; Marmot, 2007; Adler & Ostrove, 1999; Qureshi, 2021). It is an easily recognized fact that if you have more money, then you will likely be healthier. However, it is not only wealth that determines health (Adelman, 2008; Marmot, 2007; Castañeda et al., 2015)

According to Marmot (2007) employment type can change someone's risk of heart disease. There was evidence of this during the pandemic. Populations with more access to social opportunities had access to the best treatments (Qureshi, 2021). Adler and Newman discovered the major determinants of health: health care, environmental exposures, and lifestyle and healthy behaviors (Adler & Newman, 2002). Low income populations, food insecure populations, housing insecure populations, children, minority populations, and substance dependent populations are all social determinants of health directly mentioned by Adler & Newman (2002). Other social determinants of health that will be considered are survivors of domestic violence, immigrants, refugees, LGBTQ+, non-native English speakers, and those who have a disability or are impaired. These are also social determinants of health due to the lack of access to healthcare (APA, 2020; Castañeda et al., 2015).

Health Equity

According to the CDC, health equity is attained when everyone can reach their full health potential, and no one is prevented from doing so due to their SDOH (CDC, 2021). According to Clarke et al. (2016), there are impediments to receiving this information. They discovered that one's capacity to find relevant and reputable information was influenced by "age, education, and household income" (Clarke et al., 2016). If people have the access to seek healthcare, then they will be healthier (James, 2013)

Equitable health refers to the ability to be healthy in the absence of preexisting conditions (Qureshi & Xiong, 2021; Qureshi & Xiong, 2019; Clarke et al., 2021; Marmot, 2007). It is an opportunity for people to achieve the highest level of physical and mental well-being that their biological limitations will allow (Qureshi & Xiong, 2021; Qureshi & Xiong, 2019; Clarke et al., 2021; Marmot, 2007) A person who could improve their health but chooses not to, does not face health disparity. On the other hand, a person who is unable to build healthy habits or seek medical care due to a lack of social chances has not been given the opportunity to reach their full potential in terms of physical and mental health (Marmot, 2007; Braveman, 2003).

In this sense, the impact of one's social opportunities will reflect and impact the community's health. This in turn will also impact the economy which can influence both the individual and community's health (Kahn et al., 2010). The process to find credible information is stressful. An individual that is already stressed due to their social disparities will likely have a hard time find information and resources (Kiemde & Qureshi, 2021). When information technology is thoughtfully implemented, it can bridge gaps created by disparities in health (Deitenbeck et al., 2018; Negash et al., 2018). When social determinants of health are considered, information technology proves to be sustainable (Deitenbeck et al., 2018; Negash et al., 2018).

mHealth

mHealth is the use of mobile devices to promote healthier behaviors and self-education (Kahn et al., 2010; Kiemde & Qureshi, 2021; Kiemde et al., 2021). mHealth is a valuable tool. This can be seen by the more than 40,000 health-related apps available in 2012 to help people manage their health (Boulos et al., 2014). 85% of the worldwide population have mobile coverage (ITU, 2020; Qureshi, Xiong, & Deitenbeck et al.,

2019; Clarke et al., 2021). This shows that the potential for ICT and mHealth to have an impact in a community or an individual’s health outcomes.

mHealth can assist patients in receiving information and, as a result, speed up the diagnosing process (Clarke et al., 2016; Clarke et al., 2020; Clarke et al., 2021). These technologies can help reduce a patient’s out-of-pocket expenses. They aid in the reinforcement of healthy habits including sleeping, eating, and exercising. It can serve as a monitoring mechanism for people with chronic health problems. They can assist in informing people about probable diagnosis as well as how to treat ailments. It can serve as a direct line of communication as well as a helpline between healthcare providers and their patients. It was most recently used to track the pandemic’s outbreak (Deitenbeck et al., 2018; Negash et al., 2018).

Qureshi and Xiong (2019) developed a mHealth index to better understand how mobile devices are used to provide equitable healthcare. They discovered a link between mHealth, social inequalities in life expectancy, and educational attainment on Human Development in all countries throughout the world. Their research showed a link between mobile health, social inequalities in healthcare delivery, and human development outcomes. They observed a considerable positive link between the social determinants of health and health equity in relation to mHealth use at the global level in a second study (Qureshi & Xiong, 2019)

As it has already demonstrated compelling potential for tackling social determinants of health, mHealth is being used increasingly frequently by health service providers and patients alike. mHealth apps are assisting individuals in becoming healthier, and they can bridge the gap between rural and isolated populations (Boulos et al., 2014). These apps addressed issues such as chronic disease management, access to relevant health information, exercise and food intake tracking, follow-up care, and basic diagnostics for minor medical issues (Rodrigues et. al. 2015).

Relevancy

Hoehle & Venkatesh (2015) describe content relevance as a first step in creating a mobile application. Hevner (2004) also discusses relevancy of an IT artifact to solve a business problem. In this case the business problem is the knowledge activation to find health resources in your area. For many people, the way they look for health related resources is to search them and try to compare based on location and other valuable key pieces of information. Our mhealth prototype is an IT artifact that brings all the resources together in one spot, sorts them by recorded price, and location. The comparison can be done inside the portal itself instead of comparing many items in a search. Kahn et al. (2010) discusses risks to mhealth as: poorly designed campaigns, incorrect information, misinformation, loss of coordinated supply chain, loss of confidentiality are all risks that could potentially negatively impact someone’s experience with Mhealth resources (Kahn et al., 2010). Therefore, the measure of relevance here points to an mhealth risk. If our mhealth prototype is considered relevant, that could indicate that this IT artifact would be useful within the local community.

Category relevancy: measures on a four-point scale the user’s perception of the groupings of like-resources. This will show us whether the people directly helping a certain population find the groupings to be logical. This is illustrated in figure 1:

Community Resources		
Click on a category below to see local resources		
Dental Services	Disability Services for Physical Impairments	Domestic Violence Services
Financial Assistance	Food Assistance	Halfway Housing
Health and Family Planning	Immigration and Refugee Services	Infection Testing and Vaccination
Legal Assistance	Medicaid	Medical Equipment Services
Mental Health Services	Social Security Services	Substance Abuse Services
Transportation Services		

Figure 1: mHealth Prototype - Categories

The categories relevant to this area, which are shown in figure 1, are dental services, disability services for physical impairments, domestic violence services, financial assistance, food assistance, halfway housing,

health and family planning, immigration and refugee services, infection testing and vaccination, legal assistance, Medicaid, medical equipment services, mental health services, social security services, substance abuse services, and transportation services.

The other measure of relevancy is by the organization lists that are shown once in a specific category.

Organization relevancy: measures on a four-point scale the user’s perception of the resources themselves. This will show if the mHealth application is showing resources that are backed with confidence by prior users.

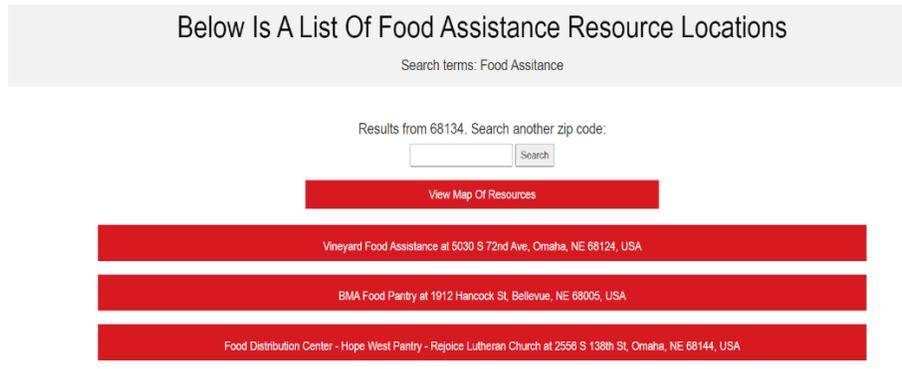


Figure 2: mHealth Prototype - Organizations

Figure 2 shows a view of some of the organizations listed under food assistance for the zip code 68134. In this, current version of the mhealth prototype, a location was automatically recorded after the site asked for permission to use the location recorded by Google.

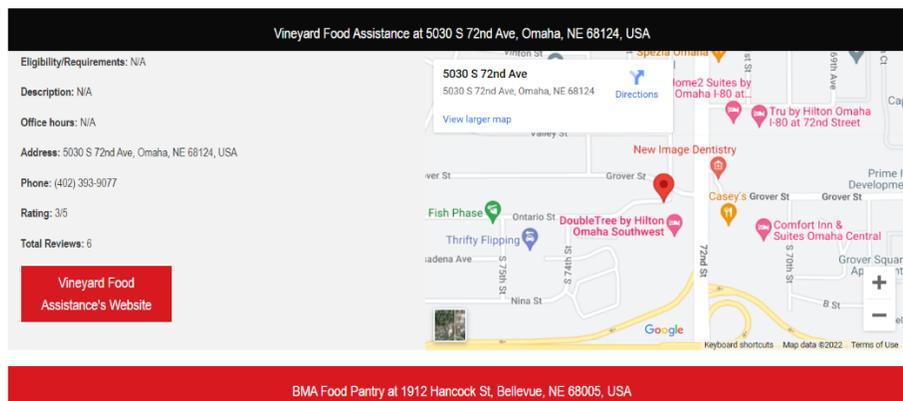
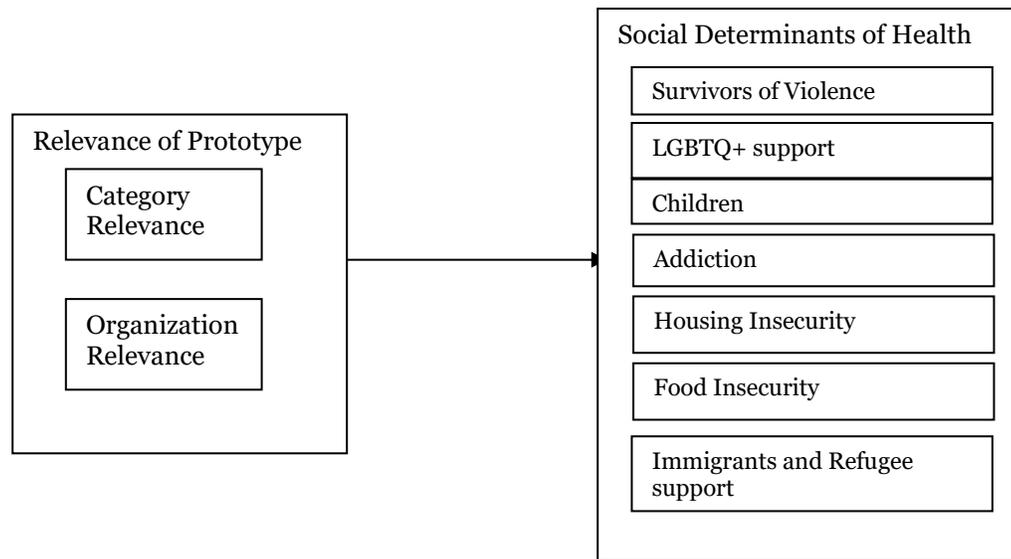


Figure 2.1: mHealth Prototype – Organizations Details

In figure 2.1, the details of the organization can be found. If the organization has editing access, they can add in eligibility, descriptions, and office hours. The other details are found through a backend search. The map is an integrated google maps, which also can be used to find the distance between the user’s location and the given resource.

Model



Our prototype has categories for low income, survivors of domestic violence, LGBTQ+, children, elderly, disabled/impaired, food insecurity, housing insecurity, minority populations, immigrants, and refugees. Therefore, our hypothesis is that these categories will be considered relevant and thus have the capability to impact social determinants of health.

Our prototype is significant because it puts all the resources in the area into categories. This makes it easier to search for specific community resource information. Those who are in a lower socio-economic status already have many stressors in their lives (Kiemde et al., 2021). If all the information is in one spot, filtered by the cost and location, and organized in a way that is relevant to the users' needs, then this can lead to a reduction in stress when looking for resources. The activation of knowledge becomes more streamlined (Noteboom & Qureshi, 2014). Whereas, if a user goes to google, they might find relevant information, but they would have to do more independent research to be able to compare services and resources. Similar to when people look for doctors based on their insurance, they have all the information as to what is cost effective, but the information is not up-to-date.

Methodology

This research follows a deductive approach to investigate the usefulness of an mHealth prototype developed to support the information seeking behaviors of people seeking socio-economic resources to be healthy. A design science approach is used to design a mHealth prototype that helps address problems of health inequities arising from lack of socio-economic and healthcare resources. Further to guidelines 3 of Hevner (2004), Design Evaluation, a rigorous method of evaluation involves collecting data through a tested instrument and analyzing the data through testing of hypotheses. This paper is one part of the evaluation we are conducting. It only looks at the relevancy of the organization and the relevancy of the resources listed on the application. However, we plan to evaluate other parts of the application in future research papers.

Data collected to evaluate and improve the prototype is analyzed using bivariate analysis. This analysis will further answer questions of "utility, quality, and efficacy [of the mHealth prototype.]" (Hevner, 2004). The focus of this specific analysis is on usefulness. The survey asked 57 questions both about the user's own experience with information seeking with respect to mHealth resources, as well as the relevancy of the mHealth prototype. The survey was sent to people currently working for non-profit, clinics, and other organizations to help a group of people with common needs. These were the people we originally partnered with to do the initial research into what resources were commonly suggested in the area. In order to not influence the survey, we attached the survey to our prototype and shared with these people, who were asked to share it with other professionals and or coworker at their workplace. Therefore, there is not a recorded

count of how many people saw or reviewed the site. 61 people filled out the survey (Community Resources, n.d.) See appendix for survey.

Data Gathering

Data was gathered to evaluate and improve a prototype to provide mhealth resources to those in-need. The data was cleaned so that it included the demographic data, the data on who the respondents are serving, the data on mhealth usage, and finally the data on the relevancy of the prototype. In the demographics data the collected attributes are age, gender, years worked with their current non-profit, clinic, or organization, and zip code. The data about who the respondents are serving is specifically trying to see which demographics the organization is helping. This was a multiple-choice style question, so if it was a clinic that served anyone then they could specify that by selecting every option. The categories available for the respondents to pick from were low income, housing insecure, food insecure, refugees, immigrants, survivors of domestic violence, LGBTQ+, elderly, children, or other. The data on mhealth usage were questions about the respondent’s own use of mhealth tools as well as the respondent predicting the possible use of their clients. Lastly, the data about the prototype were questions about how relevant the organizations were and how relevant the resource categories were.

Observation and Results

A bivariate analysis was conducted to understand if there was an association between the relevancy and the social determinants of health. Most respondents to the survey were women (74% of respondents), who are white (79% of respondents), in their 40s (46% of respondents), who had worked for 10 or more years in the organization (56% of respondents). Many of the respondents served many different communities. 85% of respondents marked that they worked with low income populations. 59 % said they worked with survivors of violence. 59% marked that they worked with populations that identify as LGBTQ+. 62% marked that they worked with non-native English speakers. 64% marked that they work with children. 51% marked that they work with the elderly populations. 54% marked that they worked with people who are disabled or impaired. 44% marked that they work with people who have an addiction. 61% marked that they worked with populations that struggle with food insecurity. 62% of respondents marked that they work with populations that struggle with housing insecurity. 79% of respondents said they worked with minority populations. 64% of respondents marked that they worked with immigrants. 61% of respondents marked that they work with populations who are refugees. It also should be noted that when averaging category relevancy and organizational relevancy both were ranked about 61% relevant.

Initial results of multivariate analysis showed evidence of multicollinearity. This is why the variables were analyzed separately. The reason for this is to identify whether the organizations or the grouping of the categories is most useful in addressing health inequities. These results are illustrated in figure 3 below:

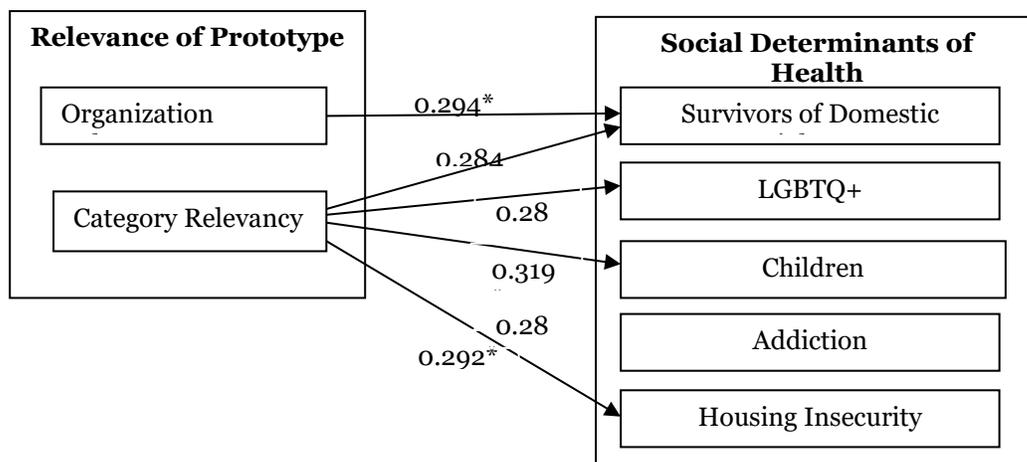


Figure 3

When testing for an association, respondents who serve survivors of domestic violence were shown to have a significant relation. This shows that there may be an association with those who work with survivors of domestic violence and the relevancy of the mHealth application. Marmot (2004) showed that when people have more access to materials to satisfy their basic needs, they had more empowerment in terms of material, psychosocial, and political dimension. This also makes sense because the mHealth application can be used discretely on your phone to find sanctuary nearby quickly, which might be favorable for those who are in domestic violence situations.

Figure 3 shows an association with those that work with populations who identify as LGBTQ+. This could be due to any number of factors. In this current area the rights of people who identify as LGBTQ+ are lacking in terms of adoption rights, housing rights, employment rights, anti-bullying rights in education, and health care rights. According to an LGBTQ+ right tracker, this area ranks low on the rights it affords to people who identify as LGBTQ+ (Movement Advancement Project: State Profiles, n.d.) Therefore, this mHealth application could be a way for those who identify as LGBTQ+ but fear their rights being affected to find healthcare that will understand and care for them in an equitable manner.

The categories would potentially be relevant for children or at least those that work with children. Due to the pandemic, mental health among children has been a major worry. This could potentially be a guide for a worried parent, guardian, or other adult in a child's life. It could potentially be a way for younger people, new parents, or new guardians to find resources to help their child.

There appears to be shows an association between the category relevance and addiction. Currently, the amount of smoking cessation covered by insurance is limited. Therefore, this mHealth application could be a way for those who struggle with addiction, whether it be smoking or other substances, to get help in quitting. This is an important result because addiction not only has to do with not being healthy but also has a mental health aspect too. It could potentially point to a way to use the application for more awareness of both mental and physical health.

There appears to be an association between category relevancy and housing insecurity. Housing insecurity is a major concern in this area. There are currently many resources for this, however people might not know where to find the resources. This is one of the many ways the mHealth application can help people access relevant information for their own health and wellbeing.

Kahn et al. (2010) describes that misinformation is a detriment that can impact an application's usefulness. The results showed that this application associated with relevance for those who are survivors of violence, identify as LGBTQ+, are children or work with children, have an addiction, and/or are insecure in housing. For mHealth to be impactful for different people who have different social determinants of health, the mHealth application has to be organized in a logical manner and has to present information that is relevant. If the information is not organized or relevant than this presents a threat of misinformation. Alder and Newman (1998) have numerous recommendations, but one of their suggestions is to have researchers show how alterations can impact health outcomes in order to benefit society. If an mHealth application can help people more accurately and effectively find health resources, it would impact someone's own empowerment and ownership of their own health (Clarke et al., 2020; Clarke et al., 2021; Qureshi & Xiong, 2019; Kiemde et al., 2021). Using Hevner (2004)'s design science, any application can be tested, improved upon, and researchers can show models of how to improve an application to be more equitable.

Future Research, Implications for the mHealth application, and Limitations

In creating an mhealth application the goal was that it enables people of all social determinants of health to access resources in their communities. It is a portal that will help people find resources that are close to them and see if they are eligible for aid from those resources. Clarke et al. (2020) showed that mHealth could give more women and younger adults access to resources. Similarly, the results show that the relevancy of the resources categories are associated with those who work with children. This shows that this

mHealth application, while being available for all, will be relevant for those who cannot currently access ideal health outcomes.

This relevance of the organization on the prototype has only been evaluated by a local community. The prototype is currently being updated so it can find resources for users throughout the United States. Once the next version of the prototype is deployed, we will reiterate this test to ensure the organization and the resources are still relevant to the general population in the United States. Social determinants of health have been applied to a general population (Adelman, 2008; Marmot, 2007; Castañeda et al.; Adler, 2002; CDC, 2018; APA, 2020; Clarke et al. 2021). Therefore, in future research we will examine whether the users can activate knowledge in a similar fashion despite being from different areas in the United States.

The results show that only a few groups of population's in-need might find the mhealth application relevant to their specific struggle. This begs the question is there a way to improve mHealth application to help more people? At this point there are a few conclusions that could be made: (1) there are many people in this area who are housing insecure, children, LGBTQ+ and addicts; (2) there is not enough data; (3) there are improvements needed to make our mhealth prototype more accessible to people who are refugees, immigrants, part of a minority populations, food insecure, disabled or impaired, elderly, non-native speakers, survivors of violence, and or low income. Therefore, some potential improvements could be to use tags in order to search for resources that are filtered for those who suffer from multiple problems. Kiemde et al. (2021) note that if someone has one issue related to social determinants of health, they most likely will have more issues.

Other improvements that could be made is to translate the application into other languages. Many responders suggested this. This makes sense, especially because the area that is currently being tested is an area that refugees are normally relocated to. Therefore, the language recommendations need to be kept in mind while improving the prototype.

This has implications for policymakers in the local community too. Policymakers could use this information to further research the social determinants of health within the local area and how to develop more programs to help more people. Our application showed association with survivors of domestic violence, LGBTQ+, children, addiction, and those who are housing insecure. Therefore, policymakers and developers near this location could focus on a way to distribute resources to these populations via a mHealth application or another form of mHealth information distribution.

Conclusions

In conclusion, this paper investigated how an mHealth application can address social determinants of health. The social determinants of health that were seen had an association with the relevance of the mHealth application were mainly survivors of domestic violence. However, it was also shown that populations who identify as LGBTQ+, children, populations who have an addiction, and populations who are insecure with housing are associated with category relevancy. This shows that the application has the organization of the resources arranged in a useful manner.

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