

# Mobile Health Applications Interventions For Prediabetic State: Protocol of Systematic Review

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## Study protocol

**Keywords:** mHealth, Prediabetes, Intervention, Systematic Review, Meta-analysis.

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# Abstract

**Background:** Individuals with prediabetic state are much more likely to develop Type-2 Diabetes Mellitus (TD2M) 4 times greater than those with normal glucose tolerance. Lifestyle changes such as daily physical activity and healthy diets can decrease the risk of prediabetic state. Mobile applications intervention could be one of the solutions to improve self-management awareness and compliance of prediabetic state intervention. There are no studies in systematic reviews of mobile phone applications intervention to prevent prediabetic state yet. Therefore, the objective of this study was to collect and summarize the evidence from randomized controlled trials (RCTs) exploring the effectiveness of mobile phone applications for intervention in prediabetic state patients.

**Methods:** This protocol was prepared in accordance with the preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) statement. The database that will be used includes PubMed, ProQuest and EBSCO with date restriction between January 2007 and July 2019 in English language only. Identification of articles will be done independently by three reviewers through the title of the articles, reviewing the abstract, and then the full-text-article. Any disagreement will be resolved by consensus. The quality assessment and possible risk of bias will be evaluated using forms adapted from the Jadad score. Extraction and content analysis will be performed systematically. Quantitative data will be presented graphically via forest plot with 95% confidence intervals. Where possible we will explore the heterogeneity and continue to conduct meta-analysis using RevMan software package.

**Discussion:** Changes in lifestyle, such as daily physical activity and a nutritious diet, can help to reduce the risk of prediabetes. Mobile phone applications, including health-related applications, is demonstrated to have a lot of promise in terms of providing tailored medical recommendations.

**Conclusion:** The proposed systematic review and meta-analyses will allow us to obtain the evidence exploring the effectiveness of mobile phone applications for intervention in prediabetic state patients.

**Systematic review registration:** This protocol has been registered in the Prospective Registry of Systematic Review (PROSPERO) database (**CRD42021243813**).

## Background

Prediabetic state is defined as Impaired Fasting Glucose (IFG), Impaired Glucose Tolerance (IGT) or both, and/or increased levels of Hemoglobin A1c (HbA1c) (1). The prevalence of IGT in 2015 about 318 million globally and predicted to increase by year 2040, about 481 million cases (2). The prevalence of prediabetic state in Indonesian adults in 2013 raise 36,6%, which is grows quickly from 10,2% in 2007 (3).

Prediabetic state can lead to diabetic state if it not well managed. Individuals with prediabetic state are much more likely to develop Type-2 Diabetes Mellitus (TD2M) 4 times greater than those with normal glucose tolerance (4). Prediabetic state can cause serious complication either through T2DM condition or not. In prediabetic state patients, the incidence of microalbuminuria is roughly twice that of normal

subjects which can be associated with serious complications such as chronic kidney disease (CKD) and macrovascular disease. In the other hand, prediabetic state can lead to different types condition of diabetic neuropathy: peripheral neuropathy, polyneuropathy, small-fiber neuropathy, and autonomic neuropathy (5).

Lifestyle changes such as daily physical activity and healthy diets can decrease the risk of prediabetic state, enhance the health of individuals with diabetes and discourage complications (6). Lifestyle modification is commonly conducted through consultations with health care professional at medical facilities. Moreover, personal coaching for physical activity interventions and personal consultations for healthy diet interventions are not widely available. So that, mobile applications intervention could be one of the solution to improve self-management awareness and compliance of prediabetic state intervention such as lifestyle modification and healthy diets (7).

Mobile ownership has been increase, with an estimated 90% of the world's population owning a mobile phone in 2020. As mobile phone ownership rapidly proliferates, so grows the number of mobile phone software applications including mobile health applications (8). Mobile phone applications for health intervention are more advantageous because they are cheaper, more convenient, and more interactive (9). It has been used in either developed or developing countries and has shown great potential to provide personalized medical advice (7). As we know, there are no studies in systematic reviews of mobile phone applications intervention to prevent prediabetic state yet. Therefore, the objective of this study was to collect and summarize the evidence from randomized controlled trials (RCTs) exploring the effectiveness of mobile phone applications for intervention in prediabetic state patients.

## Methods

### Study Design and Research Sample

This protocol was prepared in accordance with the preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) statement (Additional file 1) (10). This protocol has been registered in the Prospective Registry of Systematic Review (PROSPERO) database (**CRD42021243813**). We will be performed the systematically search process in several medical databases including PubMed, ProQuest and EBSCO. The scope of the search will be restricted to the publication published between January 2007 and July 2019 in english language only.

Database searching done by entering these following keywords: ((prediabetic state AND (minimize risk factor OR physical activity OR body mass index OR weight loss OR healthy diet OR smoking OR alcohol consumption) AND (mobile phone application OR mobile phone app OR telemedicine OR telehealth OR mobile health OR health, mobile OR health OR mobile)).

### Inclusion and exclusion criteria

The inclusion criteria of the included studies were as follows: (1) participants had prediabetic state with criteria according to American Diabetes Association (ADA), including, impaired fasting glucose (IFG) 5.6–6.9 mmol/l, impaired glucose tolerance (IGT) 7.8–11.0 mmol/l, or HbA1c (hemoglobin A1c) 5.7–6.4% without history of T2DM and diabetes medications (insulin or oral anti hyperglycemic agents); (2) participants were 18 years of age or older; (3) the study included interventions that used mobile application as a major component; (4) lifestyle modification (e.g., physical activity and healthy diets) were provided by the applications; (5) the study measured the participants' glycated hemoglobin (HbA1c), weight, fasting blood sugar, body mass index, or other health-related outcomes; (6) the study was randomized controlled trial (RCT); and (7) the full-text of article was available. If one or more inclusion criterias were not met, we excluded such studies.

## Study selection

Search results will be initially uploaded into the citation management database. Duplicate across the search will be identified and removed using this reference manager. Identification of articles will be done independently by three reviewers (YAJ, RN and DDE) through the title, continued by reviewing the abstract, and then the full-text form. Full articles of potentially relevant studies will be retrieved for detailed evaluation by all authors. In case of a disagreement, decision will be reached by consensus.

## Data Extraction

Two reviewers (RN and DDE) will be independently extracted data from the included studies into an excel table spreadsheet. Those data will be extracted included details of the studies such as author, year of study, country, sample size, study design, details of intervention and control, outcomes of interest, and the key results. Wherever possible, adjusted relative risk (RR) or equivalent and associated 95% CI will be extracted directly from studies. If the desired data had not been reported in an article, we will contact the corresponding author of the article to retrieve any missing data.

## Quality assessment

Two reviewers (RN and DDE) will independently assess the quality and risk of bias of the included studies using adapted form of Jaddad score (11). In case of dispute, the third author (YAJ) will be participated in the discussion to help resolve any disagreement.

## Data analysis

A random effect model will be used as a conservative approach as data is expected to vary across studies. Heterogeneity will be tested using the chi-squared statistic, where a *P* value less than 0.1 will be regarded as significant heterogeneity. Other assessments of heterogeneity will include  $I^2$  ( $I^2 \geq 75\%$  equates to high heterogeneity) and visual inspection of the forest plot for inconsistencies in effect sizes and their confidence intervals. If data permit, we will pool the relative effect using Review Manager (RevMan) software from Cochrane Library.

## Discussion

One strategy to reduce the risk of diabetes mellitus is to intervene early in the development of prediabetes. Changes in lifestyle, such as daily physical activity and a nutritious diet, can help to reduce the risk of prediabetes. Mobile phone applications, including health-related applications, have recently become part of daily life. It has been applied in both developed and developing countries, and it is demonstrated to have a lot of promise in terms of providing tailored medical recommendations.

## **Conclusion**

Technologies (e.g., internet, email, and mobile phone applications) can provide practical inexpensive and scalable solutions to traditional face-to-face procedures, this could also be applied in prediabetic state patients especially to promote lifestyle modification in order to further decrease the incidence of diabetes mellitus. The proposed systematic review and meta-analyses will allow us to obtain the evidence exploring the effectiveness of mobile phone applications for intervention in prediabetic state patients.

## **List Of Abbreviations**

ADA

American Diabetes Association; BMI:Body Mass Index; CKD:Chronic Kidney Disease; DPP:Diabetes Prevention Program; HbA1c:Hemoglobin A1c; IFG:Impaired Fasting Glucose; IGT:Impaired Glucose Tolerance; PRISMA:Preferred Reporting Items for Systematic Reviews and Meta-Analyses; RCTs:Randomized Controlled Trials; SMS:Short Text Message; TD2M:Type-2 Diabetes Melitus; WHO:World Health Organization.

## **Declarations**

### **Ethics approval and consent to participate**

Not applicable.

### **Consent for publication**

Not applicable.

### **Availability of data and materials**

Not applicable.

### **Competing interests**

The authors declare that they have no competing interests.

### **Funding**

The authors have no funding source to declare.

## Authors' contributions

YAJ was responsible for the formulation of research question, design the main conceptual ideas; drafting the manuscript; RN and DDE assisted with the formulation of the research question, wrote the manuscript in consultation with RNA; YAJ, RN and DDE performed the research, analysis and interpretation of data; LL and HKJ commented on manuscript drafts. All authors read and approved the final manuscript.

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