

Smartphone and Preventive medicine in young adults. A systematic review.

*Draft, the full results will be presented during conference.*

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### **Purpose of review**

Smartphones are ubiquitous among adolescents and young adults. Thus, may be perceived as a potential tool for preventive medicine thru usage of many mobile health applications. There is a potential area for the public policy that may assure a higher level of self-awareness in taking care of health and thus achieve an overall improvement in the quality of health in general population.

### **Recent findings**

This review demonstrates vast area of use of smartphones as a tool for Preventive medicine among. There is a growing number of examples of smartphone for medical and health related applications, analysis of which may allow to implement the initial assumptions and guidelines for potential state activities in this area. The analyzed research articles allow for a better understanding of this phenomenon and get to know it in a broader context. A literature review, from the last decade, allows you to build a cross-sectional picture of the situation, covering the main directions of application of smartphones for the purposes of health prevention and the challenges and limitations associated with this technology.

### **Summary**

Developed of smartphone applications, for the purpose of health prevention, is focuses on issues such as diet and healthy eating, an active lifestyle, sexual safety and addiction prevention. Additional research is needed to better understand the impact of massive usage of smartphone health prevention apps on general public health as a long-term process. It should be noted that the issue of risks related to data security and potential negative consequences and responsibility for the security of sensitive users' data is poorly recognized in the studies published so far. What seems to be an argument for actions in the field of public policies – including regulatory policies, in this area.

### **Points for Practitioners:**

### **Keywords:**

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Preventive medicine; young adults; smartphone; app; application; mHealth

## **Introduction:**

### Background

The smartphone is one of the basic tools for communication and information retrieval nowadays. It is also an example of a widely accessible and widely used technology. With a wide range of sensors and the possibility of installing additional applications, its functionality can be extended and modified. It is also the easiest and most handy device for control of the Internet of Things (IoT), especially for wearable devices (Steinhubl et al., 2015). Because of all that the smartphone is perceived as a potential tool for preventive medicine among many other mobile health (mHealth) applications (Kankanhalli et al., 2019).

Consequently, the smartphone is being used, with or without wearables, such as smart wristbands, or smartwatches, for monitoring and collecting numerous health related data such as: blood pressure, heartbeat rate, pulse, mood monitoring and other. This may be potentially beneficial for both well-being and health condition of individual users and the public health system (Krishna et al., 2009). Nowadays, most of the research is focused on how the smartphone may be used for health care, preventive medicine and prophylaxis for the elderly. There is a wide variety of examples of new ideas how it can be done and a lot of research on what the results of those attempts are (Y. Zheng et al., 2014). One of the major issues for using mHealth related technology for health related solution for the elderly, shown in a great deal of the conducted research, is a technology gap. Older people need to put a lot of effort to learn how to use new apps and new devices, each and every change in a app design, or a new app requires additional training. Nevertheless, the smartphone is considered (as an easy to access) a useful tool for preventive medicine and prophylaxis for older generations.

But young adults, the Z generation, are considered to be digital natives. The smartphone is not a new technology for them, it is rather a fundamental, everyday device, an essential part of everyday equipment (Azhar & Dhillon, 2016). For this reason it is much easier to use this technology for preventive medicine in this group (Gowin et al., 2019; Patel et al., 2015).

### Objective

The aim of this study is to provide a comprehensive view of the literature on the phenomenon of using a smartphone for preventive medicine in group of young adults (mHealth preventive medicine). The author intends to synthesize the studies devoted to this matter and map out their findings in regard to indicate possible factors of habit changes. This approach is based on the assumption that preventive care programmes may potentially permeate all aspects of private and social life (Verweij, 2000), thereby smartphone as essential daily used device, may be as well a tool for health literacy and self-health control.

### **Methodology**

A systematic review is being conducted in terms of papers indexed in Web of Science, PubMed/MEDLINE. The author performed a scoping literature search to identify relevant papers published between January 2010 and January 2020 with the use of specific keywords in combination (table 1). Search exclusion criteria included citations not in the English language, lack of abstract availability and not defined as a journal article. The collected material (946 articles) was being analysed with the qualitative data analysis methods - content analysis by using MaxQDA software. A narrative synthesis of all studies was being undertaken.

Table 1. Searched terms used in research

<b>Terms related to health and prevention</b>	<b>Terms related to telephones</b>	<b>Narrowing term</b>
eHealth	smartphone*	young adult*
mHealth	cell Phone*	
health prevention	iphone*	
preventive medicine	mobile app*	
preventative healthcare		
preventative medicine		
prophylaxis		

The following searched criteria were refined by:

- Databases:
  - Web of Science Core Collection (941)
  - MEDLINE (937)
- Document types: article
- Languages: english
- Timespan: 2010-2020

In order to identify research articles, that are related to the core topic of this paper, following search terms, in title and abstract, was conducted:

(from All Databases)

You searched for: TS=(((smartphone\*) OR (cell phone\*) OR iphone\* OR (mobile app\*)) AND ((health OR mhealth OR (health prevention) OR (preventive medicine) OR (preventative healthcare) OR (preventative medicine) OR (prophylaxis)) AND (young adult\*)))

Refined by: Databases: ( BCI OR CCC ) AND DOCUMENT TYPES: ( ARTICLE ) AND Databases: ( WOS OR MEDLINE ) AND LANGUAGES: ( ENGLISH )

Timespan: 2010-2020. Databases: WOS, BCI, CCC, DRCI, DIIDW, KJD, MEDLINE, RSCI, SCIELO, ZOOREC.

Search language=Auto

Results: 946

Disclaimer. There is an important issue of the terminology – the definition of preventive medicine, that must be address in in order to select articles in terms of their adequacy to the analysed issue. In general literature there

are three main terms that may be used with regard to of the issue in question: “health promotion”, “preventive medicine” and “prophylactic care”. According to World Health Organization (WHO) health promotion is a process whose purpose is to increase healthy behaviours and grow of health literacy in order to empowe people to increase their control over their health (*Ottawa Charter for Health Promotion*, 1986). In turn, the concept of “preventive interventions” should be translated as directed at people who are not ill (yet). The purpose of prevention is to reduce the number of people that will suffer from certain manifest diseases (Verweij, 2000). But according to Clark and Leavell (Leavell & Clark, 1965)there are three types of prevention, and from those only type one is related to people how are not ill (Hensrud, 2000):

1. *Primary prevention*, illness is prevented by influencing the causal factors of disease (disease does not occur).
2. *Secondary prevention* is the elimination, arresting or slowing down of a disease process by means of early detection and treatment.
3. *Tertiary prevention* aims at a reduction of the risks of deterioration or recurrence of diagnosed and manifest diseases.

The third term “prophylactic care” is the most extensive one. There are four levels of prophylactic care of which only level one the “Primary Prophylaxis may be addressed to people who are not ill. The goal of first level prophylactic is to prevent or increas resistance to disease that has not occurred. Therefore, the term “prophylactic care” seems inadequate in relation to the objectives of the study in question.

In conclusion, for the purpose of this research, the term preventive medicine a pro-active enterprise is understood as interpreted by Verweij as the same as primary prevention – as the protection against these causes of illness, according to the words of which „the removal of causes of illness, and protection against these causes can be considered as the ideal of preventive medicine.” The aim is to make people aware, see and avoid risks in order to protect health. (Verweij, 2000). This resonated with the opinion expressed by Hensrud that „preventive medicine, defined as the maintenance and promotion of health and the reduction of risk factors that result in injury and disease.” (Hensrud, 2000).

The other term that requiring clarification is “young adult” this concept is quite vague and interpreted differently by researchers and interchangeably used with the concept of adolescent in the scientific literature. Young adult or the older adolescent group includes people in the age range between 15 to 29 years of age (Kufe et al., 2003, p. 6). But depending on author age range limits may vary and the United Nations, defines ‘youth as those persons between the ages of 15 and 24 (Secretary-General’s Report to the General Assembly, A/36/215, 1981). An interesting concept of the division of age groups was proposed by Nancy M. Petry who defines young adults as people of ages between18-35 years (Petry, 2002). This range, after a preliminary analysis of the collected research material, seems to be the most adequate for the purposes of this study, as the most common one.

The first stage of the research consisted in analysing the content of abstracts of all identified texts using the MaxQDA software. In order to narrow down the material, the following negative selection criteria were adopted:

- the incompatibility of the age group, or the lack of narrowing down to a specific age group;
- articles not related to the subject of preventive medicine, according to the accepted definition of this term, were excluded.

The second stage involved the analysis of a pre-narrow group of articles as part of this phase, abstracts of selected articles were read (344) in terms of the topic of research and the technology solutions used. As a result, there were 124 documents left at first. The process of exclusion process covered issues such as:

- articles not related to the group of young adults (ages 18-35) were excluded;
- articles in which the smartphone was used only as a research tool to collect data;
- special cases, such as a group of colourful young male adults, from a selected district of the city;
- papers devoted to solutions in the field of eHealth but concerning the therapy process (both treatment of the disease and support for the patient during and after convalescence);
- studies that uses the phone to track and contact the group not as a solution addressed to this group;
- papers not based on primary data (not original research);
- research which data were collected before 2005, as irrelevant from perspective of modern smartphone technology;
- research in which smartphone or a phone was used as text message solution – as outdated;
- papers unrelated to the subject matter.

As a result of the process of exclusion there were only 45 papers left for the final stage.

The final stage of research consisted in analysing the content of entire articles (45 papers) in order to determine the nature of the solution used and assess its value.

**Table 2. conclusions from the analysis of selected texts**

<b>Title of paper</b>	<b>authors</b>	<b>country of origin</b>	<b>journal</b>	<b>theme / type of solution - short description</b>
Determinants of use of mobile phones for sexually transmitted infections (STIs) education and prevention among adolescents and young adult population in Ghana: implications of public health policy and interventions design	(Alhassan et al., 2019)	Ghana	Reproductive Health	This study assessed mobile phone usage among adolescents and young adult populations pursuing tertiary education and their use of these technologies in the education and prevention of STIs.  The goal of this study was to determine the most suitable solution for STIs education and prevention among young adults
Crush the Crave: development and formative evaluation of a smartphone app for smoking cessation	(Baskerville, Struik, & Dash, 2018)	Canada	JMIR Mhealth Uhealth	The aim of this was to describe the process of developing an app to support smoking cessation in young adults
Effect of a mobile phone intervention on quitting smoking in a young adult population of smokers: randomized controlled trial	(Baskerville, Struik, Guindon, et al., 2018)	Canada	JMIR Mhealth Uhealth	The aim of this study was to determine the efficacy of an evidence-informed smartphone app for smoking cessation, Crush the Crave (CTC), on reducing smoking prevalence among young adult smokers in comparison with an evidence-informed self-help guide.
Exploring elements of fun to motivate youth to do cognitive bias modification	(Boendermaker et al., 2015)	The Netherlands	Games for health journal: Research, Development, and Clinical Applications	This study assessed three approaches for the problem of heavy drinking among young adults, which may enhance user experience and motivation to train: a serious game, a serious game in a social networking context, and a mobile application. The goal of those approaches is to prevent severe health risks of abuse of alcohol.

**Table 3. conclusions from the analysis of selected texts - part 2**

<b>Title of paper</b>	<b>research method</b>	<b>main conclusions from the study</b>	<b>solution for all / selected group</b>	<b>type of solution</b>
Determinants of use of mobile phones for sexually transmitted infections (STIs)	cross-sectional analytical study among 250 adolescents and young adults aged 18–24. Data was collected using structured	male young adults (Coef. = 1.11, p = 0.000) and young adults who owned a smartphone (Coef. = 0.46, p = 0.013) were	All but study conducted an a small scale group -	Smartphone app for Informational and educational use

education and prevention among adolescents and young adult population in Ghana: implications of public health policy and interventions design	<p>questionnaire and data analysis done with STATA (version 12.0). Univariate probit regression (VCE, Robust) analysis was used to determine factors associated with adolescents and young adult population's usage of mobile phones in the education and prevention of STIs.</p> <p>Research conducted in July 2016.</p>	<p>more likely to use mobile phones for education and prevention of STIs - 101 (40.1%) indicated mobile applications as the appropriate mobile phone function for STIs education and prevention</p> <p>A mobile phone programme for STIs education that uses mobile application appears feasible, acceptable sustainable over time for adolescents and young adults.</p> <p>Public health education on STIs should incorporate statutory eHealth and mHealth components to promote acceptability among the youth</p>	250 students from Ghana's premier and biggest public university - the University Ghana, Legon.	
Crush the Crave: Development and formative evaluation of a smartphone app for smoking cessation	<p>The Spiral Technology Action Research (STAR) 5-cycle model (listen, plan, do, act, and study) was employed. 4 focus groups with young adult smokers (n=78) across 2 phases, analysis of the content of existing apps, 2 sessions with content experts, and Google Analytics to assess user behavior during a 12-month pilot.</p> <p>Research conducted between 2013 and 2014</p>	<p>Recommendation for app in terms of usability expected by users (1) positive reinforcement, (2) personalization, (3) social support, (4) quit support, (5) tracking the behavior, and (6) tracking quit benefits.</p>	smokers	Smartphone app supporting behavioural change
Effect of a mobile phone intervention on quitting smoking in a young adult population of smokers: randomized controlled trial	<p>A parallel, double-blind, randomized controlled trial with 2 arms. In total, 1599 young adult smokers (aged 19 to 29 years) intending to quit smoking in the next 30 days were recruited online and randomized to receive CTC or the control condition self-help guide, On the Road to Quitting (OnRQ) for a period of 6 months. The primary outcome measure was self-reported continuous abstinence at the 6-month follow-up.</p> <p>Research conducted between 2014 and 2015</p>	<p>CTC was feasible for delivering cessation support but was not superior to a self-help guide in helping motivated young adults to quit smoking.</p> <p>There is a need for further research to understand how digital mobile technology for smoking cessation can be improved.</p>	smokers	Smartphone app supporting behavioural change
Exploring elements of fun to motivate youth to do cognitive bias modification	<p>In the Game Study, 77 participants performed a regular CBM training, aimed at response matching, a gamified version, or a placebo</p>	<p>The mobile training appeared to increase motivation to train in terms how often participants trained, but this effect</p>	all	

	version of that training. The gamified version was presented as a stand-alone game or in the context of a social network. In the Mobile Study, 64 participants completed a different CBM training, aimed at approach bias, either on a computer or on their mobile device.	disappeared after controlling for baseline motivation to train. Adding (social) game elements can increase motivation to train.		

**Table 3. conclusions from the analysis of selected texts - part 3**

<b>Title of paper</b>	<b>commitment indicator</b> passive vs active participation (or descriptions)	<b>type of action</b> change of habit / tracking habits / informational / health education / supporting (social environment, gamification, ...) / monitoring / reminder / security / disease screening / self-management	<b>involvement of state actor</b>	<b>conclusions</b>
Determinants of use of mobile phones for sexually transmitted infections (STIs) education and prevention among adolescents and young adult population in Ghana: implications of public health policy and interventions design	Active – participants has to search for information	informational / health education	non	There is the willingness and interest to use mobile phones for health related materials. In this example for STIs education and prevention. Young adults search for such information by themselves, the most adequate method of delivery, most suitable one, for this group are mobile apps  The paper does not address the issue of security of information circulation and the risk associated with the leakage or theft of user data.
Crush the Crave: Development and formative evaluation of a smartphone app for smoking cessation	Active	change of habit– app features include: a customized quit plan, the tracking of cravings and smoking habits, notifications of money saved and health improvements achieved, direct	The US Clinical Practice Guidelines were used	The app use US Clinical Practice Guidelines (USCPG), which serves as the current standard in smoking cessation interventions. There is a need for solutions that are proved to work, and based on medical standards. There is a chance of state originated or state supported standards and solutions that might help to create apps



		dial-up to telephone-based support, virtual awards that credit performance toward reaching milestones, evidence-informed credible, and the ability to connect with a community of people for social support via social media		that might help young adults to quit smoking.  Apps for smoking cessation may be considered as another tool to help decrease smoking habit among young adults.
Effect of a mobile phone intervention on quitting smoking in a young adult population of smokers: randomized controlled trial	Active	change of habit – CtC app described above	non	Smartphone apps may not serve as useful alternatives to printed self-help guides. This technology has a potential application, but existing solutions require further research and development.
Exploring elements of fun to motivate youth to do cognitive bias modification				

## **Findings**

The scientific literature devoted to the use of smartphones for the purposes of health prevention is dominated by works devoted to the issue of solutions designed for sick people, and only a small part concerns health prevention, shaping habits and attitudes. Research on prevention medicine of young adults is dominated by the following research directions:

- - limiting the consumption of stimulants - such as alcohol or tobacco
- - healthy eating
- - sport and physical activity

type of solution identified in reviewed papers:

information / supporting diagnostics / supporting change, shaping the habit

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