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# EFFECT OF MOBILE HEALTH APPLICATIONS ON PHYSICAL ACTIVITY IN OUTDOOR SPACES

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***Abstract*—Recent studies indicate that every outdoor physical activity has positive effect on public health and quality of life of every individual [6]. The growth in wireless subscriptions, which has reached over 6 billion wireless subscribers in the world, shows that the use of Information and Technologies (ICTs), more precisely mobile applications intended for improving health and well being (mobile health applications-M-health apps) has become an integral part of everyday urban city life [16]. The aim of this research is to establish the connection between the use of emerging M-health apps and outdoor physical activity, public health and well-being of citizens. Important research questiones that guided this study are: Does the use of M-health apps have a positive influence on increasing outdoor sport and recreation activities; How could open public spaces be re-designed in order for people to use them more frequently for recreational activities; Which are the possible ways for upgrading the M-health apps to be more user friendly. The methodology is based on extensive literature review and critical analysis of existing theoretical researches. Quantitative as well as qualitative data presented in this paper is obtained by using the methods of interviews and questionnaire conducted with 300 selected stakeholders from Belgrade. The results of the research are showing general level of physical activity, recreation preferences and habits of citizens in Belgrade, with special focus on the manner, degree and frequency of use of both M-health applications and outdoor spaces. Special contribution of this paper is manifested in presenting the positive effects of M-health apps on increasing outdoor physical activity of users in Belgrade, but also in providing specific gueidilines regarding improvement of M-health apps and open public space design acording to users' suggestions.**

## I. INTRODUCTION

According to World health Organization non-adequate physical activity is considered as an important issue regarding public health, especially in urban city areas with great population, such as Belgrade. A large number of researchers reached the conclusion that any physical activity in the open air has a positive effect on the health and well being of individuals, significantly reducing the level of stress and obesity, therefore improving overall quality of urban life of citizens [1,2,3,4,5,6]. Open public spaces, with good maintainace and equipment can be used for sport and recreation and could play an important part in the sphere of public health [7].

In present time, use of Information and Communication Technologies have become integral part of everyday life in any major city. Today, use of mobile apps is shaping the way we perceive the world around us and can be of great significance in overlapping virtual and real surroundings while constantly increasing available information and possibility for interactive development. The focus of this research is on the special type of mobile applications, more particularly on the effect of mobile health apps (M-health). They are defined as a mixture of smart mobile technologies, medical sensors and ICTs [7,8,9]. M-health combine e-health and smart phone technologies [10].

## II. MOTIVATION

Main motivation for this research was to identify the possible ways for increasing outdoor physical activity and well being of citizens in Belgrade, with the help of ICTs and mobile health apps. For the purpose of this paper, background research has been focused on analysis of existing researches and extensive literature review. Recreation in open space is crucial component of any society's quality of living; Recent studies indicate that every form of recreation in the open public space influence positively on health and wellbeing of an individual, as well as on general quality of life [11]. The open space model provides places for activity, recreation, social engagement and enjoyment. It contributes to the social and environmental health of the community, providing a sustainable surroundings [12]. At the same time, interest of healthcare organizations and experts for promoting the prevention of health and manners of healthy behavior among citizens is rising [13,14] which certainly represents a major turn in the implementation of M-health applications for promoting health and healthy living.

Mobile health utilizes technology, such as smartphones, to observe and improve quality of public health. According to recent researches [15] approximately one in five users of smartphone utilize at least one M-health application (app) to boost their goals related to health, and 38% of users of health application have downloaded at least one app for physical activity (PA). Nowadays M-

health apps serve a wide variety of purposes, such as help in smoking cessation, weight loss programs, monitoring diet and physical activity, medical treatments, and management of disease [16]. The main advantages of using mobile phones and similar technologies for monitoring health are that devices like this are personal, intelligent, connected, and always with people [17].

However, in this research main goal is to analyze the effect of M-health apps on the level of outdoor physical activity of users in Belgrade, and to examine how both outdoor spaces and M-health apps could be improved. The majority of these applications are activated by phone motion, in other words, the movement of users offers the following information: the length of the route distance in kilometers, height difference, calories burned, and a variety of daily, weekly, monthly and annual reports. Application may also warn users on insufficient physical activity during the day. Some operating systems such as IOS, used by Apple devices have a version of the application incorporated in each mobile device.

The usage of mobile health applications has not yet been the subject of research in our region, therefore, this paper starts from the assumption that the usage of M-health applications in our region increases with the increased usage of smart technologies and devices, in other words the use of M-Health applications can have positive influence on the increase physical activity by the user of application, on the territory of Belgrade.

With current technological advances smartphones offer wide variety of opportunities for the expansion and growth of M-health applications, using them to record PA, and to motivate people to get more involved in PA [18]. In this research focus was on self-monitoring applications of physical activity (PA), particularly those free and accessible for users on territory of Belgrade.

## III. RESEARCH QUESTIONES

First step in this research was to identify three main research questions: Does the use of M-health apps have a positive influence on increasing outdoor sport and recreation activities; How could open public spaces be re-designed in order for people to use them more frequently for recreational activities; Which are the possible ways for upgrading the M-health apps to be more user friendly.

According to the International Telecommunication Union 95% of global population is covered with mobile service. Due to the expansion of smartphones, 3G and 4G network the use of applications is constantly increasing [19]. Mobile devices have reached more people in many developing countries than power grids, road systems or water works, offering possibility to improve healthcare system, with a tremendous opportunity for developing countries and communities to advance. It is also worth mentioning that governments are expressing interest in M-health apps as a complementary strategy for strengthening health systems and achieving the health-related Millennium Development Goals (MDGs) in low and middle-income countries. A study published in the Journal of Medical Internet Research shows that 58 % of surveyed mobile phone users have downloaded at least one mobile health app onto their device and that exercise and nutrition were the most likely areas of mobile health apps downloaded. Regarding recent studies and trends in using ICTs and mobile apps in everyday life, M-health apps are in expansion and are mainly used by citizens in urban areas [20]. In previous researches that had been done by different authors [21] was stated that mobile technologies cannot physically carry drugs, doctors, and equipment between locations, but they can carry and process information in many forms. The crux of M-health apps is in the exchange of information, which can ease collecting data in the field of healthcare [22].

## IV. METHODOLOGY

In this research special attention was brought on methodological process, consisted of both quantitative and qualitative analysis, based on participative and collaborative approach-interview and questionnaire (involvement of users). Method such as content analysis and expert observations were also used during the research. Having in mind the general aim of the research the methodological process was divided into several steps: 1. extensive literature review; 2. selection of stakeholders; 3. developing and conducting the survey; 4. collecting and presenting the results. Extensive literature review consisted out of content research regarding current trends in M-health apps development and outdoor recreational activities, presented in first part of the paper. Furthermore, background research served as a knowledge base for developing the survey.

### *A. Selection of stakeholders*

In total, more than 300 people contributed to this research. Stakeholders participated in interviews and/or questionnaire analysis. Criteria for choosing the participants were: different age, gender, education, habits, level of physical activity, etc. Stakeholders were chosen from the selected location of open public spaces in Belgrade commonly used for sport and recreational activities We identified 6 key locations: 1. Sava riverfront, 2. Danube riverfront, 3. Ada Ciganlija, 4. Kalemegdan park, 5. Tašmajdan park and 6. Olimp (Figure 1).

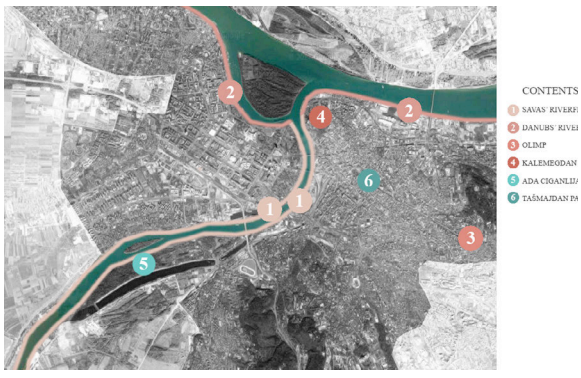


Figure 1. Position of 6 key location used for conducting the survey

### B. *Developing and conducting the survey*

The survey was consisted out of direct interviews and questionnaire analysis of stakeholders, conducted in the period of 15 days during July and August 2016, at aforementioned locations. Interviews were conducted before, during and after questionnaire analysis. They provided important information regarding research topic and served as a basis for developing specific questions. Furthermore, qualitative data from the interviews was used while defining suggestions for development that are given in next paragraph.

Second phase of the research was questionnaire analysis divided into two parts with approximately 22 questions. Questions for both interviews and questionnaire were based on background research and methods of expert observation of users behavior in open public space. First part (General part) was consisted out of questions about participants, their age, gender, activity and recreational and sport habits. Second part (Special part) is focused on specific questions about the use of M-health apps, connection between these apps and level of physical activity and use of open public spaces. Regarding this part special attention was brought on users perception on possible development of the M-health apps and open public spaces.

## V. RESULTS

The Results gathered from the participants regarding general data (Figure 1) showed that majority of the participants were actively involved in sports (52%) while 74% of all users said that they are still indulged in physical activity. Almost 25% of the participants claim that they exercise 2-3 times a week, approximately 20 to 30 minutes (46%).

**Questionnaire results- GENERAL part**

| | question | response | number | percent% |
|---|---|---|---|---|
| 1 | Were you ever actively engaged in sports? | yes | 157 | 52.33 |
| | | no | 143 | 47.67 |
| 2 | Are you indulged in any physical activity now? | yes | 222 | 74 |
| | | no | 78 | 26 |
| 3 | How often do you exercise? | daily | 47 | 15.67 |
| | | 2-3 times a week | 75 | 25 |
| | | on the weekends | 51 | 17 |
| | | few times a month | 35 | 11.66 |
| | | seasonally | 20 | 6.66 |
| | | I do not exercise | 72 | 24 |
| 4 | For how long? | 20 to 30 minutes | 105 | 46.05 |
| | | About an hour | 66 | 28.95 |
| | | More than one hour | 57 | 25 |

Figure 2. Results of the General part of the research

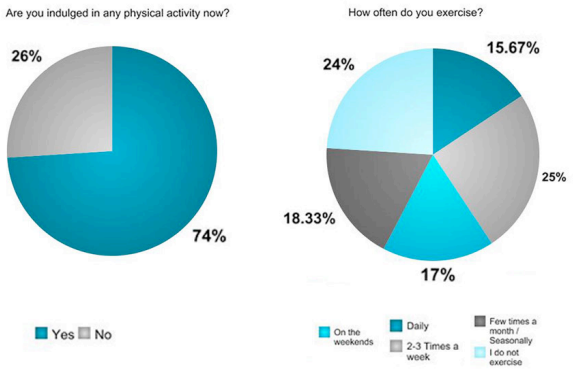


Figure 2.1 Pie charts -Results of the General part of the research

**Questionnaire results- SPECIAL part**

| | question | response | number | percent% |
|---|---|---|---|---|
| 5 | Have you heard about mobile application that tracks your physical activity | yes | 215 | 71.67 |
| | | no | 85 | 28.33 |
| 6 | Do you have/use M-health apps on your phone? | yes | 180 | 60 |
| | | no | 120 | 40 |
| 7 | How long have you been using it? | one month | 28 | 15.56 |
| | | couple months | 45 | 25 |
| | | half year | 20 | 11.11 |
| | | one year | 42 | 23.33 |
| | | more than one year | 45 | 25 |
| 8 | You downloaded application: | for free | 178 | 98.89 |
| | | with payment | 2 | 1.11 |
| 9 | How often do you check reports on your physical activity? | once a day | 33 | 18.33 |
| | | several times a week | 35 | 19.44 |
| | | couple times a month | 56 | 31.11 |
| | | when I remember | 41 | 22.78 |
| | | I do not check at all | 15 | 8.33 |
| 10 | Have you noticed any difference since you started using the application? | yes | 128 | 71.11 |
| | | no | 52 | 28.89 |
| 11 | Do notifications from your app encourage you to think more about your physical activity? | yes | 131 | 72.78 |
| | | no | 49 | 27.22 |
| 12 | Does application encourage you to walk and cycle more? | yes | 121 | 67.22 |
| | | no | 59 | 32.78 |
| 13 | Have you started thinking about additional recreation? | yes | 111 | 61.67 |
| | | no | 69 | 38.33 |
| 14 | Do you think that this application has a positive effect on your general physical condition and health? | yes | 142 | 78.89 |
| | | no | 38 | 21.11 |
| 15 | What would make you use the app more often? | more accessible | 49 | 27.22 |
| | | more user friendly | 45 | 25 |
| | | more informative and interactive | 86 | 47.78 |
| 16 | Do you prefer outdoor or indoor recreation? | indoor | 68 | 37.78 |
| | | outdoor | 112 | 62.22 |
| 17 | Explain the reasons | nature and fresh air | 94 | 52.51 |
| | | group recreation | 33 | 18.44 |
| | | free activities | 52 | 29.05 |
| 18 | What would make you use OPS for recreation more often? | more accessible | 37 | 20.56 |
| | | more activities | 55 | 30.56 |
| | | better equipment | 88 | 48.89 |

Figure 3. Results of the Special part of the research

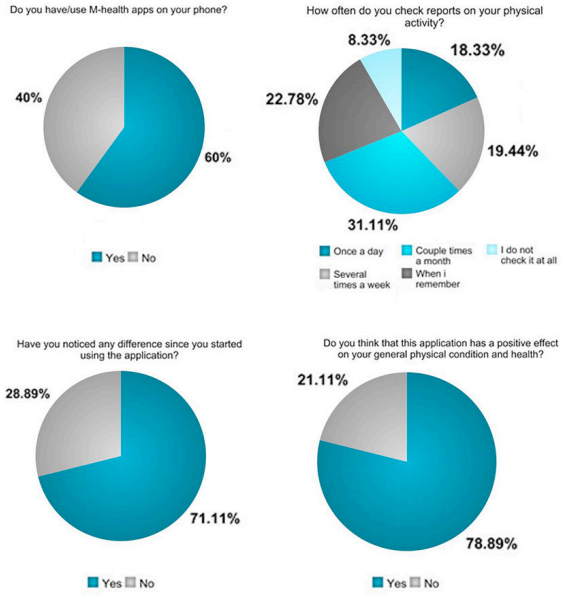


Figure 3.1 Pie charts -Results of the Special part of the research

According to the results of the Special part (Figure 3), more than 71% have heard about the M-health apps, 60% of all participants are using M-health apps, and almost all users have downloaded it for free. 28 % of users are checking the app notifications once a day, or several times a week, while only 8% do not check it at all.

Special contribution of this research present the results showing that almost 70 % of all users pointed out that app notifications have encouraged them to think more often about their level of physical activity, and also about additional recreation, which made them use the application more frequently. Finally, this could lead to increased physical activity and usage of open public space for sports and leisure activities.

Although the majority of users (62%) gave priority to outdoor recreation, stating reasons such as: contact with

nature, fresh air, greenery (52%), possibility for group recreation (19%), freedom of movement and lower financial costs (29%), during the interviews they also provided several reasons that would make them use open public space more frequently:

- more vegetation and greenery
- maintained greenery and urban furniture
- more bike lines and equipped bike stops
- clean, decorated areas for different physical activities with exercise equipment, public toilets, bins and benches
- wireless internet connection, and elements of inclusive design

Also, users gave different suggestions about improving M-health apps, such as:

- making it available for free on every mobile platform and easy to use
- combining apps for different outdoor activities into one integral app
- providing apps for comparing the results of two or more users and
- developing "custom made" apps for every city that would combine virtual and physical environment

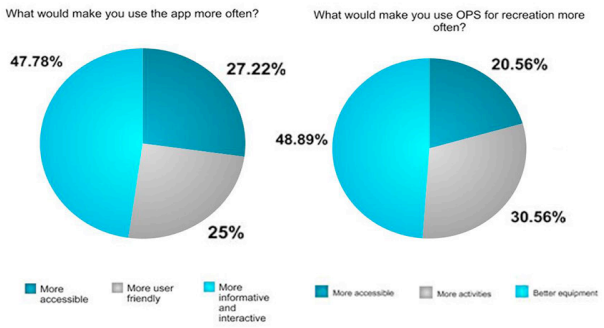


Figure 4 Pie charts -Results of the Special part of the research

## VI. DISCUSSION AND CONCLUSION

Main difference between the approach used in this research comparing to others on a same topic is that M-health apps where regarded from the aspect of improvement of medical treatments or decrease in cost, while aim of this research was to collect qualitative data regarding possible development of both M-health apps and open public space in order for stakeholder to use them more frequently. The usage of open public space can improve citizen's physical and mental health; increase recreation and activities; create sustainable environment; create tangible benefit in the field of economics and promote social equity [23]. After the research done in this paper, we can conclude that M-health apps certainly have a positive influence on physical activity of people in Belgrade and on usage of open spaces into recreational purposes. Also, redesigning open public spaces and improving M-health apps could significantly increase these activities. Concerning further research, the recommendation is that this study is repeated after users' suggestions for improvement are implemented in order to compare the results and therefore evaluate the real contribution of this research.

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