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Using mobile applications in the process of enhancing and restoring abilities in individuals with intellectual disability and other disabilities – a literature review

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Abstract

Over the past few years technology especially mobile technologies have advanced significantly, while the cost of using mobile devices have decreased considerably. It is believed that this rapid technological evolution can provide an excellent opportunity to improve the independence of a handicapped person. However, it can also be a source of social exclusion. Certain obstacles such as inadequate built-in accessibility options can limit the use of smart devices amongst this vulnerable group of people. Therefore, functionality and practicality of mobile phones should be taken into consideration. The aim of this review was to determine whether mobile applications are used in the process of monitoring the physical activity, rehabilitation and education of a person with intellectual and/or other disabilities. To examine this issue we reviewed various literature extracts: we used the databases from the National Center for Biotechnology Information (NCBI) focused on PubMed database. According to the method of finding and selected results, we qualified for further analysis of the results, which showed up when searched for key words and expressions (mobile applications, disability, rehabilitation, intellectual disability). We found 115 scientific articles. From this sample, we selected 23 articles related to our study. A significant proportion of the studies carried out seem to confirm that these mobile applications attempt to support the rehabilitation process of a person with a disability.

Keywords: smartphone, rehabilitation, modern technologies, ipad, tablet

Introduction

Mobile technologies have become ubiquitous. The number of mobile device users and the number of applications offered are growing worldwide. Nowadays almost every resident of the European Union has access to the Internet. Most of the users connect to the Internet via a mobile phone or a smartphone [1] – a device which offers multiple practical functions, such as a compass,

an accelerometer, a gyroscope, a GPS receiver, etc. Mobile phones are widely used and they are well integrated into the everyday life of a young person. This is due to the wide range of applications that allow us to monitor our physical activity, lifestyle or diet.

These amenities in smartphones can be useful not only for communication and entertainment, but also prove more accessible and open new opportunities for people with disabilities. Furthermore, this positively



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influences the process of adaptation of disabled individuals into the society

A review of literature, based on this topic, has shown an increase of interest in the use of mobile phones by adults with intellectual disabilities [2]. Studies evaluating the use of mobile devices, such as the iPad, have found that people with intellectual and developmental disabilities use them, too [3–5].

It has been concluded that mobile devices are useful in monitoring health, physical activity, and therapy. There are considerable advantages of monitoring health through mobile devices: evaluating symptoms in real time, personalized feedback, opportunities for support, constant supervision of treatment, mobility and flexibility of use, and the potential for improved treatment [5]. It has been found that hand held electronic devices show potential in practical teaching of students with disabilities and enhancing their independence by allowing them to freely communicate via social media and accessing public places by showing them alternative routes that are suitable for their disability [4].

The aim of this literature review was to determine whether mobile applications can be used in the process of monitoring, rehabilitation and education of people with intellectual disabilities and with other disabilities.

We have assumed that the widespread mobile technology development impacts significantly the use of mobile applications in monitoring, rehabilitation and education of a person with a disability.

Material and methods

According to the assumptions, we searched the PubMed database: US National Library of Medicine – National Institutes of Health. We used methods of data mining. The obtained results were searched through the use of key words and expressions: “mobile applications”, “disability”, “rehabilitation”, “intellectual disability”. The publications date back 10 years.

Results

From 115 results obtained from the Pub Med platform, we chose 23 articles linked to the study topic. We classified and categorized the studies into tables, taking into consideration the control group, Table 1 and Table 2. Our analysis of the PubMed literature showed an increase of studies published on mobile applications

Tab. 1. Using mobile applications to work with people with disabilities – PubMed platform publications 2010–2020

Author	Paper description	Study population*	Method*
Kagohara 2013	Supporting the teaching process of people with disabilities using iPods and iPads	Persons with developmental disabilities (n = 47)	LR
Rand et al. 2015	Rehabilitation with the use of tablets, for patients with self-training impaired dexterity post stroke.	Patients after stroke (n = 40)	ICS
Halim Z et al. 2015	Mobile application for hand gesture recognition system for patients with hearing impairment	Patients with hearing impairment (n = 10)	E
Gower et al. 2015	Creating new opportunities for people with disabilities	Persons with disabilities	ICS
Gray et al. 2016	Advances in e-health for people with complex care needs.	–	E
Rinne et al. 2016	Low cost technology access, mobile games for self-rehabilitation of arm disability post stroke	Patients after stroke (n = 345)	E
Ozinga et al. 2017	Determining postural stability in patients with Parkinson’s disease	Patients with Parkinson’s disease	E
Coutinho et al. 2017	Efficiency of iPad applications for visual and motor skills for children with special needs	Children with special educational needs aged 4–10 months to 7 years (n = 20)	O
Nüssli et al. 2020	Using mobile applications to motivate children in therapy	Children with disabilities	E
Neugebauer 2020	Navigation aid for blind persons by mobile application	Blind people (n = 7)	E

*Experiment – (E), Literature review – (LR), Individual case study – (ICS), Observation – (O), Special educational needs – (SPE), Intellectual disability – (NI).

Tab. 2. Using mobile applications for work with people with intellectual disabilities – PubMed platform publication 2010–2020

Author	Paper description	Study population*	Method*
Harrison et al. 2011	Presentation of a review of the field of mobile mental health	Persons with intellectual disabilities	LR
Pérez-Cruzado 2013	Increasing physical activity levels with a mobile application	Persons with intellectual disabilities (n = 40)	E
Donker et al. 2013	Systematic review of scientific evidence for efficiency of mental health applications for mobile devices	Persons with intellectual disabilities	LR
Szabo et al. 2014	Using mobile technology by individuals with aphasia: native iPad features and everyday applications	Persons with aphasia	LR
Ptomey et al. 2015	Using technologies for a weight loss program for adolescents with disabilities.	Persons with intellectual disabilities	E
Bathgate et al. 2017	Assessing diet with mobile application	Patients with Down Syndrome (n = 244)	E
Price 2017	Facilitating public transport for people with intellectual disabilities with the use of a mobile application	Persons with intellectual disabilities	E
Fage 2018	Tablet applications supporting inclusion of children with autism spectrum disorder	Children with autism spectrum disorder (n = 50)	E
Jones 2018	Mobile Healthcare and People with Disabilities	Persons with disabilities	LR
Rogerson 2019	Using a tablet mobile application to support therapy for children with autism	Parents of children with autisms (n = 17)	E
Laubscher 2019	The impact of the application on communication while playing in children with autism spectrum disorders	Children with a spectrum of autism	E
Deng 2020	Needs and obstacles in the use of assistive mobile applications among people with autism	Patients with a spectrum of autism	E
Zhang 2020	A mobile app implementing the international classification of functioning, disability and health rehabilitation set	Persons with disabilities	E

*Experiment – (E), Literature review – (LR), Individual case study – (ICS), Observation – (O), Special educational needs – (SPE), Intellectual disability – (NI).

in the context of intellectual disability. Almost all research teams presented positive effects of using modern technologies related to mobile applications in the rehabilitation of people with disabilities. In their studies, authors focused on the implications of creating new tools that support rehabilitation, programs of physical rehabilitation, activities and games dedicated to children and adolescents. Their aim was to enhance ability and compensate for deficits. All studies, we analyzed, concluded that mobile applications had a positive effect in therapy.

Discussion

Our results showed that mobile applications and their use in medical sciences have only recently started to become an area of interest to researchers. Numerous

studies on this topic have been published after 2015, while before that year very few studies have been presented on PubMed. This trend can be confirmed by the results I have obtained. We found that most of the papers published on PubMed have been issued within the last four years. The reason seems to be the dynamic development of mobile applications on smart devices. This has been verified by several studies which focus has been on the evolution of mobile applications and increase of their popularity[6–8].

Statistics on PubMed reveal the particular interest of researchers in the usefulness of mobile applications. However, our study has not confirmed any significant interest of researchers in the use of mobile applications during the rehabilitation and revalidation of people with disabilities. Studies on mobile application usually focused on the importance of adapting mobile applications to the abilities of people with disabilities [9–13].

Their authors concluded that it is enough to adequately modify programs or systems, so that it allows a person with disabilities to use it with considerable ease [14].

Studies show that adolescents with disabilities have complex needs in regard to life style and controlling body mass. Mobile applications have a potential to increase the levels of physical activity in adolescents with disabilities in relation to their healthy peers and ensure appropriate support regarding healthy lifestyles [15]. Additionally, applications such as Google Maps can be an effective tool for supporting a person with an intellectual and developmental disability. These applications play a vital role in decreasing the dependence of a person with disabilities from their parents or other caretakers by facilitating them with easier modes of transportation, or producing large print maps and therefore making expensive GPS devices less necessary [16].

Studies have also shown that using mobile technologies may be one of the ways through which people with disabilities may understand their disability better [17]. Mobile applications help people with intellectual disabilities organize their physical activity during the day more effectively, in comparison to subjects who have not experienced multimedia intervention [18,19]. Studies proved that children with autism spectrum disorder have improved their socio-adaptive behavior. Also, their social interactions with parents or peers within the school environment have increased in relation to the use of mobile applications on their tablets, involving rehabilitation, support and cognitive applications [20–23]. The number of various mobile applications and activities aimed at cognitive training or support for numerous types of disabilities have been growing in digital application stores, such as Apple Store or Google Play Store [24]. Previous studies suggest that interventions in the field of psychological health delivered through mobile applications may be efficient in treating numerous psychological disorders, such as depression, stress and anxiety [25].

Our research has found yet another important aspect related to mobile applications. This is the use of inexpensive tools such as games and various applications which can be used in the motor rehabilitation of people with disabilities [26]. Authors of experiments related to this matter, have not only proved the importance of use of games and applications, but also observed a significant and positive effect. Moreover, doctors and physiotherapists have recently started noticing and appreciating the value of mobile applications in the process of monitoring rehabilitation processes. Some authors proved this thesis [27–32]. Patient's rehabilitation can be controlled remotely with mobile applications; while monitoring diet or health from home significantly lowers the costs

of the process [33]. Therefore, mobile applications and their development may result in improved quality of rehabilitation in people with disabilities.

Conclusions

Our study leads to the following conclusions:

1. A significant proportion of the discussed studies on using mobile applications whilst working with people with disabilities, attempt to support their rehabilitation processes through these mobile applications.
2. The interest in using mobile applications to work with people with intellectual disabilities has significantly increased from 2015 in comparison to earlier years.

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Conflicts of interest

The authors declare no conflict of interest.

References

1. <https://ec.europa.eu/eurostat/documents/2995521/7771139/9-20122016-BP-EN.pdf/f023d81a-dce2-4959-93e3-8cc7082b6edd?fbclid=IwAR0vzt8d7r-p8Lj5rOSuNhMaQAJ679B9RV-U1glGctx3L1cMU-s5w7YA0kIVk>
2. Tanis ES, Palmer S, Wehmeyer M, Davies DK, Stock SE, Lobb K, et al. Self-report computer-based survey of technology use by people with intellectual and developmental disabilities. *Intellect Dev Disabil.* 2012; 50(1): 53-68.
3. Stephenson J, Limbrick L. A Review of the Use of Touch-Screen Mobile Devices by People with Developmental Disabilities. *J Autism Dev Disord.* 2015; 45(12): 3777-91.
4. Kagohara DM, Meer L, Ramdoss S, O'Reilly MF, Lancioni GE, Davis TN, et al. Using iPods and iPads in teaching programs for individuals with developmental disabilities: a systematic review. *Res Dev Disabil.* 2013; 34(1):147-56.
5. Ptomey LT, Sullivan DK, Lee J, Goetz JR, Gibson C, Donnelly JE. The use of technology for delivering a weight loss program for adolescents with intellectual and developmental disabilities. *J Acad Nutr Diet.* 2015; 115(1): 112-8.
6. Abbott C, Brown D, Evett L, Standen P. Emerging issues and current trends in assistive technology use 2007–2010: practising, assisting and enabling learning

- for all. *Disabil Rehabil Assist Technol.* 2014; 9(6): 453-62.
7. Gray CS, Mercer S, Palen T, McKinstry B, Hendry A. eHealth Advances in Support of People with Complex Care Needs: Case Examples from Canada, Scotland and the US. *Healthc Q.* 2016; 19(2): 29-37.
 8. Rand D, Zeilig G, Kizony R. Rehab-let: touchscreen tablet for self-training impaired dexterity post stroke: study protocol for a pilot randomized controlled trial. *Trials.* 2015; 16: 277.
 9. Gower V, Salatino C, Pignini L, Caracciolo A. Are mainstream mobile technologies bringing about new opportunities for people with disabilities. *Stud Health Technol Inform.* 2015; 217: 119-26.
 10. Halim Z, Abbas. A Kinect-Based Sign Language Hand Gesture Recognition System for Hearing- and Speech-Impaired: A Pilot Study of Pakistani Sign Language. *Assist Technol.* 2015; 27(1): 34-43.
 11. Smyth P, McDowell C, Leslie JC, Leader G, Donnelly M, Simpson E, et al. Managing Weight: What Do People with an Intellectual Disability Want from Mobile Technology. *Stud Health Technol Inform.* 2017; 242: 273-8.
 12. Jones M, Morris J, Deruyter F. Mobile Healthcare and People with Disabilities: Current State and Future Needs. *Int J Environ Res Public Health.* 2018; 15(3): 515. doi: 10.3390/ijerph15030515. PMID: 29538292; PMCID: PMC5877060.
 13. Olsen SH, Saperstein SL, Gold RS. Content and Feature Preferences for a Physical Activity App for Adults With Physical Disabilities: Focus Group Study. *JMIR Mhealth Uhealth.* 2019; 7(10): e15019. doi: 10.2196/15019. PMID: 31605518; PMCID: PMC6913716.
 14. Neugebauer A, Rifai K, Getzlaff M, Wahl S. Navigation aid for blind persons by visual-to-auditory sensory substitution: A pilot study. *PLoS One.* 2020 Aug 20; 15(8): e0237344. doi: 10.1371/journal.pone.0237344. PMID: 32818953; PMCID: PMC7446825.
 15. McPherson AC, Oake M, Stinson J. "Don't sweat it buddy, it's OK": an exploration of the needs of adolescents with disabilities when designing a mobile application for weight management and health lifestyles. *Disabil Rehabil.* 2019; 28:1-9.
 16. Price R, Marsh AJ, Fisher MH. Teaching Young Adults with Intellectual and Developmental Disabilities Community-Based Navigation Skills to Take Public Transportation. *Behav Anal Pract.* 2017; 11(1): 46-50.
 17. Kowalski, Morgan, Taylor. Stigma of mental and physical illness and the use of mobile technology. *J Soc Psychol.* 2017; 157(5): 602-10.
 18. Pérez-Cruzado D, Cuesta-Vargas AI. Improving Adherence Physical Activity with a Smartphone Application Based on Adults with Intellectual Disabilities (APPCOID). *BMC Public Health.* 2013; 13: 1173.
 19. Pérez-Cruzado D, Cuesta-Vargas AI. Smartphone reminder for physical activity in people with intellectual disabilities. *Int J Technol Assess Health Care.* 2017; 33(4): 442-3.
 20. Fage C, Consel CY, Balland E, Etchegoyhen K, Amestoy A, Bouvard M, et al. Tablet Apps to Support First School Inclusion of Children With Autism Spectrum Disorders (ASD) in Mainstream Classrooms: A Pilot Study. *Front Psychol.* 2018; 9: 2020.
 21. Rogerson J, Falkmer M, Cuomo B. Parental experiences using the Therapy Outcomes by You (TOBY) application to deliver early intervention to their child with autism. *Dev Neurorehabil.* 2019; 22(4): 219-27.
 22. Laubscher E, Light J, McNaughton D. Effect of an application with video visual scene displays on communication during play: pilot study of a child with autism spectrum disorder and a peer. *Augment Altern Commun.* 2019; 35(4): 299-308. doi: 10.1080/07434618.2019.1699160. Epub 2019 Dec 13. PMID: 31833399.
 23. Deng L, Rattadilok P. The need for and barriers to using assistive technologies among individuals with Autism Spectrum Disorders in China. *Assist Technol.* 2020; 19: 1-12. doi: 10.1080/10400435.2020.1757787. Epub ahead of print. PMID: 32310026.
 24. Donker T, Petrie K, Proudfoot J, Clarke J, Birch MR, Christensen H. Smartphones for smarter delivery of mental health programs: a systematic review. *J Med Internet Res.* 2013; 15(11): e247.
 25. Harrison V. Mobile mental health: review of the emerging field and proof of concept study. *J Ment Health.* 2011; 20(6): 509-24.
 26. Rinne P, Mace M, Nakornchai T, Zimmerman K, Fayer S, Sharma P, et al. Democratizing Neurorehabilitation: How Accessible are Low-Cost Mobile-Gaming Technologies for Self-Rehabilitation of Arm Disability in Stroke *PLoS One.* *PLoS One.* 2016; 11(10): e0163413.
 27. Coutinho F, Bosisio ME, Brown E, et al. Effectiveness of iPad apps on visual-motor skills among children with special needs between 4y0m-7y11m. *Disabil Rehabil Assist Technol.* 2017; 12(4): 402-10.
 28. Ozinga SJ, Linder SM, Alberts JL. Use of Mobile Device Accelerometry to Enhance Evaluation of Postural Instability in Parkinson Disease. *Arch Phys Med Rehabil.* 2017; 98(4): 649-58.
 29. Bathgate KE, Sherriff JL, Leonard H, Dhaliwal SS, Delp EJ, Boushey CJ. Feasibility of Assessing Diet with a Mobile Food Record for Adolescents and Young Adults with Down Syndrome. *Nutrients.* *Nutrients.* 2017; 9(3): 273.

30. Szabo G, Dittelman J. Using mobile technology with individuals with aphasia: native iPad features and everyday apps. *Semin Speech Lang*. 2014; 35(1): 5-16.
31. Zhang M, Yu J, Shen W, et al. A mobile app implementing the international classification of functioning, disability and health rehabilitation set. *BMC Med Inform Decis Mak*. 2020; 20(1): 12. Published 2020 Jan 28. doi:10.1186/s12911-020-1019-1
32. Nüssli S, Schmidt T, Denecke K. How to Motivate Children with Severe Disabilities to Adhere to Their Therapy? *Stud Health Technol Inform*. 2020; 271: 168-75. doi: 10.3233/SHTI200093. PMID: 32578560.
33. Silva BM, Rodrigues JJ, de la Torre Díez I, López-Coronado M, Saleem K. Mobile-health: A review of current state in 2015. *J Biomed Inform*. 2015; 56: 265-72. doi: 10.1016/j.jbi.2015.06.003. Epub 2015 Jun 11. PMID: 26071682.