Nursing Informatics 2016
W. Sermeus et al. (Eds.)

doi:10.3233/978-1-61499-658-3-491

A Systematic Review and Meta-Analysis of Intervention for Pediatric Obesity Using Mobile Technology

Jisan LEE, RN, M.Sc [a,c,1], Meihua PIAO, RN, M.Sc [a,*], Ahjung BYUN, RN [a], Jeongeun KIM, RN, PhD, INS [a,b,c]

[a] *College of Nursing Seoul National University, Seoul, Korea*
[b] *Research Institute of Nursing Science Seoul National University, Seoul, Korea*
[c] *Interdisciplinary Program of Medical Informatics Seoul National University, Seoul, Korea*

Abstract. We reviewed the effect sizes of pediatric obesity intervention studies using mobile technology. Ten databases (Cochrane CENTRAL, CINAHL, EMBASE, PubMed/Medline, KoreaMED, KMBASE, KISS, NDSL, KSITI, and RISS) were reviewed, and four studies were included in a qualitative synthesis. To obtain significant change in obesity-related outcomes among elementary school students, including parents and utilizing text messages in interventions are recommended. Furthermore, devices such as accelerometers may aid obesity management. A meta-analysis of four studies indicated that the mobile intervention positively influenced dropout rates but was ineffective for outcomes of weight control, exercise, and sugar-sweetened beverage intake.

Keywords. Mobile technology, Short Message Service (SMS), Pediatric obesity, Systematic review, Meta-analysis

1. Introduction

Pediatric obesity threatens children's health and well-being worldwide. Overweight or obese children are at great risk of diseases such as diabetes and metabolic syndrome, and are also affected psychosocially [1]. The obesity rate of elementary school students in Korea (based on body mass index [BMI]) is 20.6%, and 32% of those aged 2–19 years in the United States are overweight or obese [2,3]. To effectively manage pediatric obesity, some interventions have utilized mobile technology [4–7]. Additionally, smartphone ownership rates are increasing among children, with 72.2% of elementary school students in Korea and 68% of children aged 13–14 in the U. S. owning a smartphone [8,9]. Using Population, Intervention, Comparison, and Outcome (PICO) criteria, we assessed whether mobile technology is effective for weight or behavior change among children. Accordingly, we conducted a systematic review and meta-analysis of pediatric obesity interventions using mobile technology.

[1] First author.
* corresponding author: Meihua PIAO, E-mail: parkmihua@gmail.com

2. Methods

The process and manuscript development are consistent with the guidelines of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [10].

2.1. Literature sources and search strategy

Ten databases, Cochrane CENTRAL(27), PubMed/Medline(118), CINAHL(24), EMBASE(95), KISS(0), KoreaMED(0), KMBASE(0), NDSL(1), KSITI(1), and RISS(2), were systematically searched. Search terms were combinations of child (or children/childhood/pediatric), smartphone (mobile phone/cell phones), and obesity (obese/overweight/pediatric obesity). Publication year was limited to after January 2007, as the iPhone, a breakthrough smartphone technology, was released at that time. An additional 8 studies were found manually.

2.2. Inclusion and exclusion criteria

Inclusion criteria were as follows:

- Studies with abstract and full text in English or Korean
- Pre- and post-test studies of obesity or weight control using smartphone or mobile technology, including text messages
- Studies identifying weight loss or behavior changes as outcomes
- Elementary school students as a primary study population (interventions conducted with parents are also included)

Exclusion criteria were as follows:

- Studies that target only parents of elementary school children
- Studies that apply smartphones or mobile technology for management of other diseases (e.g., diabetes) besides obesity

2.3. Study selection and Study classification

A total of 193 articles (of an initial 276) remained after eliminating duplicates. Titles and abstracts were reviewed independently by two researchers. Studies were chosen per inclusion criteria and 42 articles underwent full text reviews. Two researchers then separately classified four final articles, randomized controlled trials (RCTs), using the study Design Algorithm for Medical literature on Intervention (DAMI) from the National Evidence-based Healthcare Collaborating Agency (NECA) [11].

2.4. Data extraction and Data synthesis

Data extraction was completed independently by two researchers with Excel 2010. Disagreements were resolved through discussion. Relevant data on study design and variables were summarized. Qualitative and quantitative syntheses were conducted using Comprehensive Meta-Analysis software.

3. Results

Three studies were included for computing BMI effect size. Mobile intervention had no significant effect on BMI (Hedges' g: -0.073, 95% CI: -0.031 to 0.185). Additionally, two studies were examined for the effect size of daily exercise and sugar-sweetened beverage intake; neither showed any significant effect (Hedges' g: 0.189, 95% CI: -0.355 to 0.733; Hedges' g: -0.316, 95% CI: -0.764 to 0.131).
Dropout rates were considered as potential mediators of intervention outcome. Mobile intervention was effective for controlling dropout rates (Odds ratio: 0.363, 95% CI: 0.178 to 0.74).

4. Discussion

Three articles had significant results and two commonalities. Parents' participation was part of the study design, and text messaging was used independently or along with the main interventions. Furthermore, two of the three studies added a pedometer or accelerometer to mobile technology. We recommend future studies include parents, text messaging, and activity-measuring accessories in study design.
Mobile intervention had significant effects on dropout rates, but not on weight control, exercise, or intake of sugar-sweetened beverages (SSBs). Nevertheless, all authors positively evaluated the effects of mobile technology on management of pediatric obesity. This finding could be due to the following reasons. First, intervention group attrition rates were twice lower than control group rates in all four studies. Second, four studies obtained positive, although nonsignificant, outcomes of self-monitoring, screen time, SSB intake, weight maintenance, and negative mood control.
A limitation of this study is that only four studies were selected. We recommend additional systematic review and meta-analysis after further studies are performed.

5. Acknowledgments

This work was supported by the National Research Foundation of Korea (NRF) Grant funded by the Korean Government (MSIP) (No. 2010-0028631).

References

[1] S.R. Daniels, D.K. Arnett, R.H. Eckel, S.S. Gidding, L.L. Hayman, S. Kumanyika, T.N. Robinson, B.J. Scott, S.S. Jeor, and C.L. Williams, Overweight in children and adolescents pathophysiology, consequences, prevention, and treatment, *Circulation* **111** (2005), 1999–2012.
[2] *Sample survey in 2014 students' health* inspection. Ministry of Education, Seoul, 2015.
[3] M. Ng, T. Fleming, M. Robinson, B. Thomson, N. Graetz, C. Margono, E.C. Mullany, S. Biryukov, C. Abbafati, and S.F. Abera, Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: a systematic analysis for the Global Burden of Disease Study 2013, *The Lancet* **384** (2014), 766–781.
[4] J. Niet, R. Timman, So. Bauer, E. Akker, H. Buijks, C. Klerk, H. Kordy, and J. Passchier, The effect of a short message service maintenance treatment on body mass index and psychological well-being in overweight and obese children: a randomized controlled trial, *Pediatric obesity* **7** (2012), 205–219.

[5] J.S. Huang, L. Dillon, L. Terrones, L. Schubert, W. Roberts, J. Finklestein, M.C. Swartz, G.J. Norman, and K. Patrick, Fit4Life: a weight loss intervention for children who have survived childhood leukemia, *Pediatric blood & cancer* **61** (2014), 894–9000.
[6] N.L. Nollen, M.S. Mayo, S.E. Carlson, M.A. Rapoff, K.J. Goggin, and E.F. Ellerbeck, Mobile technology for obesity prevention: a randomized pilot study in racial-and ethnic-minority girls, *American journal of preventive medicine* **46** (2014), 404–408.
[7] J.R. Shapiro, S. Bauer, R.M. Hamer, H. Kordy, D. Ward, and C.M. Bulik, Use of text messaging for monitoring sugar-sweetened beverages, physical activity, and screen time in children: a pilot study, *Journal of nutrition education and behavior* **40** (2008), 385–391.
[8] *2013 Youth Media Use Survey*. Ministry of Gender Equality and Family, Seoul, 2013.
[9] A. Lenhart and D. Page, *Teens, Social Media, and Technology Overview 2015*, Pew Research Center, 2015.
[10] D. Moher, A. Liberati, J. Tetzlaff, and D.G. Altman, Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement, *Annals of internal medicine* **151** (2009), 264–269.
[11] S. Kim, J. Park, H. Seo, Y. Lee, B. Jang, H. Son, H. Suh, and C. Shin, NECA's guidance for undertaking systematic review and meta-analyses for intervention, *Seoul: National Evidence-based Healthcare Collaborating Agency* (2011).