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Meta-Analysis

Meta-Analysis: Effectiveness of Web-Based Intervention to Increase Physical Activity in Older People

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ABSTRACT

Background: The increasing global population of older people and the trend of life expectancy make the discussion of physical activity an urgent urgency, given its role in preventing various non-communicable diseases and increasing life expectancy. Web-based intervention is believed to be an intervention that can change habits related to physical activity in older people. This study aimed to find out whether web-based intervention is effective in increasing physical activity for older people.
Subjects and Method: This research is a meta-analysis based on the PRISMA flow diagram. The article search process is carried out through journal databases, in the form of: Google Scholar, PubMed, and ResearchGate. Keywords to search for articles are: "Aged" OR "older adult" OR "elderly" AND "Exercise" OR "exercise" OR "physical activity" OR "physical activities" OR "physical exercise" OR " physical exercises" OR "physical fitness" AND "Internet-Based Intervention" OR "internet-based interventions" OR "web-based interventions" OR "web-based interventions" OR "online interventions" OR “internet intervention” OR “mobile health” OR “mhealth” OR “tele-health” OR “ehealth” AND “randomized control trials” OR “randomized control trials” OR “RCT”. The articles included are study design randomized control trial (RCT), articles with research subjects older people aged 50 years and over, and the intervention used is web-based intervention. Articles that meet the criteria are then analyzed using the Revman 5.3 application.
Results: A total of 9 articles were found from the Netherlands, Spain, England, Belgium, and Sweden. The data collected showed that web-based intervention increase physical activity in older people, and it was statistically significant (SMD= 0.78; 95% CI=0.15 to 1.41; p= 0.020).
Conclusion: Web-based intervention is effective for increasing physical activity for older people who are more than 50 years old.

Keywords: web-based intervention, physical activity, older people, meta analysis.

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BACKGROUND

Physical activity is defined as body movement resulting from skeletal muscle movement that requires energy expenditure with various frequencies, intensity, and duration (WHO, 2020). Physical activity can be done in various ways, such as: walking, swimming, dancing, and even doing household activities such as; sweeping, babysitting, gardening, and so on. All forms of physical activity will be beneficial if done regularly with sufficient duration and intensity

(Langhammer, Bergland and Rydwik, 2018; WHO, 2020).

Regular physical activity is empirically proven to reduce 6-10% of the main risk factors for non-communicable diseases and increase life expectancy (Lee et al., 2012; Sheikholeslami et al., 2018), which can indirectly reduce the burden of non-communicable diseases. communicable disease in middle income countries (Katzmarzyk et al., 2022). The importance of increasing physical activity, making physical activity and lifestyle a determinant of health and longevity for older people (Langhammer, Bergland and Rydwik, 2018). WHO (2020) and the Physical Activity Guidelines for American's (2018) suggest that the elderly do moderate to vigorous physical activity (MVPA) 3.0 to 6.0 METs for a total of 150 to 300 minutes per week through multi-component physical activity including balance training, aerobic, and muscle-strengthening activity.

The age of 50 years is the most appropriate age to increase physical activity in preventing various diseases that will occur at the age of 65 years (Peels et al., 2014; Zubala et al., 2017). With the increasing population of older people (European Commission, 2020) and the trend of increasing life expectancy globally (WHO, 2011), efforts to improve the quality of human life through physical activity are of particular concern to the world. This is evidenced through the Global Action Plan for Physical Activity 2018-2030, where WHO sets a target to reduce the rate of physical inactivity by 15% with four strategic objectives through 20 multidimensional policy actions (WHO, 2018).

Web-based intervention as an approach to physical activity intervention is a self-guided program (or it can also be with the help of a health provider) through internet-based interventions including program content, multimedia, online interactive activities, and subjective guidance or feedback (Murray, 2012). Murray stated that web-based intervention is a key intervention in self-monitoring and behavior change. This is in accordance with the general purpose of web-based physical activity intervention, namely to provide support, control activities, and monitor physical activity (Mouton and Cloes, 2014; Khan et al., 2019). So, the purpose of this research is to find out whether web-based intervention is effective for increasing physical activity in the elderly.

SUBJECTS AND METHOD

1. Study Design

This study is a meta-analysis study conducted based on the PRISMA (Preffered Reporting Items for Systematic Reviews and Meta-Analyses) guidelines 2020 (Page et al., 2021). The articles in this study were obtained from several databases, namely Google Scholar, PubMed, and ResearchGate. Keywords to search for articles are: "Aged" OR "older adult" OR "elderly" AND "Exercise" OR "exercise" OR "physical activity" OR "physical activities" OR "physical exercise" OR " physical exercises" OR "physical fitness" AND "Internet-Based Intervention" OR "internet-based interventions" OR "web -based interventions" OR "web-based interventions" OR "online interventions" OR “internet intervention” OR “mobile health” OR “mhealth” OR “telehealth” OR “ehealth” AND “randomized control trials” OR “randomized control trials” OR “RCT”.

2. Inclusion Criteria

The inclusion criteria for the articles were Randomized Control Trial research design, published in 2011-2020, open acces article, English language, research subjects were older adults aged over 50 years with/or without comorbidities, which were given an internet-based physical activity intervention, the results obtained were the duration

of physical activity (minutes/day), with the unit of effect size of the relationship used was mean SD.

3. Exclusion Criteria

The exclusion criteria in this research article were: articles with non-internet based interventions, articles with mixed population under 50 years, articles with mixed method research.

4. Operational Definition of Variables

The search for articles was carried out by considering the eligibility criteria defined using the PICO model. Population: older adults. Intervention: web-based intervention. Comparison: not a web-based intervention. Outcome: physical activity. With operational definitions as follows:

Web-based Intervention is a self-guided or therapist-assisted program that can only be accessed via the internet, and aims to provide support, control, and monitoring of physical activity performed by older adults.

Older adults are the human population aged over 50 years.

Physical activity is a series of skeletal muscle movements that require energy expenditure. Physical activity is done in various ways, such as: walking, swimming, dancing, and even doing household activities. Physical activity is calculated based on the duration of minutes/day.

5. Data Analysis

Articles were analyzed using the Review Manager (RevMan) 5.3 application to calculate effect size and heterogeneity, and form the final results of the meta-analysis. The results of data processing are presented in the form of forest plots and funnel plots.

RESULTS

Process of searching article wascarried out by searching several journal databases including Google Scholar, Pubmed, and ResearchGate. it can be seen using the PRISMA FLOW flowchart shown in Figure 1.

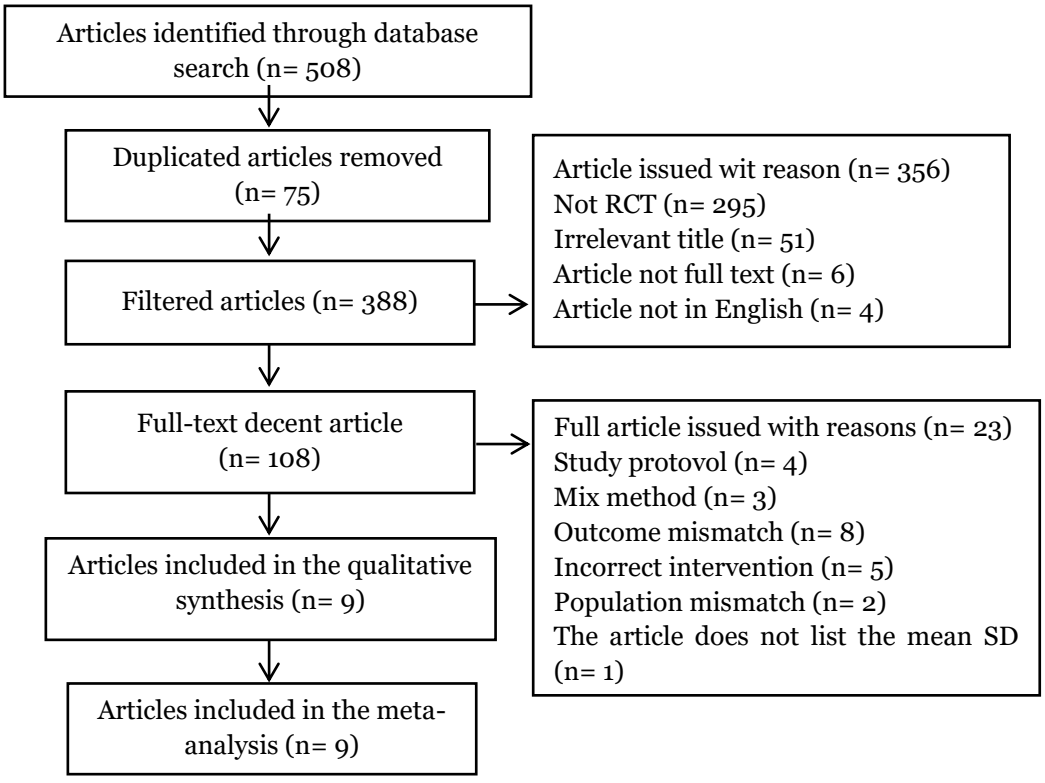

Figure 1. Results of PRISMA Flow Diagrams

Figure 2. Research Distribution Map

figure 1. Research related to exclusive breastfeeding in mothers who visited antenatal care consisted of 9 articles from the initial search process yielding 508 articles, after the deletion process, articles were published with 388 requirements for full-text review more carry on. A total of 9 articles that met the quality assessment were included in the quantitative synthesis using a meta-analysis.

It can be seen in Figure 2 that the research articles come from one continents, namely Europe (Netherlands, Spain, England, Belgium, and Sweden). Table 1, researchers conducted an assessment of the quality of the study. Table 2 shows that 9 articles from a cross-sectional study provide evidence about the association of mothers who made antenatal care visits to exclusive breastfeeding.

Based on the results of the forest plot, a randomized controlled trial study showed that that website-based interventions on physical activity in the elderly have a significant positive effect compared to non-website interventions (SMD= 0.78; 95% CI= 0.15 to 1.41; p= 0.020). As for the study of heterogeneity of research data shows I^2= 98% so that the data can be said to be heterogeneous.

The funnel plot results show publication bias with an overestimated effect characterized by an asymmetric distribution between the right and left plots. There is one plot on the right, eight plots on the left. The plot on the right side of the graph has a standard error (SE) between 0.2 and 0.3. The plot on the left side of the graph has a standard error (SE) between 0 and 0.3.

Table 1. Assessment of study quality published by the Center fro Evidence Based Medicine (CEBM)

No	Indicator	Publication (Author and Year)								
		Wijsman et al. (2013)	Vroege et al. (2014)	Weegen et al. (2015)	Broekhuizen et al. (2016)	Recio-rodriguez et al. (2016)	Grey et al. (2019)	Poppe et al. (2019)	Van Dyck et al. (2019)	Ek et al. (2020)
1	Does the study address a clear research focus?	1	1	1	1	1	1	1	1	1
2	Is the RCT research method appropriate to answer the research question?	1	1	1	1	1	1	1	1	1
3	Are there enough subjects in the study to establish that the findings were not coincidental?	1	1	1	1	1	1	1	1	1
4	Were the subjects randomly divided into the experimental and control groups? If not, can this be biased?	1	1	1	1	1	1	1	1	1
5	Does the study use inclusion or exclusion criteria?	1	1	1	1	1	1	1	1	1
6	Were the two groups comparable at the start of the study?	1	1	1	1	1	1	1	1	1
7	Were objective and unbiased outcome criteria used?	1	1	1	1	1	1	1	1	1
8	Is the measurement method used objectives and valid to measure the results? If not, is there any blinding in the study?	1	1	1	1	1	1	1	1	1
9	Is the effect size practically relevant?	1	1	1	0	1	1	1	1	1
10	Is the estimated effect, correct? Is there a confidence interval?	1	0	1	1	1	0	1	1	1
11	Are there any Confounding factors that have not been taken into account?	1	1	1	0	1	1	1	0	1
12	Can the results be applied to your research?	1	1	1	1	1	1	1	1	1
	Total	**12**	**11**	**12**	**10**	**12**	**11**	**12**	**11**	**12**

Table 2. Description of Primary Research included in the Meta-Analysis

No	Author (Year)	Country	Study Design	Sample		Popu-lation (P)	Intervention (I)	Compa-rison (C)	Outcome (O)	Mean (SD)	
				WBI	Non-WBI					WBI	Non-WBI
1	Wijsman et al (2013)	Netherlands	RCT	119	116	60-70 years	PA: non-specific EH: PA auto-tracking feedback, digital PA coaching	Usual Care	Physical Activity Time	16.8 (26.4)	14.4 (32.0)
2	Vroege et al (2014)	Netherlands	RCT	114	112	60-70 years	PA: non-specific EH: PA auto-tracking feedback, digital PA coaching	Usual Care	Physical Activity Time	11.1 (2.2)	0.15 (1.5)
3	van der Weegen et al (2015)	Netherlands	RCT	65	68	≥50 years	PA: non-specific EH: PA auto-tracking feedback, digital PA coaching	Usual Care	Physical Activity Time	47.5 (26.5)	44.1 (20.3)
4	BroekhuIzhen et al (2016)	Netherlands	RCT	119	116	≥60 years	PA: non-specific EH: PA auto-tracking feedback, digital PA coaching	Usual Care	Physical Activity Time	16.8 (18.6)	14.4 (23.8)
5	Recio-Redriguez (2016)	Spain	RCT	379	386	60-70 years	PA: non-specific EH: PA auto-tracking feedback, digital PA coaching	Usual Care	Physical Activity Time	23.3 (52.1)	7.7 (35.2)
6	Grey et al (2019)	England	RCT	30	29	50-74 years	PA: non-specific	Usual Care	Physical Activity Time	12.0 (44.0)	1.0 (50.0)
7	Poppe et al (2019)	Belgium	RCT	29	29	≥50 years	PA: non-specific EH: PA auto-tracking feedback, digital PA coaching	Usual Care	Physical Activity Time	106.3 (78.4)	64.2 (75.1)
8	van Dyck et al (2019)	Belgium	RCT	61	61	≥65 years ol	PA: walking EH: PA auto-tracking feedback; digital PA recording; online social support	No ANC Visit	Physical Activity Time	25.6 (30.2)	22.1 (14.1)
9	Ek et al. (2020)	Sweden	RCT	127	125	≥50 years	PA: endurance; stretching EH: digital-tailored advice	No ANC Visit	Physical Activity Time	59.7 (27.6)	60.3 (26.0)

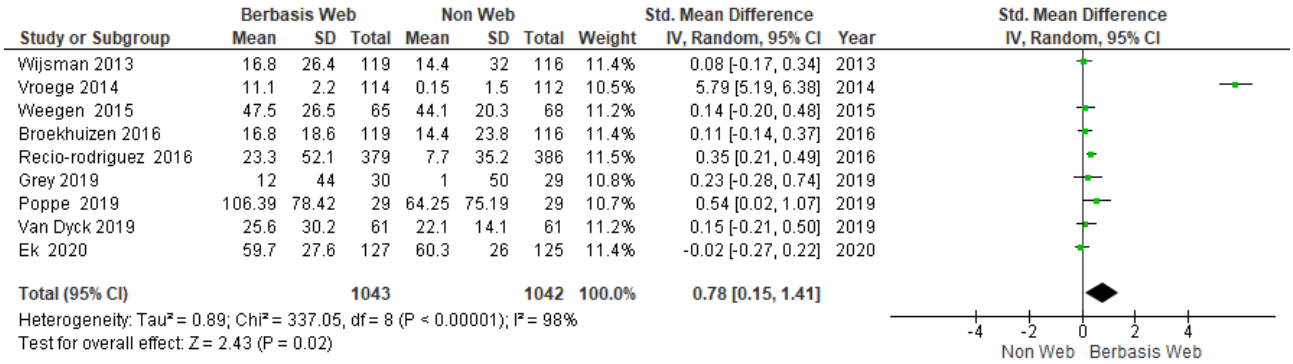

Figure 4. Forest Plot the Effectiveness of a Web-Based Intervention On Physical Activity in the Elderly

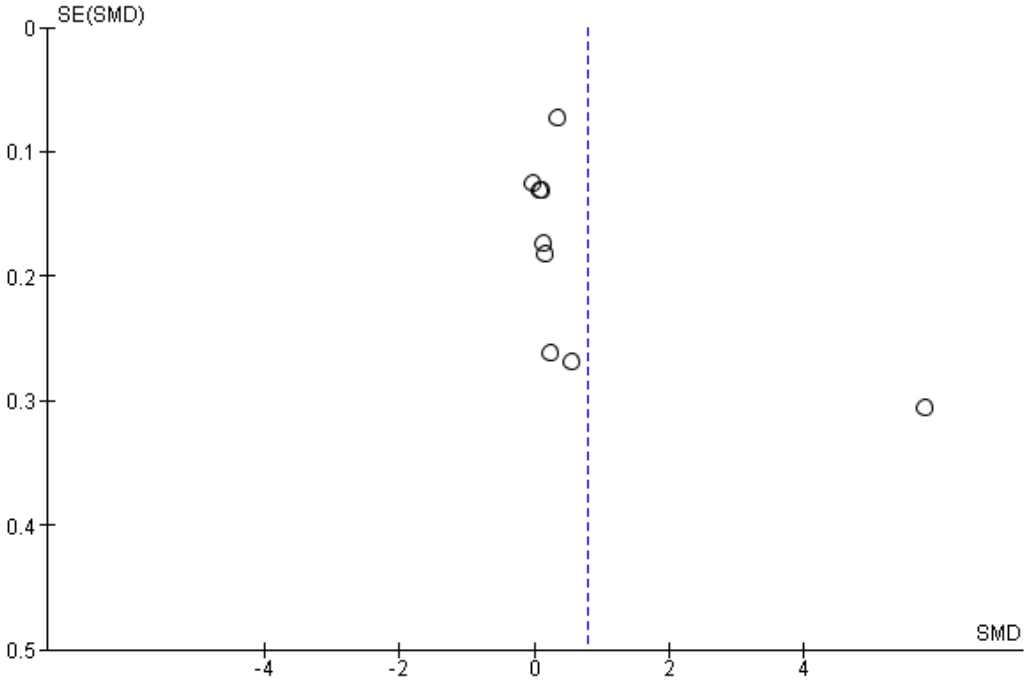

Figure 4. Funnel plot the Effectiveness of a Web-Based Intervention On Physical Activity in the Elderly

DISCUSSION

The results of this meta-analysis show that web-based physical activity intervention has the potential to significantly increase the physical activity of older people (SMD = 0.78; 95%CI= 0.15-1.41; p = 0.02) with data heterogeneity of I2 = 98%. This result is in line with the meta-analysis conducted by Gal et al (2018) which underlined that the use of additional devices accompanied by applications from smartphones can increase daily physical activity activities in the adult population. Device and internet-based interventions are indeed believed to increase self-monitoring (Murray, 2012) which is not only beneficial for increasing physical activity in older people but also in other populations such as young people with neurodevelopmental disorders (Khan et al., 2019), pregnant women. (Hayman et al., 2017), increasing physical activity and reducing depression in prostate and colorectal cancer patients (Golsteijn et al., 2018), even having a role in reducing body

fat percentage in the obese population (Nawi and Jamaludin, 2015) .

In his writings, Murray (2012) argues that a web-based intervention that is applied as a behavior change program has advantages in terms of cost-effectiveness and ease of implementation in self-monitoring. Web-based interventions bind the population to greater adherence to physical activity (Recio-Rodriguez et al., 2016; Hayman et al., 2017), although in some population cases, such as people with obesity, internet-based interventions in the form of virtual coaching have no effect significant effect on the number of physical activity performances carried out (Watson et al., 2012), but in the end the internet-based coaching intervention was found to be able to function to maintain population level activity. This indicates that the success of a physical activity promotion program is not only influenced by the population's adherence to adherence, but also other things described in Behavior Change Techniques.

Various physical activity intervention approaches focus on behavioral change techniques (Chase, 2013; Zubala et al., 2017) which can be specified and translated into BCTs taxonomy (Michie et al., 2013). In this meta-analysis found several articles that discuss BCTs explicitly. Gray et al. (2019) describe each stage of web-based intervention through the BCT taxonomy, such as: goal setting and action planning through introductory sessions, feedback on behavior and self-monitoring of behavior via email and pedometer feedback. On the other hand, Poope et al (2019) stated that the eHealth as an intervention has the principle of the HAPA (health action process approach) model which explains that the key to behavior change depends on behavioral determinants in the form of risk perception, outcome expectancies, self-efficacy, intention, action planning, coping planning, and monitoring. Not only about intervention, the principles of behavior change theory were also explicitly studied by (Recio-Rodriguez et al., 2016) who presented the results of changes in physical activity based on the theory of planned behavior, in the form of precontemplation, contemplation, preparation, action, and maintenance.

In BCTs taxonomy, a successful behavior change intervention is not only seen from changes in motivation that occur or changes in behavior itself, but can also be seen from the goals in the form of outcomes from the results of the interventions carried out (Michie et al., 2013), even if the outcomes obtained just doing more physical activity (Hagger and Chatzisarantis, 2014; Zubala et al., 2017).

In this meta-analysis we chose to analyze articles with MVPA duration as an outcome in minutes per day to be able to see the effectiveness of the behavioral changes that occurred, instead of looking at the total MVPA time per week. Machida et al (2019) found that bouts or short periods of intense activity varied in adults with short bouts ranging from 1-4 minutes and long bouts being up to 13% of the total recommended MVPA. This daily bouts calculation becomes interesting if it is correlated with the metabolic syndrome. Jefferis et al (2016) found that MVPA with longer bouts (≥10 min/day) was associated with lower adiposity and better metabolic health in the elderly population.

This meta-analysis study only focuses on the outcomes of physical activity behavior change interventions that are applied through web-based interventions. Other research that explores the construct of behavior change techniques on physical activity can be carried out as a follow-up analysis in order to see the extent to which web-based intervention has an effect on the stage of change in the physical activity of

older people. Based on this study, it can be concluded that overall web-based intervention has a significant positive effect on increasing daily physical activity in elderly individuals.

AUTHOR CONTRIBUTION

Gina Fazrina explores and collects data. Hapsari Cahyaningrum assesses the risk of bias and analyzes statistical data. While determining the theme, data extraction, and manuscript creation were carried out by the two, and it was agreed by both of them together.

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This study is self-funded.

CONFLICT OF INTEREST

There is no conflict of interest in this study.

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