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Effectiveness of Primary Care-Based Interventions Promoting Physical Activity: A Meta-Analysis Study

Fiziksel Aktiviteyi Teşvik Eden Birinci Basamak Temelli Müdahalelerin Etkililiği: Bir Meta-Analiz Çalışması

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Abstract: The benefits of physical activity in promoting health and preventing chronic diseases have been proven; however, inactivity remains a major problem in many countries worldwide. This meta-analysis aimed to evaluate the effectiveness of primary care-based interventions for physical activity promotion. The literature search was carried out on Medline, Cochrane Library, Web of Science, and Scopus databases. Randomized controlled studies performed on adults, included interventions for promoting physical activity, had a follow-up period of at least 12 months, and performed intention-to-treat analysis were reviewed. A total of 16 randomized controlled trials from 7 different countries were included in the meta-analysis (n=8,762). The most common interventions were providing informative materials about physical activity (10 studies), phone calls for support and follow-up (10 studies), and providing an exercise prescription/program for the participants (9 studies). In five studies, participants were given self-monitoring tools to follow up on their own activity levels. Interventions provided low or low-medium increases in the physical activity duration (standardized mean difference [SMD]=0.21, 95.0% CI: 0.15 – 0.27), energy spent on physical activities (SMD=0.14, 95.0% CI: 0.05 – 0.23), and the number of steps (SMD=0.32, 95.0% CI: 0.19 – 0.44). Although interventions aimed to increase the physical activity level showed limited effectiveness, given the strong health benefits of physical activity, promotion programs in this regard need to be integrated into primary health care.
Keywords: Primary health care, Exercise, Physical activity, Meta-analysis

Özet: Fiziksel aktivitenin sağlığı geliştirme ve kronik hastalıkları önleme konusundaki faydaları kanıtlanmış olmasına karşın hareketsizlik dünyanın birçok ülkesinde önemli bir sorun olmaya devam etmektedir. Bu meta-analizde, fiziksel aktiviteyi teşvik etmek için yapılan birinci basamak temelli müdahalelerin etkililiğinin değerlendirilmesi amaçlanmıştır. Literatür taraması Medline, Cochrane Library, Web of Science ve Scopus veri tabanlarında yapılmıştır. Yetişkinler üzerinde gerçekleştirilen, fiziksel aktiviteyi teşvik etmeye yönelik müdahaleleri içeren, takip süresi en az 12 ay olan ve intention-to-treat analizi yapılan randomize kontrollü çalışmalar gözden geçirilmiştir. Yedi farklı ülkeden toplam 16 randomize kontrollü çalışma meta-analize dahil edilmiştir (n=8,762). En yaygın müdahaleler, fiziksel aktivite hakkında bilgilendirici materyallerin sağlanması (10 çalışma), destek ve takip için telefon görüşmeleri yapılması (10 çalışma) ve katılımcılar için egzersiz reçetesi/programı hazırlanmasıdır (9 çalışma). Beş çalışmada, katılımcılara kendi etkinlik düzeylerini görebilmeleri için aktivite takip araçları verilmiştir. Müdahaleler; fiziksel aktivite süresi (standartlaştırılmış ortalama fark [SMD]=0,21, %95,0 GA: 0,15 – 0,27), fiziksel aktiviteler için harcanan enerji (SMD=0,14, %95,0 GA: 0,05 – 0,23) ve adım sayısı (SMD=0,32, %95,0 GA: 0,19 – 0,44) düzeyleri üzerinde küçük veya küçük-orta düzeyde artış sağlamıştır. Fiziksel aktivite düzeyini artırmaya yönelik müdahalelerin sınırlı etkililik göstermiş olmalarına karşın, fiziksel aktivitenin güçlü sağlık yararları göz önüne alındığında, bu konudaki teşvik programlarının birinci basamak sağlık hizmetlerine entegre edilmesi gerekmektedir.
Anahtar Kelimeler: Birinci basamak sağlık hizmeti, Egzersiz, Fiziksel aktivite, Meta-analiz

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1. Introduction

Lifestyle-related risk factors (such as physical inactivity, tobacco use, unhealthy diet, and excessive alcohol intake) are among the leading causes of Disability-Adjusted Life Years (DALY). The most common chronic health problems, including cancer, cardiovascular diseases, diabetes mellitus, and lung diseases, are strongly linked to lifestyle (1). A healthy lifestyle, including regular exercise, is associated with a healthier and longer life expectancy (2). Physical inactivity was attributed to 34.6 million DALYs in 2015 (equivalent to approximately 3% of all causes) (1). Although health promotion interventions have increased in recent years, more than one-third of the adult population does not meet the physical activity recommendations, especially in developed countries (3, 4).

Insufficient physical activity creates a significant economic burden on countries and health systems (5). According to national estimates, total per capita health expenditures for inactive adults in the United States (USA) were 30% higher than for active adults in 2014 (6). Worldwide, physical inactivity was estimated to cost healthcare systems $53.8 billion in 2013, corresponding to 0.67% of all health expenditures in the world in that year (7).

According to the OECD (Organization for Economic Co-operation and Development) data, approximately 78% of the population aged 15 and over visited primary care physicians at least once a year in developed countries (8). Patient visits are important opportunities for lifestyle counseling in preventive medicine (9). American College of Sports Medicine (ACSM) and the American Medical Association (AMA) emphasized that physical inactivity should be considered a 'vital sign' in primary care, and physical activity should be evaluated together with other clinical measurements such as blood pressure and weight status (10-12). Similarly, WHO European Region stated that practices such as assessment of physical activity level, providing counseling, and referral when necessary should be integrated into standard primary health care services (13).

Studies on the effectiveness of interventions applied in primary health care to increase the level of physical activity began in the 1980s (14). Over the next 15-20 years, systematic reviews and meta-analyses have been published evaluating intervention studies, mostly with short follow-up periods (14-19). Over the years, the number of randomized controlled studies with extended follow-up periods on this subject has increased. This meta-analysis aimed to evaluate the effectiveness of randomized controlled intervention studies with at least 12-month follow-up period for physical activity promotion in primary health care.

2. Materials and Method

2. 1. Meta-analysis eligibility criteria

The criteria for eligibility were as follows:

1. Studies having adult participants (≥16 years),
2. Articles whose full-text language is English,
3. Studies in which participants were selected from a primary health care facility,
4. Studies conducted all interventions to increase physical activity including individual or group-level counseling, providing materials/tools, face-to-face or telephone interviews (studies in which different behavior change interventions such as nutrition and smoking cessation or pharmacological interventions were applied together in addition to physical activity were excluded),
5. Randomized controlled trials,
6. Studies with a minimum follow-up period of 12 months after randomization,
7. Studies that give the change in physical activity level (in minutes or energy consumption level) or steps count as the dependent variable or that can be calculated with the data presented in the article,

8. Studies presented their results by performing the intention-to-treat analysis.

2. 2. Search strategy, screening, and data extraction

Studies were searched in four databases. Medline, one of the most frequently used databases for systematic reviews and meta-analysis, Cochrane Library, which contains reports of trials from many sources, and Web of Science and Scopus, which have broad coverage, were used for article search. These databases were considered adequate to reach trials that met the inclusion criteria of the meta-analysis. Search terms were: "physical activity" OR "exercis*" AND "primary care" OR "primary healthcare" OR "primary health care" OR "general practi*" OR "family physician" OR "family practice". Searches were limited to the title, abstract, and keyword sections of the articles. In addition, the reference lists of the relevant articles and the previously published systematic reviews were also hand-searched, and the articles that could be related to this meta-analysis were evaluated. All articles from the date of the search (May 2021) were reviewed retrospectively.

The articles obtained from the databases were imported into EndNote X8.1 (EndNote X8.1 by Thomson Reuters). Most of the trials reached on the article search were published in journals indexed in more than one database. Therefore, the duplication rate has increased. After removing the duplicated articles, the titles and abstracts of the remaining articles were evaluated by two researchers regarding eligibility criteria. Abstracts that did not meet the eligibility criteria were excluded. Full texts of the remaining articles were assessed by two authors to determine eligibility. The conflicts between the two authors in determining eligibility were resolved by discussion with the third author. The article selection flowchart is presented in Figure 1. One author extracted data from selected articles using a piloted form, including author and year, study location, study design and characteristics of the participants, inclusion and exclusion criteria, intervention characteristics, and outcome measures.

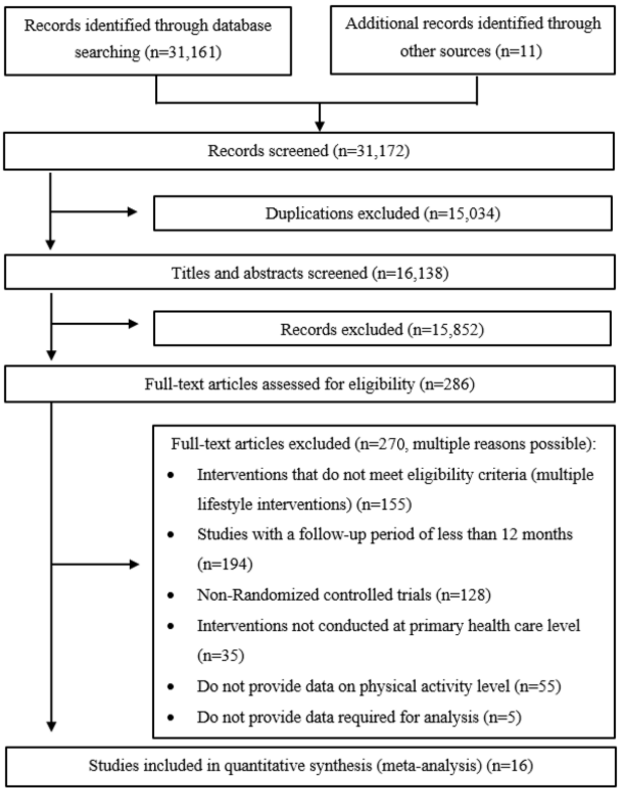

Figure 1. Study selection flow diagram

2. 3. Methodological quality appraisal

The modified Jadad scale was used for the quality assessment of the included studies (20). It is an eight-item scale designed to evaluate randomization, blindness, withdrawal and drop-out, inclusion and exclusion criteria, adverse effects, and statistical analysis (Table 1). Total scores of 4-8 represent good to excellent quality and 0-3 to poor quality (20). The methodological quality of the studies was appraised by two authors. The conflicts between the two authors were resolved by discussion with the third author.

Table 1. Modified Jadad scale

Items	Response	Score
1. Was the study described as randomized?	Yes	+1
	No	0
2. Was the method of randomization appropriate?	Yes	+1
	No	-1
	Not described	0
3. Was the study described as blinded?*	Yes	+1
	No	0
4. Was the method of blinding appropriate?	Yes	+1
	No	-1
	Not described	0
5. Was there a description of withdrawals and dropouts?	Yes	+1
	No	0
6. Was there a clear description of the inclusion/exclusion criteria?	Yes	+1
	No	0
7. Was the method used to assess adverse effects described?	Yes	+1
	No	0
8. Was the method of statistical analysis described?	Yes	+1
	No	0
*Double-blinding=1, single-blinding=0.5		

2. 4. Statistical analysis

The effect sizes of the studies were analyzed by considering the change levels of the participants between the baseline and the 12th-month data. For one study that did not have a 12th-month measurement, 15th-month data was considered (21). There was more than one intervention group in 4 studies (22-25). In 3 of these, the data of the intervention groups were combined by the authors of the relevant articles (23-25). In the effect size calculation strategy for the other study (22), effect size calculations were carried out by selecting the group with more intensive intervention among the intervention groups in accordance with Cochrane's recommendations (26). Data given as medians and interquartile ranges were converted into means and standard deviation values using the formulas in the literature (27, 28). Effect sizes were presented as Cohen's d (standardized mean difference [SMD]). The statistical analysis was carried out by using RevMan (Review Manager [RevMan] Version 5.4, The Cochrane Collaboration, 2020).

Heterogeneity was evaluated by interpreting the p-value of Cochran's Q test and I^2. The I^2 between 0-40% and p-value<0.1 were interpreted as low heterogeneity, and the fixed-effect model was chosen to calculate the effect sizes (29). Otherwise, the effect sizes were calculated by the random-effects model. Publication bias was examined with funnel plots. In accordance with the recommendations in the literature, the funnel plot was conducted if the number of studies in the analysis was ten or more (30).

2. 5. Ethical statement

Ethical approval for the study was granted from the Ethics Committee of Marmara

University School of Medicine (Protocol code: 09.2021.625, Date: 07.05.2021).

3. Results

3. 1. Descriptive characteristics of studies and participants

A total of 8,762 participants were randomized in the 16 studies included in the meta-analysis. Excluding lost to follow-ups, the number of participants included in the final analyses was 6,426 (73.3%). The ages of the participants ranged from 18 to 85, and the majority of them were women (61.2%). Four studies were conducted in the population aged 60 years or over (31-34). Studies were conducted in 7 different countries, mostly in the United Kingdom (6 studies) and New Zealand (4 studies). In 5 of the studies, participant selection criteria included the presence of at least one chronic disease or chronic disease-related risk factors (Table 2) (21, 35-38).

Table 2. Characteristics of studies included in the meta-analysis

Author, year	**Country**	**Participants** (Undergoing randomization / Analyzed at the end of the follow-up period)	**Female participants** (%)[a]	**Age range** (mean ± sd)**, years**[a]	**Other features of participants**
Elley, 2003[b]	New Zealand	878/750	66.2	40-79 (Intervention [I]:57.2±10.8; Control [C]:58.6±11.5)	-
Harris, 2015[b]	United Kingdom	298/273	53.7	60-75 (Not reported)	-
Harris, 2017[b]	United Kingdom	1023/956	64.1	45-75 (Not reported)	-
Hillsdon, 2002	United Kingdom	1658/674	51.0	45-64 (I1:54.6±5.5; I2:55.0±5.9; C:55.0±5.7)	-
James, 2017	Australia	203/118	70.4	≥18 (57±13)	-
Kinmonth, 2008	United Kingdom	365/321	62.0	30-50 (40.6±6.0)	Individuals having a parent with type 2 diabetes mellitus
Kolt, 2007	New Zealand	186/165	66.1	≥65 (I:74.1±6.2; C:74.3±5.9)	-
Kolt, 2012	New Zealand	330/270	53.9	≥65 (I:74.3±6.2; C:73.9±5.9)	-
Lawton, 2008	New Zealand	1089/1008	100.0	40-74 (I:59.1±6.8; C:58.7±6.9)	-
Martín-Borràs, 2018	Spain	422/339	60.9	18-85 (I:69.5±8.4; C:68.2±8.9)	Individuals having at least one chronic disease
Morey, 2009	USA	398/355	0.0	≥70 (I:77.7±5.0; C:77.4±4.9)	-
Peacock, 2020	United Kingdom	204/184	36.0	40-70 (64.0±6.0)	Individuals at moderate or high risk of developing type 2 diabetes mellitus and/or cardiovascular disease
Petrella, 2010[b]	Canada	360/329	57.2	55-85 (I:64.2±7.4; C:65.8±6.7)	-
Riera-Sampol, 2021	Spain	370/263	49.4	35-75 (62.2±8.8)	Individuals having at least two of the specified

					cardiovascular disease risk factors: Male over 55 years old or female over 65 years old, diabetes mellitus, hypertension, BMI>30 kg/m^2, smoking, dyslipidemia, family history of cardiovascular disease
Rome, 2014	Sweden	528/178	68.6	18-84 (52.2±13.0)	Individuals having at least one of the specified medical conditions: Cardiovascular disease, type 2 diabetes mellitus, obesity, musculoskeletal problems, moderate mental illness, respiratory problems
Taylor, 2021	United Kingdom	450/243	64.0	18-75 (50.0±12.0)	Individuals having at least one of the specified chronic diseases: Obesity, type 2 diabetes mellitus, hypertension, lower extremity osteoarthritis, depression

[a] *Characteristics of the participants at the randomization stage are presented.*
[b] *Cluster Randomized Controlled Trial*
I:Invervention group, C:Control group

3. 2. Interventions in the studies

Informative materials about physical activity were provided to participants in 10 studies (22, 24, 25, 31-35, 37, 39). Phone calls for support and follow-up were made in 10 studies (22, 23, 25, 31-34, 39-41), and supportive text messages were also sent to the participants in 1 study (34). While most of the studies included interventions at the individual level, group training, and group exercise sessions were applied in 2 studies (21, 37). In five studies, participants were given tools to monitor their own activity levels, such as pedometers/accelerometers/activity monitors, physical activity diaries, or notebooks (22, 31, 32, 35, 38). Exercise prescriptions/programs were provided for the participants in more than half of the studies (9 studies) (22, 31, 32, 34, 36, 38-41). Other interventions were providing information about local community activity organizations (such as walking) and encouraging participation in them (21), supportive home visits (25), and granting access to an internet-based physical activity support system (Table 3) (38).

Various healthcare professionals, particularly primary care physicians (25, 32, 34, 35, 38, 39, 41), and nurses (22, 25, 31, 34-36, 39, 40) took part in the studies to perform practices such as counseling and preparing individual exercise programs. In 13 studies, theoretical approaches were applied to create behavior change. Of these, transtheoretical model was used in 5 studies (33, 34, 36, 37, 41), motivational interview in 4 studies (21, 23, 39, 40), self-determination theory in 2 studies (35, 38), social cognitive theory in 2 studies (24, 34), theory of planned behavior 1 study (25), and health belief model in 1 study (there are studies applying more than one strategy) (Table 3) (23).

Table 3. Interventions conducted in the studies

Author, year	Study group	Interventions	People delivered the intervention
Elley, 2003	Control	-	GP, nurse[a]
	Intervention	1 interview with primary care clinician using motivational interview techniques, written exercise prescription, supportive phone calls (≥3 times; 10-20 minutes), quarterly newsletters, and other mailed materials (containing specific exercise programs)	
Harris, 2015	Control	-	Nurse
	Intervention	Interviews based on behavioral change techniques (4 sessions including goal setting, increasing self-efficacy and social support, overcoming barriers, and building lasting habits), information handbook, self-monitoring tools and individual physical activity program	
Harris, 2017	Control	-	Nurse
	Intervention 1	Self-monitoring tools, a physical activity diary (including a 12-week walking plan), and an individualized handbook (including encouraging social support, goals and planning and self-monitoring)	
	Intervention 2	Intervention 1 and individualized physical activity counseling (10–20-minute sessions, 3 times in total)	
Hillsdon, 2002	Control	-	Health promotion Specialist[a, b]
	Intervention 1	Initial health check, 6 supportive phone calls using motivational interview techniques	
	Intervention 2	Initial health check, 6 supportive phone calls (advice about the importance of physically active lifestyle) based on health belief model	
James, 2017	Control	Providing a physical activity promotion brochure containing the National Physical Activity Guidelines	Exercise physiologist[c]
	Intervention 1	An initial 60-minute interview (goal setting) and four 30-minute follow-up interviews (assessment of progress and challenges towards goals), all face-to-face	
	Intervention 2	Similar as Intervention 1, but with follow-up calls with phone calls	
Kinmonth, 2008	Control	An advice leaflet with brief information on the benefits of increasing physical activity	Trained facilitator from a range of health professions[d]
	Intervention 1	Control intervention, supportive phone calls (6 times) to promote the program and teach behavior change strategies, monthly support by mail (7 times)	
	Intervention 2	Control intervention, supportive home visits (1 hour; 4 times) and phone calls (9 times) similar in content to Intervention 1	
Kolt, 2007	Control	-	Exercise counselor[e]
	Intervention	8 telephone counseling sessions (containing general information about physical activity and improving problem-solving skills, social support, and physical activity self-efficacy) and mailed supportive material (including a walking log and pamphlets)	
Kolt, 2012	Control	Exercise prescription based on increasing the time spent with physical activity and supportive phone calls (3 times; lasting 10-30 minutes) in the following 4 months	GP, physical activity counselor
	Intervention	Exercise prescription based on the goal of increasing the number of daily steps, self-monitoring tools, and phone calls in the same way as with the control group	
Lawton, 2008	Control	-	Nurse[a]
	Intervention	Exercise prescription, supportive telephone calls (average of 5 interviews per participant, each lasting 15 minutes), and a 30-minute face-to-face assessment interview at 6 months	
Martín-Borràs, 2018	Control	-	Physical activity specialist[a]
	Intervention	60-minute group exercise sessions (twice a week for 12	

		weeks) and discussion at the end of sessions on mechanisms for promoting the continuation of routine daily activities and increasing social support, organizing group walking programs	
Morey, 2009	Control	-	Health counselor, GP, Nurse[c, e]
	Intervention	1 initial counseling session, an exercise booklet, phone calls (12 times), encouraging phone messages (12 times), self-monitoring tools and feedback to the participant about their progress (4 times in total, quarterly)	
Peacock, 2020	Control	Short interview (20 minutes) about the benefits of physical activity and giving written materials	Health trainers from a range of health professions[f]
	Intervention	In addition to the control group, wearable activity monitors and 20–30-minute counseling sessions (4 times in total, quarterly)	
Petrella, 2010	Control	Exercise prescription	GP[e]
	Intervention	Exercise prescription, counseling, and supportive telephone interviews according to the stage of change (4 times in total, quarterly)	
Riera-Sampol, 2021	Control	Exercise prescription (non-individualized, with standard recommendations)	Nurse[e]
	Intervention	Individualized exercise prescription suitable for the participant's stage of change, and motivational interviews and follow-up interviews (three times at 2nd, 6th, and 9th months)	
Rome, 2014	Control	Information about local fitness centers and exercise groups	Physiotherapist, Health educator[e]
	Intervention	Two group exercise sessions (45-60 minutes) at moderate intensity and two training sessions (2 hours) explaining the benefits of exercise, explaining exercise recommendations (standard), and conducting motivational interviews according to the stage of change	
Taylor, 2021	Control	Exercise prescription	GP[f]
	Intervention	Exercise prescription, self-monitoring tools, and access to an internet-based physical activity support system	

[a] Motivational interviewing, [b] Health belief model, [c] Social cognitive theory, [d] Theory of planned behavior, [e] Transtheoretical model, [f] Self-determination theory
GP: General practitioner

3. 3. Methodological quality assessment of studies

In the assessment made according to the modified Jadad scoring, the total scores of 16 studies ranged from 5 to 7.5. No studies were excluded as a result of the assessment. Unmet criteria were mostly blinding (Item 3 and Item 4) and reporting of adverse events (Item 7) (Table 4). Due to the nature of the interventions, a double-blind design could not be conducted in any of the trials. Adverse effects related to interventions were reported in more than half of the studies (n=9) (21, 22, 31-33, 35, 38, 40, 41).

Table 4. Methodological quality assessment of the included studies according to the modified Jadad scale

	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Total
Elley, 2003	1	1	0,5	1	1	1	0	1	6,5
Harris, 2015	1	1	0,5	1	1	1	1	1	7,5
Harris, 2017	1	1	0	0	1	1	1	1	6
Hillsdon, 2002	1	1	0	0	1	1	0	1	5
James, 2017	1	1	0,5	1	1	1	0	1	6,5
Kinmonth, 2008	1	1	0	0	1	1	0	1	5
Kolt, 2007	1	1	0,5	1	1	1	1	1	7,5
Kolt, 2012	1	1	0,5	1	1	1	1	1	7,5
Lawton, 2008	1	1	0	0	1	1	1	1	6
Martín-Borràs, 2018	1	1	0,5	1	1	1	1	1	7,5
Morey, 2009	1	1	0	0	1	1	0	1	5

Peacock, 2020	1	1	0,5	1	1	1	1	1	7,5
Petrella, 2010	1	1	0	0	1	1	1	1	6
Riera-Sampol, 2021	1	1	0,5	1	1	1	0	1	6,5
Rome, 2014	1	1	0	0	1	1	0	1	5
Taylor, 2021	1	1	0,5	1	1	1	1	1	7,5

3. 4. Change in physical activity duration

Figure 2 shows the effect sizes of 10 studies examining the change in physical activity duration. The fixed-effect model was used for the analyses since the Cochran's Q test and the I^2 values indicated low heterogeneity (Q=13.74, sd=9, p=0.13, I^2=34). In the fixed-effect model, the mean effect size of the studies was calculated as 0.21 (SMD, 95.0% CI: 0.15 – 0.27, p<0.001). The interventions resulted in a statistically significant low increase in physical activity minutes. The distribution of the studies in the funnel plot does not show asymmetry (Figure 3).

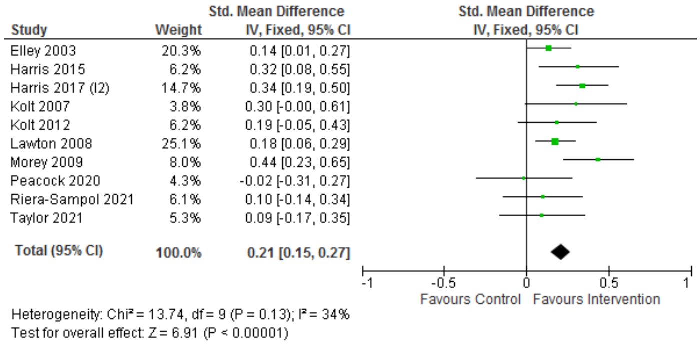

Figure 2. Forest plot of studies measuring the change in physical activity duration

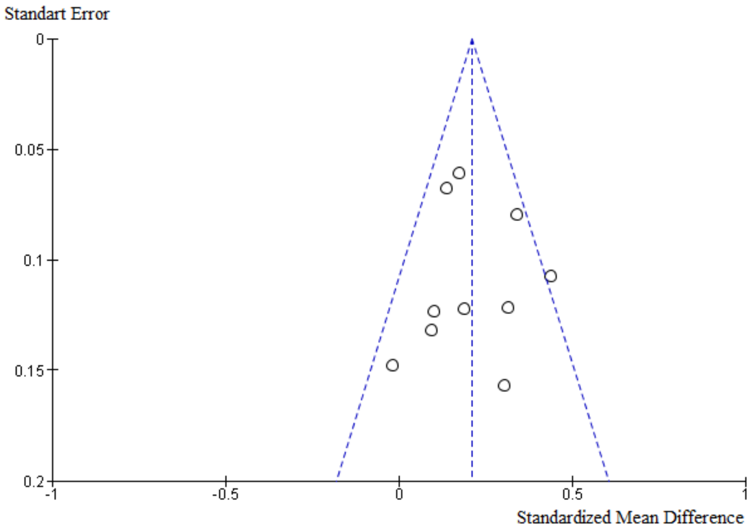

Figure 3. Funnel plot of studies measuring the change in physical activity duration

3. 5. Change in the level of energy spent on physical activities

A total of 8 studies evaluated the change in total energy expenditure during activities in measuring the effect of interventions (Figure 4). The random-effects model was used for the analyses since the Cochran's Q test and the I^2 values showed significant heterogeneity between the studies (Q=12.34, sd=7, p=0.09, I^2=43). In the random-effects model, the mean effect size of the studies was calculated as 0.14 (SMD, 95.0% CI: 0.05 – 0.23, p=0.003). Accordingly, the interventions provided a low-level increase in the energy spent on physical activities, and this increase is statistically significant.

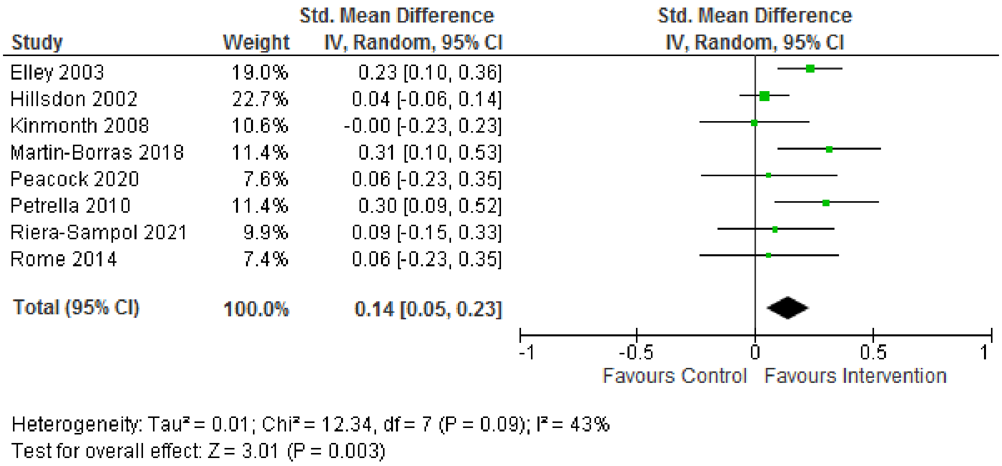

Figure 4. Forest plot of studies measuring the change in energy level spent on physical activities

3. 6. Change in number of steps

In 3 studies using a pedometer/accelerometer as a measurement method, the changes in the number of steps of the participants were presented. Cochran's Q test and I^2 values favored low heterogeneity; therefore, the fixed-effect model was used for the analysis (Q=0.11, sd=2, p=0.95, I^2=0). The mean effect size of the studies showed that interventions provided a low-moderate increase in the number of steps (SMD=0.32, 95.0% CI: 0.19 – 0.44, p<0.001) (Figure 5).

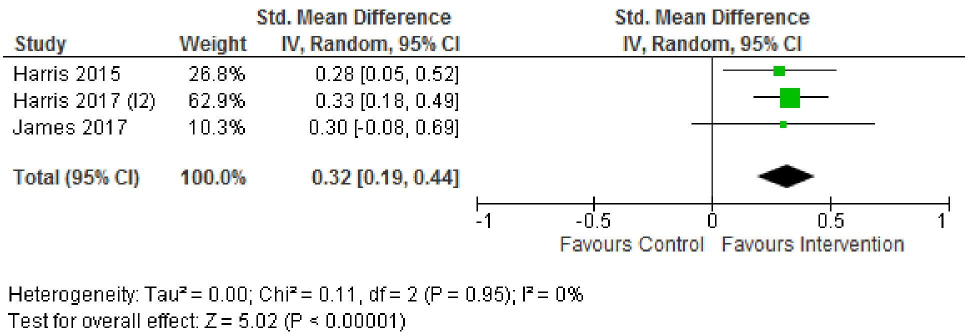

Figure 5. Forest plot of studies measuring change in number of steps

3. 7. Adverse events

The most frequently reported adverse events were falls, injuries, muscle soreness, and deterioration in health problems already present. Fractures have been reported rarely and ranged from 1-5% in 3 studies (22, 31, 38). No life-threatening serious adverse events associated with the intervention were identified in any of the studies. Total adverse events did not differ between control and intervention groups in most of the studies. However, in Lawton's study, falls and injuries were more common in the intervention group (40). Also, self-reported falls and cardiovascular events recorded in primary care were lower in the intervention groups in the study by Harris et al. (22).

4. Discussion

In this meta-analysis evaluating interventions for physical activity promotion in primary health care, 16 randomized controlled trials were reviewed. In the results of the analyses, the mean effect size values showed an increase in activity at low or low-medium levels. The results of our study are similar to previous studies in the literature. In one of the first systematic reviews on this topic, Eaton et al. examined eight intervention studies published between 1984 and 1996 with different follow-up periods (14). The effect size values of the included randomized controlled studies were distributed between 1.04-1.81 (OR) (14). In the meta-analysis published by Williams in 2007, the mean effect size value of 6 randomized controlled studies with a follow-up period of 4 months to 2 years was found to be 1.20 (relative risk [RR], 95%, CI: 1.06-1.35) (19). Similarly, in a meta-analysis published in 2011, 8 randomized studies with a follow-up period of 6 to 12 months had a low effect on the change in physical activity level (RR=1.16, 95% CI: 1.03-1.30) (17). In Orrow's study (2012), 12-month measurements in 14 included randomized controlled trials were examined, and the mean effect size of interventions was found to be 1.42 (OR, 95% CI: 1.17-1.73) for studies with categorical data as dependent variables and 0.25 (SMD, 95% CI: 0.11-0.38) for studies with continuous data (16).

The most prominent initiatives in the studies included in this meta-analysis were providing informative written materials, making phone calls for support and follow-up, and providing an exercise prescription/program. Factors affecting human behavior can be grouped as individual (such as people's level of knowledge or belief in their ability to change their behavior and habits), social (related to how people relate to one another and their impact on other people's behavior), and environmental (a person's area of residence, local facilities, economic situation, or technological possibilities) factors (42). An 'ecological' approach, which addresses the factors affecting behavior in all three groups, is considered the most effective approach in creating behavior change (42). However, studies included in the meta-analysis mostly focus on individual factors. Only two studies included interventions for social factors (group exercise/educational sessions, interviews about the ability to create social support, and providing information about group walking programs), and there were no studies involving interventions on environmental factors (21, 37). Studies in the meta-analysis often included a combination of different disciplines for interventions such as counseling/training. Physicians, nurses, and physiotherapists are the most common professions. A similar approach was recommended in a review that evaluated 3502 articles examining behavior change interventions in primary care. It was stated that collaborative team-based studies involving physicians and nurses were more effective in behavior change than a single profession (43).

In the five studies included in the meta-analysis, the participants were given tools to monitor their own activity levels, such as a pedometer/accelerometer/activity monitor or physical activity diary (22, 31, 32, 35, 38). It was stated that giving individuals tools to monitor their own activity levels can create a behavioral change to reduce the time spent sedentary (44, 45). In our study, the mean effect size of studies using activity tracking tools was found to be 0.24 (SMR, 95.0% CI: 0.14-0.33). In a recently published meta-analysis, the mean effect size value of 5 studies using activity level monitoring tools was found to be 0.44 (95.0% CI: 0.26 - 0.62) higher than our study (46).

4. 1. Strengths and limitations

The strengths of this study include the inclusion of intervention studies with a high number of participants from 7 different countries. Although approximately half of the studies are from the UK, the representation of different countries increases the generalizability of the results to primary health care. In addition, the inclusion of studies with a minimum follow-up period of 12 months in the analysis revealed results that give an idea about the sustainability of the impact of the interventions. All the studies included in the analysis were randomized controlled trials with high levels of evidence and low risk of bias. Also, the effect sizes of interventions were calculated over the change in physical activity levels of the participants between baseline and at the end of the follow-up period in all studies.

There are some limitations in this study. In most of the trials, the measurement of physical activity levels based on the statements of participants. The effect size values calculated from these studies could be differ from the true level due to non-objective measurement of the physical activity levels. Another limitation is the reduction in the number of studies included due to the selection of studies with a follow-up period of at least 12 months in the meta-analysis. Therefore, subgroup analyses could not be performed. Also, only English-language publications were included in the article screening to reach trials with better study design standards and higher report completeness rates (47, 48). Although there are conflicting publications on the impact of this strategy on meta-analyses, the possibility that it might minimally increase the mean effect size should be considered (47). In addition, the methodological quality assessment of the studies included in the meta-analysis was performed by the Modified Jadad scoring. However, biases not reported in the studies could have affected the results of the meta-analysis. Finally, although the possibility of publication bias in the funnel plot evaluation seems low, studies that found interventions ineffective may have been missed due to not including articles from local databases or unpublished studies.

5. Conclusion

In this meta-analysis, which included a total of 16 randomized controlled trials, it was found that the effects of the interventions on the change in physical activity level at the end of the 12-month follow-up period were low to moderate. The highest effect size value was found in studies measuring the number of steps. Although the frequency of use of behavior change models in studies was high, the focus was mostly on individual determinants among the factors affecting behavior.

The interventions were found effective, albeit to a limited extent. Hence interventions to promote and improve physical activity should be incorporated into primary care, considering the strong health benefits of activity demonstrated in the literature. Initiatives should also address the social and environmental determinants that influence behavior. In addition, the chance of success of physical activity counseling may increase with the widespread use of physical activity measurement tools such as pedometers. The increase in randomized controlled trials with long follow-up periods will enable future meta-analyses to include more studies and to reveal the differences between the effectiveness levels of interventions with subgroup analyses.

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Ethics

Ethics Committee Approval: The study was approved by Ethical Committee Marmama University of Health Sciences Clinical Research (Decision no:09.2021.625, Date: 07.05.2021

Informed Consent: The authors declared that it was not considered necessary to get consent from the patients because the study was a retrospective data analysis

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