



Telehealth to Improve Physical Activity in Adults with Diabetes Mellitus: A Narrative Review

Triana Karnadipa^{1*)}; Ari Nurfikri¹; Safrin Arifin¹

^{1*)} Vocational Education Program Universitas Indonesia

ARTICLE INFO

Article history:

Received 11 December 2021

Accepted 21 April 2022

Published 10 June 2022

Keyword:

Diabetes mellitus
Physical activity
Telehealth
Telemedicine

ABSTRACT

Physical activity has been evaluated to decrease mortality rates in people with diabetes mellitus. After the COVID-19 pandemic, healthcare delivery was leaned towards telemedicine or telehealth to conduct social distancing. The primary aim of this review is to evaluate formats and strategies used in telemedicine to improve physical activity in adults with diabetes mellitus. ProQuest, Medline, and CINAHL were searched for studies involving adults with diabetes mellitus (>18 years old); telemedicine; and physical activity outcomes. The quality of the studies was appraised using the JBI Critical Appraisal Checklists for risk of bias, study design, and quality of evidence. Data syntheses were conducted following simplified approach by Popay et al. Themes were developed based on the findings. Five randomized controlled trials met the inclusion criteria. The risk of bias was determined low in most of the studies. Text messages were the most common method. Pedometer, accelerometer, and International Physical Activity Questionnaires were commonly used to quantify the level of physical activity. Frequent reminders using text messages to the participants were the common strategy to ensure their adherence. The telehealth intervention has not yet shown significant positive effects on physical activity in people with diabetes mellitus. Further studies conducting synchronous and hybrid telehealth to improve physical activity in adults with diabetes mellitus were needed.

Kata kunci:

Diabetes mellitus
Aktivitas fisik
Telehealth
Telemedicine

*) corresponding author

Triana Karnadipa

Physiotherapy Department Vocational
Education Progra Universitas Indonesia

Email: triana.karnadipa@ui.ac.id

DOI: 10.30604/jika.v7i2.1030

Copyright @author(s)

ABSTRAK

Aktivitas fisik telah dievaluasi untuk menurunkan angka kematian pada penderita diabetes mellitus. Setelah pandemi COVID-19, pemberian layanan kesehatan condong ke telemedicine atau telehealth untuk melakukan social distancing. Tujuan utama dari tinjauan ini adalah untuk mengevaluasi format dan strategi yang digunakan dalam telemedicine untuk meningkatkan aktivitas fisik pada orang dewasa dengan diabetes mellitus. ProQuest, Medline, dan CINAHL dicari untuk penelitian yang melibatkan orang dewasa dengan diabetes mellitus (>18 tahun); telemedis; dan hasil aktivitas fisik. Kualitas studi dinilai menggunakan JBI Critical Appraisal Checklists untuk risiko bias, desain studi, dan kualitas bukti. Sintesis data dilakukan mengikuti pendekatan yang disederhanakan oleh Popay et al. Tema dikembangkan berdasarkan temuan. Lima uji coba terkontrol secara acak memenuhi kriteria inklusi. Risiko bias ditentukan rendah di sebagian besar penelitian. Pesan teks adalah metode yang paling umum. Pedometer, akselerometer, dan Kuesioner Aktivitas Fisik Internasional biasanya digunakan untuk mengukur tingkat aktivitas fisik. Pengingat yang sering menggunakan pesan teks kepada para peserta adalah strategi umum untuk memastikan kepatuhan mereka. Intervensi telehealth belum menunjukkan efek positif yang signifikan terhadap aktivitas fisik pada penderita diabetes mellitus. Diperlukan penelitian lebih lanjut yang melakukan telehealth sinkron dan hibrida untuk meningkatkan aktivitas fisik pada orang dewasa dengan diabetes mellitus.

This open access article is under the CC-BY-SA license.



INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disorder that occurs due to ineffective production of a blood sugar regulating hormone, insulin, or when the body cannot utilize insulin properly. (World Health Organization, 2021a) This condition would lead to hyperglycaemia, or increased sugar level in blood. Over time, uncontrolled diabetes would cause serious disruptions to several body's systems, particularly the nerves and blood vessels. Based on recent report in 2019, diabetes had directly caused 1.5 million deaths. Non-insulin dependent or type-2 Diabetes is the most common type of diabetes and commonly caused by overweight and physical inactivity. During covid-19 pandemic, the prevalence of diabetes mellitus had increased by 6.2% in Indonesia since 2019. (Pusat Data dan Informasi, 2020) In addition, 11,6% of 1,488 people who died due to covid-19 infection had DM as their comorbidity factor. Thus, there is an urgent need to address effective care to prevent and control DM.

Physical activity has been recommended to treat people with non-communicable diseases, including people with type 2 diabetes mellitus. (Geidl et al., 2020) It is because physical activity has beneficial effects on blood pressure and blood glucose, which is the most important aspect in diabetes care. (Hill, 2019; Umeh, 2017) Moreover, according to a systematic review by Geidl et al., higher levels of physical activity can reduce mortality rates in people with type 2 diabetes mellitus. (Geidl et al., 2020) Moreover, people with NCD is recommended to do a minimum 150 minutes of physical activity to improve their life expectancy. In addition, two studies had found that higher level of physical activity is correlated with lower body mass index (BMI). (Bradbury et al., 2017; Suliga et al., 2018) Lower BMI in people with diabetes mellitus could lead to lower glucose level in blood, which is an essential aspect in diabetes care. (Umeh, 2017) Therefore, people with diabetes mellitus should do physical activity regularly and adequately to maintain their health.

The ongoing covid-19 has brought challenges to healthcare throughout the world. As social distancing is recommended by World Health Organization, particularly for people with diabetes who is in the high-risk group. Therefore, many physiotherapists practice had adopted telehealth as a method to deliver their physiotherapy service. (Bertoncello et al., 2020; World Health Organization, 2021b) Telehealth was applied to improve access to physiotherapy, thus patient with diabetes mellitus may receive treatment from their home. (Cottrell & Russell, 2020) Physiotherapy using telehealth could be delivered asynchronously or synchronously (real-time). The most common synchronous methods used in tele-physiotherapy were messaging, email, virtual reality and real-time activity tracker, whereas the real-time telehealth commonly used telephone or videoconferencing. (Cottrell & Russell, 2020) However, based on our recent literature search, a body of literature review evaluated the use of telehealth to improve physical activity level in people with diabetes mellitus was not yet established.

Drawing upon what had already been discussed, this study attempts to explore the effective telehealth formats and strategies to improve physical activity level in people with diabetes mellitus. The findings of this study could help health practitioners in decision making, especially in choosing effective telehealth strategies and methods to treat patient with diabetes mellitus.

METHOD

Literature Review

This literature review explores studies that evaluate effectiveness of telehealth; the formats and strategies shaping the telehealth. Data was synthesised following Popay et al's four steps: (1) developing a theory to explain how telehealth works, why and for whom; (2) developing a preliminary synthesis of findings of included studies; (3) exploring relationships in the findings; and (4) evaluating robustness of the synthesis. These steps were done to minimise bias and improve transparency of this review. (Popay et al., 2007)

Search Strategy

Searches were conducted on the following databases: CINAHL, ProQuest, dan MEDLINE between July 2021-August 2021 (Appendix 1). The search terms were developed according to previous reviews about telehealth and diabetes mellitus. Remaining related terms were searched through MeSH and non-MeSH subject headings. The search strategy consisted of the following keywords:

1. Diabetes Mellitus (MeSH Term) OR noninsulin depend OR insulin depend OR diabetes insipidus
2. e? health OR m? health OR online OR internet OR web OR Telecommunications OR Telemedicine OR Remote Consultation OR Telehealth OR OR telemonitor OR telerehabilitation OR Health education OR Patient education OR Health promotion OR Self Care OR Self manage*
3. physical exertion OR physical training OR physical activity OR functional activity OR physical education OR physical fitness OR physical endurance OR lifestyle OR activities of daily living

The keywords were searched separately and in combination. The results were restricted to full text in the English language. Due to a lack of studies meeting this criterion, the date of publication was not limited, and the results were reported based on the searches conducted with the above search strategy.

Selection Criteria

Studies were included if they met all the following criteria:

1. Level of evidence: randomised controlled trials (RCTs) and controlled trials (CT)
2. Population: adults and older adults with diabetes mellitus between 18 to 75 years old
3. Intervention: telehealth targeting improvement in physical activity level
4. Comparison: another intervention or no intervention
5. Outcomes: physical activity level outcomes

Exclusion criteria: telehealth not for people with diabetes and not aiming to improve physical activity level; grey literature, or non-English language studies.

Study Selection

TK and AN conducted study selection, data extraction, and quality assessment. SA, the third author, resolved any

disagreement. All full text was retrieved for further appraisal.

The JBI Critical Appraisal Checklists were utilised for the quality assessment of each included study. (The Joanna Briggs Institute, 2018) The following six criteria were evaluated: a) randomization method, b) concealed allocation, c) baseline similarity, d) blinding of outcome assessors, e) cointerventions, and f) intention-to-treat analysis. The six criteria were evaluated as ‘yes’, ‘no’, or ‘unclear’ (in a case of unclear reporting) for their methodological quality.

Data Extraction

Data were extracted using modified JBI Data Extraction Form for Experimental/Observational Studies. (Edoardo & Zachary, 2017) Information about study methodology; study population, sample size, demographics, baseline characteristics; interventions; and outcomes were extracted.

Data Analysis

This review used narrative review of the findings to answer the questions. (Popay et al., 2007) The components of TIDier checklists were adopted to ensure complete reporting of intervention. (Hoffmann et al., 2014) The description of formats and strategies; materials and procedures; the modes of delivery; frequencies, duration, intensity; and the assessment of adherence were reported.

RESULTS AND DISCUSSION

After searching the databases, 826 results were identified. Of these, 737 were excluded after reviewing the title and the abstract since they did not study people with diabetes or not physical activity level. Twenty papers were retrieved for full-text examination. Thirteen articles were critically appraised. Finally, five papers were included for review (Figure 1).

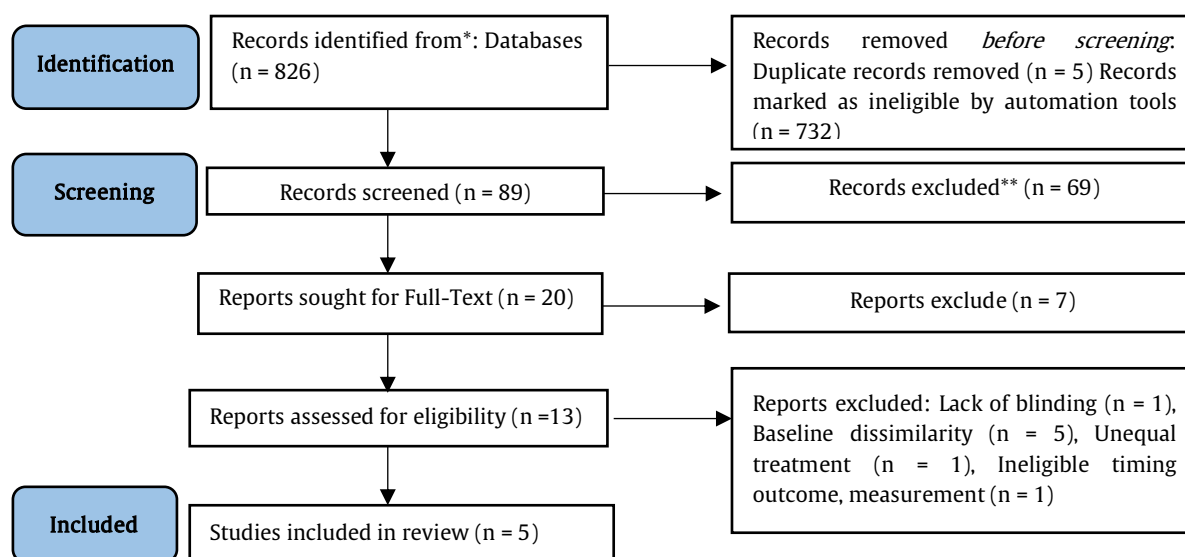


Figure 1 Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) chart of included and excluded studies

Participants

Seven RCTs were included with a total of 2,454 participants. The prevalence of female and male participants was 61.82% and 38.18%, respectively. Age was ranged from 27-74 years. Type-2 diabetes were 318 participants and prediabetes were 2136 participants. Participants with prediabetes were the most common (Table 1).

Description of studies

Most of the studies were conducted in USA (n = 3), India, UK (n=1), and Belgium (n=1). The studies were conducted between 2016 to 2020. Most of the studies used asynchronous model of telehealth, with one study applied hybrid model. (Azar et al., 2016) Three studies utilised text-messages as their modality (Agboola et al., 2016; Nanditha et al., n.d.; Polgreen et al., 2018); one study used a combination of live video conference, instructional video, and drop in

exercise (Azar et al., 2016); and one applied a combination of website and mobile application. (Poppe et al., 2019) (Table 2).

Two studies compared telehealth with no intervention. (Azar et al., 2016; Poppe et al., 2019) One study provided reminder telephone calls and pedometer for the control group. (Agboola et al., 2016) One study gave only Fitbit for their control participants. (Polgreen et al., 2018) One study only provided text-messages containing lifestyle modification advice at the baseline (Table 1). (Nanditha et al., n.d.) The most common prescribed exercises were personalised physical activity. (Agboola et al., 2016; Azar et al., 2016; Poppe et al., 2019) Two studies prescribed either 6000 steps walking and brisk walking (Table 2). (Nanditha et al., n.d.; Polgreen et al., 2018)

Outcome measure

Five studies used either pedometer and/or questionnaire to calculate the level of physical activity (Table 1). All included studies used pedometer to count daily numbers of

steps as a parameter of physical activity. While ActiGraphGT3X+ Accelerometers were used in two recent studies (Nanditha et al., n.d.; Poppe et al., 2019), two studies utilized Fitbit as a pedometer (Azar et al., 2016; Polgreen et al., 2018). Only one study used ActiPed+ Pedometer (Agboola et al., 2016). Stanford 7-Day Physical Activity Recall Questionnaire and International physical activity questionnaire (IPAQ) were used in two studies to evaluate the physical activity level of participants (Azar et al., 2016; Poppe et al., 2019).

Telehealth Formats and Strategie

The aim of this review is to identify formats and strategies used to deliver telehealth to people with Diabetes Mellitus. Prominent characteristics of telehealth to improve physical activity for people with Diabetes Mellitus were discussed. Surprisingly, asynchronous model was mostly used in the included studies (Agboola et al., 2016; Nanditha et al., n.d.; Polgreen et al., 2018; Poppe et al., 2019). Most of those studies used text-messages as a modality, while one study used both website and mobile app. Only one study applied hybrid model with video conference, instructional video, and exercise sessions as their modalities (Azar et al., 2016).

The most of telehealth formats were prescribed individually and in the participant's environment, following their daily routine. In asynchronous telehealth, participants were commonly reminded or encouraged to increase their activity level for at least 30 minutes a day while they were coached on healthy behaviour topics (Agboola et al., 2016; Nanditha et al., n.d.; Polgreen et al., 2018). Whereas, in a study utilised a mobile app, the participants filled out a questionnaire, analysed their barriers, and personalised their own activity and monitoring plan (Poppe et al., 2019). Particularly, only one study conducted a hybrid telehealth (Azar et al., 2016). The participants were instructed to watch videos containing education on healthy behaviour and exercise recommendations. In addition, they were encouraged to attend seven drop-in exercise sessions to improve their physical activity level. Most telehealth was delivered either by the researchers or interdisciplinary team, while one study involved a patient and public involvement group (Table 2).

Effects of telehealth on physical activity in people with diabetes mellitus

Most of the studies found that telehealth did not bring significant effects to physical activity level in people with diabetes mellitus, except for one study (Poppe et al., 2019). One study, however, found that telehealth effects on physical activity were significant in a certain period (3rd and 4th month) but decreased significantly at the end of the study (Agboola et al., 2016). It is because most of the telehealth programme in the included studies provide authority for their participants to design their personalised activity programme. Several factors to these negative effects were identified as follows: 1) the participants forgot to wear their step counter; 2) technical difficulties, particularly in older people; 3) their lack of ambitiousness to increase their daily step goal; 4) their chosen level of physical activity goals; 5) lack of personal leisure time; 6) differences in the chosen timeframe to do physical activity (everyday vs in the weekend); 7) level of education. Despite of the negative effects, virtual group activities were preferred and viewed to bring similar benefit as in-person session by

the participants (Azar et al., 2016). Moreover, two studies found that most of the participants (42-94%) were satisfied and would like to continue with the telehealth programme (Agboola et al., 2016; Azar et al., 2016). More than 70% of the participants even would like to recommend the programme to their friend and buy the technologies on sale price (Azar et al., 2016).

This literature review was conducted to evaluate the telehealth to improve physical activity level in adults with diabetes mellitus. The literature search found five studies that meet pre-determined quality criteria using the JBI Critical Appraisal Checklists. All five studies were evaluated to have a low risk of bias. In three RCTs, telehealth using text-messages as a modality showed conflicting effects (Agboola et al., 2016; Nanditha et al., n.d.; Poppe et al., 2019). Only one study found significant difference favoured the telehealth (Poppe et al., 2019). Whereas, two studies applying hybrid telehealth and combination of website and mobile app found no significant difference (Azar et al., 2016; Polgreen et al., 2018). The studies found that the physical activity increased at least until the 4th month, however decayed until the end of the study. Most of the studies allowed the participants to personalised or choose their preferred activity and goals while they are reminded to do their activity plan and encouraged to increase their activity level (Agboola et al., 2016; Azar et al., 2016; Nanditha et al., n.d.; Polgreen et al., 2018; Poppe et al., 2019). The chosen activities were walking, brisk walking, or personalized activities such as gardening or dancing. The models of telehealth were mostly asynchronous and one hybrid. Text-messages were commonly used as a modality to educate and remind the participants to do physical activity. The telehealth program was commonly designed and delivered by the interdisciplinary health team. The insignificant effect of telehealth was explained to be caused by the technical issues, unambitious personalised activity plan, and personal factors on the participant's side (Figure 2).

Overall, the included studies reported that telehealth did not significantly improve physical activity level in people with diabetes mellitus, except for one study (Poppe et al., 2019). This is in contrast with a previous systematic review with similar topic by Cassimatis and Kavanagh in 2012 who support telehealth to improve physical activity participation in adults with diabetes mellitus (Cassimatis et al., n.d.). In addition, the systematic review found that sustained behavioural changes could reduce insulin resistance and improve glucose control. However, the included evidence in the systematic review applied resistance and aerobic exercise in the telehealth strategies. This difference might be the potential reason on their significant effects compared to our findings that applied personalised physical activity and walking goals.

Table 1
Characteristics of Included Studies

First Author	Study Design	Total Participant	Age range, mean, and SD (years)	Types of Diabetes	Intervention Group	Control Group	Outcomes		
							Physical Activity	Other outcomes	
Agboola et al. 2016	RCT	Total=126 E=64 C=62	E=50.3±10.5 C=52.6±12.6	Type 2 Diabetes	Text-messages two times a day with activity feedback, a pedometer, a reminder telephone call	Reminder telephone calls with Pedometer	ActiPed+ Pedometer		HbA1c test, Weight (lb), Feasibility and Satisfaction Questionnaire
Azar et al. 2016	RCT	Total= 74 E=37 C=37	E=59.6±11.9 C=59.8±10.5	Prediabetes, Gestational Diabetes, Type 2 Diabetes	eCMP Programme: weekly face-to-face group meetings via video conferencing and pre-recorded exercise videos, and seven drop-in exercise sessions	No Intervention (Waiting list)	Stanford Physical Recall, Fitbit	7-Day Activity	Short Form-8 Health Survey, BMI, blood pressure, Dietary Approaches to Stop Hypertension, and Generalized Anxiety Disorder Scale
Polgreen et al. 2018	RCT	Total=138 E-1=46 E-2=44 C: 48	E-1: 43.0±16.0 E-2: 47.4±15.1 C: 44.6±16.7	Type 2 Diabetes	E-1: Fitbit with text-messages containing a step goal and a reminder E-2: Fitbit with text-messages as a reminder	Fitbit only	Fitbit		Quantitative insulin sensitivity check index, BMI, weight, blood pressure
Poppe et al. 2019	RCT	Total=54 E-1=24 E-2=12 C=18	E-1:62.91±7.16 E-2:58.92±9.52 C:64.89±8.62	Type 2 Diabetes	E-1: My Plan 2.0 (in website and mobile phone) for physical Activity with telephone calls as reminder. E-2: My Plan 2.0 (in website and mobile phone) for sedentary behavior with telephone calls as reminder.	No Intervention (Waiting list)	International physical activity questionnaire (IPAQ), ActiGraphGT3X+ Accelerometers		Health Action Process Approach (HAPA)
Nandhita et al. 2020	RCT	Total=2062 E=1031 C=1031	E= 52.0±10.2 C= 52.1±10.3	Prediabetes	E=Text-messages containing advice, tips, and goals setting to brisk walking for at least 30 minutes a day and stay active	Text-messages containing lifestyle modification advice at the baseline	ActiGraph Accelerometers	GT3X+	HbA1c, BMI, waist circumference, blood pressure, fasting plasma glucose, lipid levels, acceptability of SMS, dietary variables, and EQ-5D-3L

Table 2
Formats and strategies of Telehealth for included studies

Study	Prescribed Exercise	Model	Key Characteristics of Telehealth				Setting	Procedure	TiDier Components		
			Modality	Application	Dosage				Format	Provider	Adherence reported?
Agboola et al. 2016	Physical Activity: dancing, gardening, walking etc.	Asynchronous	Text-messages	-	30 minutes/day for at least 5 days in a week	PE	The participants were texted twice a day, in the morning and the evening. Morning messages provided feedback on the previous activity. Afternoon and evening messages provided coaching on healthy behaviour.	Individual	Interdisciplinary team	Yes	
Azar et al. 2016	Personalised Physical Activity Programme	Hybrid	Video Conference, Instructional Video, Drop-in exercise sessions	-	NS	PE, Health Centre	As a part of Electronic Cardio-Metabolic Program (eCMP), participants were given instructional videos and exercise modalities to improve their physical activity. Participants were encouraged to attend 7 drop-in exercise sessions.	Individual	Interdisciplinary team	Yes	
Polgreen et al. 2018	Walking Exercise	Asynchronous	Text-Messages	-	6000 steps/day	PE	The participants were given a Fitbit Zip. They were sent reminders or both reminders and goal setting in text messages. Participant can choose to text at 7:00, 8:00, and 9:00. They were encouraged to walk at least 6000 steps a day or at personal goals.	Individual	Researchers	Yes	
Poppe et al. 2019	Personalised Physical Activity	Asynchronous	Website Mobile App	My Plan 2.0	Personal goals	PE	The participants were required to sign-up and login into My Plan 2.0 Website and Mobile App. Then, they chose either physical activity or sedentary behaviour programme. According to their chosen programme, they filled out a questionnaire, created their personal action plan, foresee their barriers, and select their monitoring methods. They were emailed or notified about their goals, reviews on their previous activity or barriers, education and their achievements in points.	Individual	NS	Yes	
Nandhita et al. 2020	Brisk Walking	Asynchronous	Text-Messages	-	At least 30 minutes a day	PE	The participants were sent a text-messages 2-3 time a day. The messages contained tips, suggestions and positive encouragements for healthy behaviors including goal setting, physical activity, diet plans and personal strategies for healthy lifestyle. The contents of daily text-messages were different to avoid repetition. Participants with sedentary or light physical activity at baseline were suggested to walk briskly every day for at least 30 min. People with strenuous occupations or sufficient physical activity per day were recommended to maintain these activities.	Individual	Patient and Public Involvement Group	Yes	

Our findings were also in contrast with two systematic reviews evaluated the effects of telehealth in other chronic metabolic disease such as coronary artery disease and cardiac disease.(Rawstorn et al., 2016; TuranKavradim et al., 2020)The findings were also in contrast with two systematic reviews evaluated telehealth effects in other chronic metabolic disease such as coronary artery disease (CAD) and cardiac disease.Kavradim et al.found moderate positive effects of telehealth to improve physical activity in cohort with CAD.(TuranKavradim et al., 2020) The studies included in this systematic review use more telephone counselling/coaching, telecardiology monitoring, and online smart-phone platform, rather than text-messages. Therefore, the use of more engaging modalities in telehealth could be a potential factor in promoting the successful telehealth in adults in diabetes mellitus, Rawstorn et al.found significantly higher physical activity level favouring telehealth in adults with cardiac disease portrayed in higher step counts and energy expenditure.(Rawstorn et al., 2016) Compared to our findings, the significant higher step counts maintained only until 3rd or 4th month but decayed significantly until the end of the study period. This might because of better adherence and behaviour change in Rawstorn et al.

Our findings were similar to a SR by Jin et al. who found conflicting effects of telehealth to improve PA in adults with coronary heart disease.(Jin et al., 2019) The SR found only six out of 21 trials showed positive effects of telehealth on PA and MET levels, while the other 15 did not show significant effects. The studies included in this review used similar modalities as our review which were the combination of internet, smartphone app, online monitoring, text-messages, and telephone calls. Regarding feasibility, our findings found that 42-94% of participants were satisfied and 72% wanted to continue with the telehealth despite of the outcomes.

LIMITATION OF THE STUDY

The limitation of our review as follows: no meta-analysis was conducted due to high heterogeneity of the included studies; this review only included small numbers of studies; the evidence evaluated heavily on the asynchronous format; and, lastly, standardized mean difference were not counted to determine the effectiveness of telehealth.

CONCLUSIONS AND SUGGESTIONS

The telehealth intervention has not yet shown significant positive effect on physical activity in people with diabetes mellitus. Due to the personalised activity programme of telehealth, several factors were identified such as forgot to wear, technical issues, lack of ambitiousness, lack of leisure time, chosen goals, chosen timeframe, and level of education. Virtual group format is recommended to be applied as it was preferred by the participants. Advance analysis programme to determine appropriate motivational technique to induce behaviour change is also recommended to improve adherence and long-term effects. More future studies on telehealth to improve physical activity for people with diabetes mellitus with synchronous or hybrid formats are needed to conclude the effects of telehealth.

ETHICAL CONSIDERATIONS

Funding Statement

The authors did not receive support from any organization for the submitted work.

Conflict of Interest Statement

The author has declared no conflict of interest(s).

REFERENCES

- Agboola, S., Jethwani, K., Lopez, L., Searl, M., O'Keefe, S. & Kvedar, J. (2016). Text to move: A randomized controlled trial of a text-messaging program to improve physical activity behaviors in patients with type 2 diabetes mellitus. *Journal of Medical Internet Research*, 18(11). <https://doi.org/10.2196/jmir.6439>
- Azar, K. M. J., Koliwad, S., Poon, T., Xiao, L., Lv, N., Griggs, R. & Ma, J. (2016). The electronic cardiometabolic program (eCMP) for patients with cardiometabolic risk: A randomized controlled trial. *Journal of Medical Internet Research*, 18(5). <https://doi.org/10.2196/jmir.5143>
- Bertoncello, C., Cocchio, S., Fonzo, M., Bennici, S. E., Russo, F. & Putoto, G. (2020). The potential of mobile health clinics in chronic disease prevention and health promotion in universal healthcare systems. An on-field experiment. *International Journal for Equity in Health*, 19(1). <https://doi.org/10.1186/s12939-020-01174-8>
- Bradbury, K. E., Guo, W., Cairns, B. J., Armstrong, M. E. G. & Key, T. J. (2017). Association between physical activity and body fat percentage, with adjustment for BMI: a large cross-sectional analysis of UK Biobank. *BMJ Open*, 7, 11843. <https://doi.org/10.1136/bmjopen-2016>
- Cassimatis, M., Kavanagh, D. J. & Health, W. (n.d.). *GTH2012/Cassimatis Effects of type 2 diabetes behavioural telehealth interventions on glycaemic control and adherence: a systematic review*.
- Cottrell, M. A. & Russell, T. G. (2020). Telehealth for musculoskeletal physiotherapy. *Musculoskeletal Science and Practice*, 48. <https://doi.org/10.1016/j.msksp.2020.102193>
- Edoardo, A. & Zachary, M. (2017). *Joanna Briggs Institute Reviewer's Manual*. The Joanna Briggs Institute. <https://doi.org/https://doi.org/10.46658/JBIMES-20-01>
- Geidl, W., Schlesinger, S., Mino, E., Miranda, L. & Pfeifer, K. (2020). Dose-response relationship between physical activity and mortality in adults with noncommunicable diseases: A systematic review and meta-analysis of prospective observational studies. In *International Journal of Behavioral Nutrition and Physical Activity* (Vol. 17, Issue 1). BioMed Central Ltd. <https://doi.org/10.1186/s12966-020-01007-5>
- Hill, J. (2019). LONG-TERM CONDITIONS The older person with diabetes: considerations for care. In *British Journal of Community Nursing* (Vol. 24, Issue 4). <http://tinyurl.com/y3nd86za>.
- Hoffmann, T. C., Glasziou, P. P., Boutron, I., Milne, R., Perera, R., Moher, D., Altman, D. G., Barbour, V., Macdonald, H., Johnston, M., Kadoorie, S. E. L., Dixon-Woods, M., McCulloch, P., Wyatt, J. C., Phelan, A. W. C. & Michie, S. (2014). Better reporting of interventions: Template for intervention description and replication (TIDieR) checklist and guide. *BMJ (Online)*, 348. <https://doi.org/10.1136/bmj.g1687>
- Jin, K., Khonsari, S., Gallagher, R., Gallagher, P., Clark, A. M., Freedman, B., Briffa, T., Bauman, A., Redfern, J. & Neubeck, L. (2019). Telehealth interventions for the secondary prevention of coronary heart disease: A systematic review and meta-analysis. *European Journal of Cardiovascular*

- Nursing*, 18(4), 260–271.
<https://doi.org/10.1177/1474515119826510>
- Nanditha, A., Thomson, H., Susairaj, P., Srivanichakorn, W., Oliver, N., Godsland, I. F., Majeed, A., Darzi, A., Satheesh, K., Simon, M., Raghavan, A., Vinitha, R., Snehalatha, C., Westgate, K., Brage, S., Sharp, S. J., Wareham, N. J., Johnston, D. G. & Ramachandran, A. (n.d.). *A pragmatic and scalable strategy using mobile technology to promote sustained lifestyle changes to prevent type 2 diabetes in India and the UK: a randomised controlled trial*. <https://doi.org/10.1007/s00125-019-05061-y>/Published
- Polgreen, L. A., Anthony, C., Carr, L., Simmering, J. E., Evans, N. J., Foster, E. D., Segre, A. M., Cremer, J. F. & Polgreen, P. M. (2018). The effect of automated text messaging and goal setting on pedometer adherence and physical activity in patients with diabetes: A randomized controlled trial. *PLoS ONE*, 13(5). <https://doi.org/10.1371/journal.pone.0195797>
- Popay, J., Baldwin, S., Arai, L., Britten, N., Petticrew, M., Rodgers, M. & Sowden, A. (2007). Guidance on the conduct of narrative synthesis in systematic reviews: A product from the ESRC Methods Programme. *Guidance on the Conduct of Narrative Synthesis in Systematic Reviews: A Product from the ESRC Methods Programme, METHODS BR* (April 2006), 13. <https://doi.org/10.13140/2.1.1018.4643>
- Poppe, L., de Bourdeaudhuij, I., Verloigne, M., Degroote, L., Shadid, S. & Crombez, G. (2019). A self-regulation-based eHealth and mHealth intervention for an active lifestyle in adults with type 2 diabetes: Protocol for a randomized controlled trial. *JMIR Research Protocols*, 8(3). <https://doi.org/10.2196/12413>
- Pusat Data dan Informasi. (2020). *Infodatin: Tetap Produktif, Cegah, dan Atasi Diabetes Melitus*. Kementerian Kesehatan RI.
- Rawstorn, J. C., Gant, N., Direito, A., Beckmann, C. & Maddison, R. (2016). Telehealth exercise-based cardiac rehabilitation: A systematic review and meta-analysis. In *Heart* (Vol. 102, Issue 15, pp. 1183–1192). BMJ Publishing Group. <https://doi.org/10.1136/heartjnl-2015-308966>
- Suliga, E., Cieřła, E., Rębak, D., Kozieł, D. & Gęszek, S. (2018). Relationship between sitting time, physical activity, and metabolic syndrome among adults depending on body mass index (BMI). *Medical Science Monitor*, 24, 7633–7645. <https://doi.org/10.12659/MSM.907582>
- The Joanna Briggs Institute. (2018). *Critical Appraisal Tools*. The Joanna Briggs Institute. <http://joannabriggs-webdev.org/research/critical-appraisal-tools.html>
- TuranKavradim, S., Özer, Z. & Boz, İ. (2020). Effectiveness of telehealth interventions as a part of secondary prevention in coronary artery disease: a systematic review and meta-analysis. In *Scandinavian Journal of Caring Sciences* (Vol. 34, Issue 3, pp. 585–603). Blackwell Publishing Ltd. <https://doi.org/10.1111/scs.12785>
- Umeh, K. (2017). Personal care plans and glycaemic control: the role of body mass index and physical activity. *British Journal of Nursing*, 26(10), 543–551.
- World Health Organization. (2021a, April 13). *Diabetes*. World Health Organization . <https://www.who.int/news-room/fact-sheets/detail/diabetes>
- World Health Organization. (2021b, September 2). *Coronavirus disease (COVID-19) advice for the public*. World Health Organization . <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public>