Living Well – Key Transition Points

Exercise and physical activity amongst those with obesity, type II diabetes and hypertension: A review of reviews

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List of Abbreviations

Aerobic Exercise Training	AET
Aerobic Training	AT
Behaviour Change Technique	BCT
Behavioural Physical Activity Intervention	BPAI
Behavioural Weight Management Programs	BWMP
Body Mass	BM
Body Mass Index	BMI
Cardiorespiratory Fitness	CRF
Combination Training	CT
Diastolic Blood Pressure	DBP
Did Not Report	DNR
Fat Free Mass	FFM
Fat Mass	FM
Heart Rate	HR
Heart Rate Reserve	HRR
High Density Lipoprotein	HDL-C
High Intensity Interval Training	HIIT
Hypertension	HTN
Low Density Lipoprotein	LDL-C
Mean Difference	MD
Median	MDN
Metabolic Equivalents	METs
Moderate Intensity Continuous Training	MICT
Moderate Intensity Training	MIT
Moderate Physical Activity	MPA
Non-Communicable Disease	NCD
Overweight	OW
Physical Activity	PA
Pulse Wave Velocity	PWV
Rating Of Perceived Exertion	RPE
Resistance Training	RT
Sprint Interval Training	SIT
Standardised Mean Difference	SMD
Systolic Blood Pressure	SBP
Total Cholesterol	TC
Triglycerides	TRG
Type II Diabetes Mellitus	T2DM
Waist Circumference	WC
World Health Organisation	WHO

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Executive Summary

- Physical activity and exercise have long been accepted as means to reduce disease risk, and as such there are UK government and World Health Organisation (WHO) PA guidelines of at least 150 minutes of moderate, or at least 75 minutes of vigorous activity weekly, or a combination of both.
- Despite this, only 61% of the population achieve these guidelines, and prevalence of NCD are increasing nationally and globally.
- This work therefore aims to review meta-analyses exploring the impact of exercise and/or physical activity interventions with individuals living with overweight and obesity, T2DM and hypertension in order to guide future interventions for such populations.
- Forty-four titles (n=89,451 participants, five studies DNR) were included in the review of reviews.
- Overall, findings display that structured exercise of various types and dose are effective in improving outcomes related to these conditions, and that behaviour change theories and/or techniques can enhance outcomes.
- Collectively the literature suggests that at least 150 minutes per week should be recommended, with aerobic training needed to bring about CRF improvements
- Resistance training should be encouraged to promote strength and balance improvements as well as enhancing body composition.
- Interventions should be behaviour informed, with those encompassing BCT/theories showing greater improvements to physical and behavioural outcomes.
- There are limitations to the literature included, including studies which were reported to be of poor quality and instances of missing information making extrapolation or interpretation of findings challenging. Therefore, future work must aim to undertake research, which is rigorous, comprehensive and encompasses a variety of outcome measures.

1. Introduction

Physical activity, defined as any bodily movement produced by skeletal muscles that produces energy (World Health Organisation, 2020), has long been accepted as a means to reduce disease risk (J. C. Morris, MD, 1958; J. N. Morris, Clayton, Everitt, Semmence, & Burgess, 1990). In 2008 physical inactivity was reported to account for 6% of coronary heart disease (CHD) burden, 7% of type II diabetes mellitus (T2DM) burden, and 9% of premature mortality (I. M. Lee et al., 2012). More recent analysis shows that 7.2% of all-cause deaths and 7.6% of cardiovascular disease (CVD) deaths are attributable to physical inactivity (Katzmarzyk, Friedenreich, Shiroma, & Lee, 2022). Despite this, only 61% of adults achieve the PA guidelines of 150+ minutes per week with 27% achieving less than 30 minutes per week (Sport England, 2022). This clearly highlights an increased non-communicable disease (NCD) risk for a large proportion of the population. It has been reported that by 2030, one in five women and one in seven men will be living with obesity (World Obesity Federation, 2022). Global cases of T2DM increased by almost 103% between 1990 and 2017, (J. Liu et al., 2020) with prevalence predicted to increase to 7079 per 100,000 by 2030 (Khan et al., 2020). Additionally, one in four adults have high blood pressure (12.5 million people) and this is predicted to increase to 1.5 billion people globally by 2025 (Public Health England, 2017). Taken together, this evidence highlights a need to take action to reduce or manage NCD prevalence and points toward physical activity as a means to do so. The WHO Global Action Plan on Physical Activity (GAPPA) calls for efforts to achieve a 15% relative reduction in physical inactivity (Hämäläinen et al., 2020). Therefore, there is a clear need for interventions to promote and increase PA participation in the general population.

There has been a deluge of literature examining the impact of PA and exercise on health and NCD outcomes. Where there is a large literature base on a topic area, systematic reviews and meta-analyses (which include quantitative analysis), are generated to synthesise findings from this wide scope of evidence. There has been an exponential increase in the number of meta-analyses published between 2007 and 2020 (Hernandez, Marti, & Roman, 2020). Subsequently, in order to collect and extract outcomes from several meta-analyses reviews, a review of reviews is appropriate (Hasanpoor, Hallajzadeh, Siraneh, Hasanzadeh, & Haghgoshayie, 2019). This work therefore aims to review meta-analyses exploring the impact of exercise and/or physical activity interventions with individuals living with overweight and obesity, T2DM and hypertension.

2. Methods

2.1. Search Strategy & Inclusion Criteria

Three systematic searches of electronic databases CINAHL Plus (Medline, PubMed Central, SportsDiscus), Science Direct and Web of Science were carried out in June 2022. The search strategy was developed by the author and reviewed by a subject librarian at the University of Chester. The databases were searched for ("physical activity" OR exercise OR walking) AND ("weight loss" OR "weight reduction" OR obesity OR overweight OR "weight management") AND review AND adult); ("physical activity" or exercise or fitness or "physical exercise")) AND (diabetes type 2 or diabetes mellitus type 2 or diabetes 2) AND adult*; and (("physical activity" or exercise or fitness or "physical exercise")) AND (hypertension or "high blood pressure" or "elevated blood pressure" or htn or hypertensive)) AND (adult*) to search for literature related to overweight and obesity, T2DM and hypertension respectively. The search terms and criteria were adapted to suit the requirements of each database to ensure consistency of systematic searching. To be included, the meta-analyses had to be published since 2012, in a peer-reviewed journal, in English.

2.2. Identification of relevant studies

The overweight and obesity literature search returned 476 titles. Of these, 435 were excluded by title screening, due to not being review papers. Forty-one titles were exported to EndNote (X9) for abstract and full-text screening. Twenty-seven titles were further removed due to not meeting the inclusion criteria. This left fourteen titles to be included in the review of reviews.

The T2DM literature search returned 138 titles for screening. Of these, 115 were exported to EndNote for abstract and full-text screening. Eighty were removed on title screening due to not being a review paper. A further fifteen were removed due to not including a meta-analysis. This left twenty titles to be included in the review of reviews.

The HTN literature search returned 94 titles. Of these, 14 were excluded on title screening. Eighty were therefore exported to EndNote for abstract and full-text screening. Forty-five were excluded due to not being a review article, and a further seventeen were excluded due to not meeting the inclusion criteria. Finally, eight titles were excluded due to not including a meta-analysis. This left ten titles to be included in the review of reviews.

3. Results

The three searches returned a total of 708 titles for screening, of these a total of 44 titles (n=89,451 participants, five studies did not report [DNR] this data) were included in the review of reviews. The findings of each of the subject areas are presented below.

3.1. Overweight and Obesity

3.1.1. Study Characteristics

Fourteen systematic reviews with meta-analysis were included for the overweight and obesity literature. The review characteristics are summarised in Table 1. Interventions included 30,325 participants (3 DNR) and ranged from walking interventions (treadmill, track and outdoor), MICT, HIIT, RT of various doses and durations. Several reviews included the addition of behaviour interventions including coaching, web-based or phone-based applications, physical activity monitors etc. All studies focused on those who were OW or obese as defined by BMI ≥ 25 kg/m^2 or >30 kg/m^2. The key findings of each study are summarised into sections below. Key quantitative data was extracted to Table 1.

3.1.2. Body Mass and Body Composition Outcomes

Eight of the fourteen reviews included in the overweight and obesity review measured at least one, but often numerous, body composition outcomes (Armstrong et al., 2021; Berry, Kassavou, & Sutton, 2021; Clark, 2015; de Vries, Kooiman, van Ittersum, van Brussel, & de Groot, 2016; Johns, Hartmann-Boyce, Jebb, & Aveyard, 2014; Kim & Seo, 2020; Mabire, Mani, Lizhou, Mulligan, & Baxter, 2017; Rugbeer, Constantinou, & Torres, 2021). Walking, MICT, SIT, AT, all had beneficial impacts on outcomes as will be explored below. Intensity and frequency were found to have moderating effects (Armstrong et al., 2021). The importance of including RT for body composition outcomes is higlighted.

Brisk walking interventions (average of 46 minutes, 4/week at 73% HRmax, for 12-16 weeks) were shown to have a significant impact on weight loss, BMI, FM, BF% and waist circumference of obese participants (Mabire et al., 2017). Furthermore, baseline BMI had no moderating effect on the outcomes in this meta-analysis. Research comparing MICT with SIT found no difference between methods in seven studies, however there were differences in fitness outcomes favouring MICT as reported in section 3.1.4. Armstrong et al. (2021) found that compared to control, aerobic exercise (3-7 days, 45-60mins, 3-12 months) significantly reduced WC by 3.2cm. Exercise of a vigorous intensity was found to produce superior results compared to moderate intensity in the seven (of 25) studies that allowed for a direct comparison between moderate and vigorous intensities. How intensity was quantified however differed (Table 1). Furthermore, exercise frequency but not weekly volume appeared to have a moderating effect on WC outcomes. Researchers found that every additional day of exercise per week was associated with a 0.68cm greater reduction (Armstrong et al., 2021). Age appeared to attenuate results in this analysis, with every 10 years of increased age associated with an attenuated response of 0.6cm.

Clark (2015) explored the effectiveness of diet alone with diet in addition to RT or AT. Their analysis found that diet in combination with RT was significantly more effective than diet alone for reducing FM whilst retaining FFM. Interestingly, males responded significantly better than females concerning these outcomes whilst females showed larger responses to diet alone, and diet + AT for reduction in total body mass and FM but not FFM. There was no significant difference between diet + AT and diet + RT when considering BM only. Contrastingly, a meta-analysis which explored behavioural weight management programs in comparison to diet only interventions, have shown to bring about significantly greater weight loss at 12 months compared to diet only interventions despite the difference not being significant at three months (Johns et al., 2014). This might suggest that whilst diet only is an effective weight loss tool in relatively short term periods, physical activity should be promoted to enhance longer term outcomes and indeed to bring about other health benefits independent of overweight and obesity.

Mulitple reviews examined the use of tools such as mobile and web-based applications and software to promote physical activity and weight-loss. Kim and Seo (2020) found that a mobile smartphone based program had significant impacts on weight loss in young adults. The interventions included lifestyle, education, coaching and feedback and this occurred between 5-24 times over 2-6 months equating to around 1-2.5 contacts per week. Digital platforms were also explored by Berry et al. (2021) who found that digital self-monitoring had a significant effect on weight loss with tailored interventions significantly more effective than non-tailored. de Vries et al. (2016) explored whether the addition of a PA monitor had an impact on behavioural physical activity intervention outcomes. Their meta-analysis found that the addition of a PA monitor did not significantly impact body mass, however it did have a positive impact on steps per day, MVPA, PA kilocalories per week all of which are associated with health independent of body mass. Only five studies of the 14 within this meta-analysis measured body mass changes. Furthermore, it might be that these behavioural based interventions were equally effective without the addition of PA monitors. Effective behaviour change techniques are covered in section 3.5.

3.1.3. Cardiometabolic Health Markers

Only two studies explored the impact of physical activity interventions on cardiometabolic health markers of those with overweight and obesity. Regarding TC, HDL-C, LDL-C and TRG Clark (2015) found that there was no significant difference in intereventions (diet, diet + AT, diet + RT). In this review females showed significantly greater effect of diet + ET in changes to HDL-C compared to men. Ballard, Davis, Wong, Lyn, and Thompson (2022) found that walking groups, generally using interventions of moderate to vigorous intensity, which met the PA guidelines, improved TC and LDL-C significantly more than the control groups. Interestingly, there was no significant difference between the outcomes of those walking at moderate versus vigorous intensity. Furthermore, the total walking volume had no impact on the effectiveness. There was an effect for BMI, with greater improvements to TC, TRG, HDL-C and LDL-C in women with obesity.

3.1.4. Physical Fitness

Only two studies explored the impact of physical activity interventions on physical fitness of those with overweight and obesity. In a review of 66 studies, Baak et al. (2021) found that all training modalities (aerobic training, resistance training, HIIT and combination training) improve CRF (VO_{2max} in ml/kg/min). Aerobic training and HIIT were more effective than RT in this regard and CT did not improve the outcomes. Rugbeer et al. (2021) evaluated the outcome of HIIT versus MICT on VO_{2max} or VO_{2peak}, and found that MICT was superior in improving CRF compared to SIT. Regarding muscle strength outcomes, RT and CT were effective whilst AT alone was not.

3.1.5. Behaviour Change

Interventions which include diet and PA and have a clearly described behaviour strategy have a significantly greater impact on weight loss compared to diet only (Johns et al., 2014). When comparing to PA interventions only, the differences are significant at 3-6 months therefore supporting the role of behaviour change strategies in bringing about impactful outcomes. In face-to-face interventions only behavioural practice and rehearsal had positive moderator effects on PA (E. Carraca et al., 2021). Interestingly, when authors included only objectively measured PA, four BCT positively moderated PA; 1) behavioural practice and rehearsal, 2) action planning, 3) social support and 4) social reward. Amongst digital interventions five BCT were shown to have significant moderator effects on PA; 1) goal setting behaviour, 2) goal setting outcome, 3) graded tasks, 4) social incentive and 5) self-monitoring of behaviour which negatively moderated PA (E. Carraca et al., 2021). Similar to this, Kim and Seo (2020) reviewed five studies which explored the use of smartphone-based health applications and found that there were significant increases in physical activity and weight loss for the intervention groups. However, this did not translate to significant effects on BMI.

Digital self-monitoring has been shown to have a statistically significant effect on weight loss, MPA, and kilocalorie intake (Berry et al., 2021). Seven studies used a combination of tools including websites, telephone calls, mobile phone applications and emails: two used mobile phone applications only, and three used websites only. The most used BCTs identified were social support, goal setting (behaviour), feedback on behaviour, and self-monitoring of outcome which appeared in four studies. Goal setting was coded in three-studies. Only four studies offered tailored advice to participants, and this was found to significantly improve the effectiveness of the intervention when compared to nontailored interventions. Another method of self-monitoring is through the use of PA monitors. de Vries et al. (2016) explored the use of such monitors with behavioural interventions and found that when compared to controls (weight loss/usual care) there was a significant positive intervention effect on steps per day and MVPA. However, when compared to the behavioural intervention without PA monitors there was no significant intervention effect for MVPA whilst there was for walking MET-minutes per week and PA energy expenditure (kilocalories per week). Samdal, Eide, Barth, Williams, and Meland (2017) analysed 82 reports (from 48 studies) and found that at both short and long-term, goal setting of behaviour and self-monitoring of behaviour significantly impacted upon intervention outcomes. This included goal setting of outcome, feedback on outcome behaviour, setting graded tasks and adding objects to the environment at long-term. Autonomy supportive communication style, goalsetting of behaviour and receiving feedback on the outcome of the behaviour were all associated with trial effects, explaining 100% of between study variation.

3.1.6. Psychosocial Outcomes

The research examined found that some interventions had a significant positive effect on quality of life (QoL), however a variety of assessment methods were used. Baillot et al. (2018) found that there was no significant effect favouring exercise (2-5/week, 12-90 minutes per session, ≤ 16 weeks) for physical or mental QoL, or for change in depression whilst cautioning that this finding could be attributed to low-quality evidence. This finding regarding depression was in agreement with that of E. V. Carraca et al. (2021) who reported 1-6 sessions per week for a duration of 12-90 minutes between 6-76 weeks. However, this study also found that exercise had a significant positive effect on QoL, and that CT specifically was more effective in improving physical subcomponents including physical functioning, role physical, bodily pain, and general health. Combination training was also the only method reported to impact social functioning and role-emotional subcomponents. Authors also suggested that age could have an impact on the findings, with overall mental component significantly improved in adults aged 40-65 years and those >65 years whilst the role-emotional subcomponent improved significantly in those <40 and >65 years.

3.1.7. Section Summary

- Walking, MICT, SIT and AT show benefits to body mass and waist circumference. Resistance training is beneficial for body composition, e.g. fat-free mass.
- Intensity and frequency of exercise moderate body mass outcomes.

- Diet and exercise is superior compared to diet alone for body composition outcomes at 12 months, highlighting the importance of exercise in such interventions.
- Walking, in line with PA guidelines improves TC and LDL-C. This outcome was more pronounced in women with obesity.
- AT & HIIT are superior for improving CRF, while RT is required to bring about strength improvements.

3.2. Type II Diabetes

3.2.1. Study Characteristics

Nineteen systematic reviews with meta-analysis were included for the T2DM literature. The review characteristics are summarised in Table 2. Interventions included 40,184 participants (2 DNR) and ranged from cycling, walking (treadmill, track and outdoor), MICT, HIIT, RT of various doses and durations, yoga, tai chi and a form of Qigong. Several reviews included the addition of behaviour interventions including coaching, web-based or phone-based applications, physical activity monitors etc. All studies focused on those who had a diagnosis of T2DM. The findings of each study are summarised into sections below. Quantitative data was extracted to Table 2.

3.2.2. Body Composition Outcomes

In both clinical and community settings, behaviour interventions informed by models and/or theories were shown to have a significant impact on BMI (Avery, Sniehotta, Flynn, Trenell, & van Wersch, 2012). This was seen in addition to changes in PA behaviour as presented in section 3.2.5. This has been replicated in literature showing diet and PA interventions have a significant impact on body mass at 3, 6, 12 and 24 months (Cradock et al., 2017). Pedometers and accelerometers were found to have no significant impact on BMI despite improving PA (Baskerville, Ricci-Cabello, Roberts, & Farmer, 2017).

Regarding the type of training, evidence suggests there is no effect of type of intervention on WC and BM outcomes, with structured exercise significantly beneficial (Hayashino, Jackson, Fukumori, Nakamura, & Fukuhara, 2012). This agrees with research which found that various types of exercise, performed for an average of 3.2 sessions per week, for 52 minutes, at an intensity of 5.1METs, significantly decreases WC (Igarashi, Akazawa, & Maeda, 2021). It may be that supervision is important; Pan et al. (2018) found that CT, supervised AT, supervised RT and anaerobic training all showed greater benefits to weight reduction compared to unsupervised AT. Whilst some evidence does suggest that BMI is most greatly influenced by AT compared to RT, it is important to consider other measures such as WC in addition to body mass (Yang, Scott, Mao, Tang, & Farmer, 2014).

3.2.3. Cardiometabolic Health Markers

In both clinical and community settings, behaviour interventions informed by models and/or theories have been shown to have a significant impact on HbA1c (Avery et al., 2012; Cradock et al., 2017). The BCT and theory findings are reported in section 3.2.5 of this report. Pedometers and accelerometers were found to have no significant impact on HbA1c, blood pressure or lipid profile despite improving PA (Baskerville et al., 2017). However, these interventions did on occasion include further behaviour change components which could have diluted the impact of using pedometers alone.

Munan et al. (2020) found that various exercise types, both acute and chronic, significantly reduce mean 24-h glucose as measured using CGM. Furthermore, timing of the exercise, and glycaemic control seem to influence results with exercise in the fasted state and in the morning being of significant impact. Structured exercise training (a mean dose of 3 sessions of 30-75 minutes for 20 weeks) in patients with T2DM was associated with SBP and DBP reductions; an effect that was magnified when the training volume exceeded 150 min/week (Figueira et al., 2014). In the same study, PA advice alone was associated with significant, but less pronounced, SBP and DBP reductions. Authors also found that a previous diagnosis of hypertension was associated with greater impacts of AT and RT on BP. Interestingly, CT did not have the same impact on BP. Pan et al. (2018) have also reported on differences in outcomes between various modalities of exercise including supervised and unsupervised AT, RT and CT. Their analysis found that CT was comparable to supervised RT and supervised AT in reducing HbA1c. Supervised AT and supervised RT were more powerful in improving SBP, TC, and HDL than combined exercise. Moreover, supervised exercise showed more benefit than unsupervised exercise for most comparison groups. Interestingly these differences weren't seen for body composition measurements.

Findings have shown that structured exercise improves BP and lipids significantly with no effect of the type of exercise (AT, RT or CT) (Hayashino et al., 2012). This study also found that exercise improved HbA1c, fasting plasma glucose, waist circumference and body weight. Like other literature presented here, there seemed to be an effect for age with older participants gaining greater BP outcomes. Furthermore, longer duration interventions (both number of weeks and minutes spent exercising) brought about greater benefit. The authors did not report key intervention details relating to FITT principle making interpretation somewhat limited. The findings of this work are in agreement with research which did account for FITT, and reported a significant decrease in HbA1c, with no impact of frequency, intensity or time, but the overall duration (weeks) being significantly associated with HbA1c outcomes (Igarashi et al., 2021). Jayedi, Emadi, and Shab-Bidar (2022) were able to quantify the weekly supervised AT required to bring about improvements to HbA1c, reporting that for every 30 min/week increase in PA there was an improvement to HbA1c with the greatest reduction was seen at 100 min/week. Beyond this, the benefits were less effective.

In addition to the time given to exercise, intensity may also be important to consider. In a meta-analysis of RT only, intensity was shown to be correlated with beneficial impacts on HbA1c and insulin, with RT of high intensity bringing about the greatest benefit. Using resistance bands however has been shown to have no significant impact on HbA1c. Conversely, Yang et al. (2014) reported comparable outcomes on glycaemic control (HbA1c and fasting blood glucose) when comparing AT and RT over a median of four months. Jayawardena, Ranasinghe, Chathuranga, Atapattu, and Misra (2018); (McGinley, Armstrong, Boule, & Sigal, 2015) compared “exercise training” with yoga, and whilst they found a significant difference in blood markers including FBG, PPBG, HbA1c and BMI authors cautioned against drawing conclusions due to the heterogeneity of the eight studies included. Furthermore, some of the comparator groups considered “exercise” interventions were in fact information-only interventions with no encouragement to exercise and no exercise prescribed. A form of Chinese Qigong practice, which typically involves meditation, slow-flowing movement, and deep rhythmic breathing was found to have a significant beneficial impact on markers including HDL-C, FBG, HbA1c and LDL-C. However, it is difficult to interpret these findings, as intensity of the exercise interventions were not reported.

3.2.4. Physical Fitness

Physical fitness outcomes were reported in a minority of studies. Resistance bands were found to have a significant impact on lower extremity strength when comparing between groups, and this extended to upper extremity when within-group analyses was carried out (McGinley et al., 2015). Additionally, exercise interventions including strength, balance, tai-chi, walking, CT and VR have been shown to improve both laboratory and clinical balance tests compared to control groups in a population of older adults with T2DM however had no significant impact on timed up and go and fall efficacy tests (Qin et al., 2021). A study which warns of low-quality evidence is that of Nery et al. (2017) which explored the effect of RT compared to AT, reporting VO_{2max} to be more greatly improved in those undertaking RT. This conflicts with a meta-analysis comparing AT and RT, finding AT to be associated with greater improvements to VO_{2max} and HR_{max} compared to RT over interventions with a median of four months (Yang et al., 2014).

3.2.5. Behaviour Change

In both clinical and community settings, behaviour interventions informed by models and/or theories were shown to have a significant impact on PA, measured both using objective and subjective methods (Avery et al., 2012). These changes to PA behaviour were upheld at <1 month and >6 months for studies using objective measurement of PA. For those using subjective measurement of PA, the effects were upheld at all periods except for 24 months. Researchers identified 25 BCT across the 17 interventions, with a minimum of two and a maximum of 14 BCT per intervention. Importantly, analysis found that interventions underpinned by theories or models, the use of specific BCT (generalisation of a target behaviour, follow-up prompts, prompt review of behavioural goals, provide information on where and when to perform PA, plan social support/social change, goal setting (behaviour), time management, prompting focus on past success, barrier identification/problem solving and providing information on the consequences specific to the individual) moderated the effectiveness. Clinically significant improvements to HbA1c were reported for studies utilising >10 BCT, interventions underpinned by theory, and durations of ≥ 6 months. In another study, clinical benefits to HbA1c were also found in four of 46 BCT identified which included 'instruction on how to perform a behaviour', 'behavioural practice/rehearsal', 'demonstration of the behaviour' and 'action planning', as were intervention features 'supervised physical activity', 'group sessions', 'contact with an exercise physiologist', 'contact with an exercise physiologist and a dietitian' (Cradock et al., 2017). Haghighi, Mavros, and Singh (2018) found that 10 of 18 behaviour interventions included in their review significantly increased PA. Meta-regression showed that there were significant direct relationships between total contact, more face-to-face counselling, and increased PA behaviour. Kongstad (2019) reported small to moderate overall effect size when comparing remote feedback interventions to standard treatment. Interventions using pedometers, with more contact (≥14) and inclusion of supervised PA/exercise were not associated with clinically significant improvements in HbA1c (Avery et al., 2012). The use of pedometers and accelerometers was also explored by Baskerville et al. (2017). This research found that there was a significant increase in PA using both methods, when compared to a control group. There was also a potential increased impact in those who were diagnosed within five years.

An important factor to consider is drop-out rate or adherence to an intervention. Research examining the impact of HIIT, HICT and MICT found no impact of intervention on drop-out, i.e., those enrolled on HIIT-HICT had the same odds ratio to drop out when compared to MICT. Interestingly, there were more dropouts in longer duration HIIT- HICT protocols compared to MICT. This suggests that when the time-investment is the same, dropout rate increases with HI activity (Jabardo-Camprubi, Donat-Roca, Sitja-Rabert, Mila-Villarroel, & Bort-Roig, 2020).

3.2.6. Section Summary

- Structured exercise training has significant benefits to weight loss, waist circumference regardless of type.
- Various types of exercise intervention (≥150 minutes per week) have significant impact on HbA1c, CGM, SBP & DBP.
- There is some evidence that supervision improves outcomes.
- Longer duration was also associated with improved outcomes.
- Utilising >10 BCT, and durations of >6 months improved HbA1c outcomes.
- Contact and face-to-face counselling was associated with increased PA behaviour.

3.3. Hypertension

3.3.1. Study Characteristics

Ten systematic reviews with meta-analysis were included in the hypertension literature. The review characteristics are summarised in Table 3. All studies recruited adults with hypertension, with one study also including adults with pre-hypertension. Due to all included studies focusing on markers of cardiometabolic health e.g., blood pressure and body mass, these will be reported in one section. Quantitative data was extracted to Table 3.

3.3.2. Cardiometabolic Health Markers

Dassanayake, Sole, Wilkins, Gray, and Skinner (2022) performed a meta-analysis on a relatively small sample of four studies. Meta-analysis found that aerobic exercise and physical activity interventions performed 3 times per week for between 8-16 weeks have significant benefits to 24-h ambulatory BP in those with resistant HTN compared to non-exercise controls. Findings are somewhat difficult to extrapolate however, due to a lack of reporting of intervention details, specifically the intensity and duration of individual sessions. In older adults (>60 years) with resistant hypertension, findings have shown that exercise decreases age-related HTN (Kazeminia et al., 2020). Furthermore, subgroup analysis suggested that RT might be of greater benefit than AT in this population. Once again however, information regarding FITT was lacking, thus making extrapolation of the findings challenging.

One study which aimed to examine the effect of different AT intensities on outcomes, found that medium intensity training (MIT: defined as 55-85%HRmax/VO_{2max} or 50-60% of peak power) was the most beneficial for reducing both SBP and DBP (Lu et al., 2022). Whilst they found that HV-HIIT and LV- HIIT were more beneficial for body mass, fitness and HRmax values, authors cautioned that further investigation was required, and that the prescription of exercise must be appropriate according to the severity of HTN. In further support of the role of AT for BP are findings by Saco-Ledo, Valenzuela, Ruiz-Hurtado, Ruilope, and Lucia (2020). This research found that AT can significantly reduce BP, including overnight ambulatory blood pressure in patients taking medication for HTN. The findings suggest a dose of ≥3 sessions/ week, ≥30 min/session, and an intensity of ~60% to 70% HR_{max} or VO_{2peak} for ≥3 months to elicit these results.

In addition to BP effect, AT, CT and isometric RT have been shown to impact upon pulse wave velocity, (PWV: a marker of arterial stiffness) in adults with hypertension (Lopes et al., 2021). There was no impact on PWV with dynamic RT however. S. H. Lee and Chae (2020) agree that a variety of modes of AT can successfully reduce BP amongst hypertensive individuals, thus recommending the participant should chose the type of AT based on their preference. Their evidence, similar to that of Saco-Ledo et al. (2020) suggested that the chosen activity should be performed for 8 weeks or longer, three times weekly at moderate, or twice weekly at vigorous intensity to maximise blood pressure outcomes. Moderate-intensity walking, undertaken three to five times per week, of 20 to 40 minutes duration, and 150 minutes per week for approximately three months was shown to lower both SBP and DBP according to a recent Cochrane review (L. L. Lee et al., 2021). Considering specifically the longer-term outcomes of interventions including younger adults (mean age 42 years) one meta-analysis found that behavioural and PA interventions can have significant impacts on SBP and DBP in the short term (3-6 months). Higher levels of contact time, irrespective of intensity, were associated with a greater benefit to BP in this time frame. However, the intervention effects were not seen at 12 month follow up.

Tai-chi interventions have been reported to have significant benefits on markers including SBP, DBP, TC, TRG, LDL-C AND BG. There was no significant impact on HDL-C. Authors did caution that the evidence was of very low to moderate quality (Liang et al., 2020). Only two-studies reported on the impact of QoL, and both focused on Tai-Chi (Liang et al., 2020; Song et al., 2021). Within these studies, Tai-chi interventions were found to have a significant benefit on QoL. The most common dose was 24-form Tai-Chi, 5-8 sessions per week, for 30-50 minutes. The quality of evidence was classed as very low to moderate in one study (Liang et al., 2020), and the methodological limitations of included studies were also raised by Song. A lack of evidence does not necessarily mean that the other interventions in this review of reviews didn't have an impact on QoL, simply that it wasn't measured. Future research should therefore include such measures in the evaluation of their interventions.

3.3.3. Section Summary

- MIT is superior for improving SBP and DBP outcomes.
- HIIT is superior for body mass, CRF and HR max outcomes, but the suitability in the population must be considered.
- Increased contact time was associated with improved BP outcomes.
- Tai-chi improved cardiometabolic health markers but had no impact on body mass.

4. Summary

This work sought to review meta-analyses exploring the impact of exercise and/or physical activity interventions with individuals living with overweight and obesity, T2DM and hypertension. Forty-four titles (n=89,451 participants, five studies DNR) were included in the review of reviews. Overall, findings display that structured exercise of various types and dose, meeting the PA guidelines, are effective in improving outcomes related to these conditions.

In both overweight and obesity, and T2DM literature, structured exercise, regardless of type, were found to improve body composition outcomes of participants. This was seen in walking interventions of 46 minutes per session, 4 times per week at 73% HRmax (Mabire et al., 2017), aerobic exercise of a similar duration (45-60 minutes per session) 3-7 times per week for between 3-12 months (Armstrong et al., 2021) and 52 minutes per session, three times per week at 5.1METs (Igarashi et al., 2021). Each of these would be sufficient a dose to achieve the PA guidelines of 150+ minutes per week. Some literature suggests that there are additional benefits from each additional day of the activity (Armstrong et al., 2021) and supervised activity may be more beneficial than unsupervised activity regarding body composition outcomes (Pan et al., 2018). If focusing specifically on fat-free mass and fat loss, resistance training is likely to play an important role with dietary intervention plus resistance training favoured for decreasing fat mass (Clark, 2015). Regarding hypertension literature, none of the meta-analysis reported on body composition outcomes. Given the association between obesity and hypertension (Jiang, Lu, Zong, Ruan, & Liu, 2016), this is something future literature should aim to include as secondary outcomes.

Once again, a variety of exercise types were shown to be beneficial in improving cardiometabolic health outcomes including blood glucose, glucose management, blood lipids and blood pressure. This was evident in all three areas, however the marker focused on varied between groups. In both the overweight and obesity, and T2DM literature, interventions of RT, AT and walking were shown to improve lipids with no effect for intensity (Ballard et al., 2022) or intensity and frequency (Clark, 2015). The FITT is poorly reported in these analyses; however, it was clear that interventions achieved the PA guidelines which can serve as a useful marker for future work. This is in agreement with the T2DM literature which suggested a dose of >150 minutes per week brought about the best improvements to BP (Figueira et al., 2014). The hypertension literature also seemed to show favour for interventions which broadly met the PA guidelines. This was shown in a variety of exercise types including AT, HIIT, MICT, CT (Dassanayake et al., 2022; Kazeminia et al., 2020; Lu et al., 2022; Saco-Ledo et al., 2020) and walking (L. L. Lee et al., 2021). There was evidence that RT may outperform AT in a population of older adults, once again promoting the inclusion of RT in future interventions (Kazeminia et al., 2020). HbA1c seems to respond well to a dose of 100 minutes per week beyond which the benefits were lessened, however other markers may require the additional time and therefore future interventions should be encouraged to at least achieve the PA guidelines. It was also suggested that CT may be favoured for HbA1c improvements (Pan et al., 2018). Longevity of the intervention is also important to promote, with greater benefits seen in interventions of longer duration (Hayashino et al., 2012; Igarashi et al., 2021). Regarding body mass and fitness outcomes, there was evidence that both low volume and high volume HIIT would be more beneficial compared to MICT (Lu et al., 2022). The suitability of HIIT for patients with hypertension requires attention, and therefore it might be that HIIT is utilised later in an intervention, when BP has been effectively managed.

Exercise training was consistently reported to increase CRF (Baak et al., 2021; Rugbeer et al., 2021; Yang et al., 2014). Specifically, MICT (64-76% HRmax) was shown to be superior to SIT (all out perceived effort) for increasing CRF (Rugbeer et al., 2021). Combination training and RT were not shown to be favourable for CRF, however RT was required to bring about strength improvements (Rugbeer et al., 2021) and this included evidence to support the use of resistance bands to increase both upper and lower body strength (McGinley et al., 2015).

Very few studies reported on psychosocial outcomes such as depression and QoL. This is disappointing given the impact that these conditions can have on such factors (Boutayeb, 2010). There was no evidence that exercise had a significant impact on depression amongst those with obesity (Baillot et al., 2018; E. V. Carraca et al., 2021) however this could be attributable to the low-quality evidence included. These papers reported a dose of 2-5 sessions/week, 12-90 minutes per session, ≤ 16 weeks and 1-6 sessions per week for a duration of 12-90 minutes between 6-76 weeks respectively (Baillot et al., 2018; E. V. Carraca et al., 2021). The latter did find a positive effect on QoL including physical subcomponents, role-emotional subcomponents, and social functioning. The latter two were seen in CT only (E. V. Carraca et al., 2021).

Behaviour change techniques were well reported within the overweight and obesity, and T2DM literature. There was clear evidence that interventions informed by theory, or including BCT lead to improved outcomes in terms of weight loss (Berry et al., 2021; de Vries et al., 2016; Johns et al., 2014; Kim & Seo, 2020) and PA behaviour (Avery et al., 2012; Baskerville et al., 2017; Berry et al., 2021; E. Carraca et al., 2021; de Vries et al., 2016; Samdal et al., 2017). Self-monitoring, either digitally or otherwise, was repeatedly reported as an effective BCT however the effectiveness of pedometers and PA monitors specifically was conflicting (Avery et al., 2012; Baskerville et al., 2017; de Vries et al., 2016). Behavioural practice and rehearsal, goal setting, feedback, contact with interventionist, social support, social incentive, social planning, action planning, focus on past success were all listed as important and effective BCT. Autonomy of communication style was also reported as important (Samdal et al., 2017).

Future interventions should therefore aim to ensure that they are informed by behaviour change theory and/or incorporate planned BCT to promote their effectiveness.

To conclude, there is a vast quantity of literature which supports the benefits of PA and exercise for those living with overweight/obesity, T2DM and hypertension. Taken together, the literature suggests that at least 150 minutes per week should be recommended for future interventions, with aerobic training needed to bring about CRF improvements, whilst RT should be encouraged to promote strength and balance improvements as well as enhancing body composition through fat-free mass. Interventions should be behaviour informed, with those encompassing BCT/theories showing greater improvements to physical and behavioural outcomes. There are limitations to the literature included, including studies which were reported to be of poor quality and instances of missing information making extrapolation or interpretation of findings challenging. Therefore, future work must aim to undertake research, which is rigorous, comprehensive and encompasses a variety of outcome measures.

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Table 1: Review Characteristics and Summary Findings – Overweight and Obesity					
Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
1. Armstrong et al. (2021)	The effect of aerobic exercise on waist circumference in adults with overweight or obesity	25 (1686)	OW & obese adults	Frequency: 3-7 days [5 most common] Intensity: 19 = moderate, 15= vigorous, 3 = HIIT) 40% to 80% VO2max, 50% to 70% VO2peak reserve, 50% to 75% VO2peak, 3.6 to 6.0 METs, 55% to 85% HRmax, 50% to 80% HRR, 10 to 17 RPE,	Regular aerobic exercise significantly reduced WC by 3.2 cm (95% confidence interval [CI] -3.86, -2.51, $p \leq 0.001$). Vigorous intensity interventions led to greater reduction in WC compared with moderate intensity ($k = 38$, $\beta = -1.86$ cm, 95% CI -2.73, -1.00, $F [1, 36] = 19.10$, $p = 0.0001$). Exercise frequency also had a moderating effect on WC ($k = 38$, $\beta = -0.68$ cm, 95% CI-1.30, -0.06, $p = 0.03$) [every additional day of exercise weekly was associated with a 0.68-cm greater reduction]. Weekly volume did not have the same moderating effect

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				50% to 95% HRpeak. Time: 15-60 min [45 and 60 mins most common] Type: Walking, treadmill, cycle ergometer most common Duration: 10 = 3 months, 2= 3.5 months, 6 = 4 months, 2 = 6 months, 3 = 12 months, Supervision: majority were supervised	Age had a moderating effect on change in WC ($k = 36$, $\beta = 0.06$, 95% CI -0.0002, 0.12, $p = 0.05$), such that for every 10 years of age older is associated with an attenuated response (0.6 cm). Adherence > 85% in 14 studies. 9 = DNR

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2. Baak et al. (2021)	The impact of various types of exercise interventions on physical fitness (CRF and muscle strength)	66 (3964)	Adults with OW (BMI ≥25 kg/m^2) or obesity (BMI ≥30 kg/m^2)	Frequency: Various Intensity: Various % HRmax, kcal/day, VO2peak, VT, HRR, RPE, kcal/session Time: Various Type: AET, RT, CT Duration: 2-70 weeks (Mdn: 12)	<u>Aerobic Capacity:</u> AET significantly ↑ VO_{2max} (mean difference (MD) 4.08 ml/min/kg (95% CI 3.22, 4.95), P < 0.00001) with a medium effect size (SMD) 0.70 (95% CI 0.58, 0.82)). RT significantly ↑ VO_{2max} (MD 4.52 ml/min/kg (95% CI 1.56, 7.28), P = 0.001) with a large effect size (SMD 0.81 (95% CI 0.22, 1.41)). CET significantly ↑ VO_{2max} (MD 4.57 ml/ min/kg (95% CI 2.14, 7.00), P = 0.0002) with medium effect size (SMD 0.78 (95% CI 0.40, 1.16)). HIIT significantly ↑ VO_{2max} (MD 4.31 ml/min/kg (95% CI 2.81, 5.80), P < 0.00001). with a large effect size (SMD 0.84 (95% CI 0.57, 1.11)). <u>Muscle Strength:</u> AT had no significant effect on muscle strength (SMD 0.26 (95% CI −0.06, 0.58), P = 0.12). RT had a significant effect on muscle strength (SMD 0.74 (95% CI 0.54, 0.93), P < 0.00001).

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					CT had a significant effect on muscle strength (SMD) 0.62 (95% CI 0.27, 0.96), P = 0.0004). <u>Between Methods Comparison:</u> AT v. RT: AT improved VO_{2max} more than RT (MD −1.40 ml/min/kg (95% CI −2.41, −0.38, P = 0.007) with a small effect size (SMD −0.37 (95% CI −0.63, −0.12)). When three poor quality studies were removed the difference was no longer statistically significant. AT v. CT: AT compared to CT showed no significant difference in VO_{2max}. RT v. AT: significant difference in effect in favour of resistance training for muscle strength (SMD 0.49 (95% CI 0.19, 0.78), P = 0.001).

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					RT v. CT: No significant difference for muscle strength
3. Baillot et al. (2018)	Effect of exercise on psychosocial outcomes in adults with obesity	22 (2510)	Adults with BMI ≥30 kg/m^2	Frequency: 2-5/week; 2= 7-7/week Intensity: 16 = light-moderate, 6 = DNR Time: 12-90min Type: 11 ET, 3= RT, 5 = CT, 2 = ET v RT Duration: ≤ 16 weeks (68%) Supervision: 73% supervised, 45% one-to-one Adherence: all >70%	No significant effect favouring exercise was detected in the pooled analysis either for physical (g = 0.16; p=.13; 95% CI = [-0.05-0.37]) or mental QoL (g=0.20; p= .18; 95% CI =[0.09-0.48]) No significant differences in change in depression between the exercise and control groups (g=-0.23 (95%CI [-0.70,0.19], p=.25, I2 =31%).
4. Ballard et al. (2022)	Effects of walking, independent of diet and weight-loss, on lipids and	21 (1129)	Adult women with OW (BMI: ≥ 25 kg/m^2) &	Frequency:	TC: Walking groups improved an average of 6.67 mg/dL more than the control groups. (P = .04; SE =

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	lipoproteins in women with overweight and obesity		obesity (BMI: ≥30 kg/m^2)	Intensity: 71% were moderate intensity, 29% vigorous Time: 720-13000min. over intervention Type: walking Supervision: 71% were supervised Duration: 8-104 weeks	3.19; 95% CI: +0.42 to +12.92, I^2 = 64%; Q-*df*= 54.04, P< 0.01). LDL: walking groups improved an average of 7.38 mg/dL more than the control groups (overall RMD = +7.38 mg/dL, P = .04; SE = 3.64; 95% CI: +0.26 to +14.51, I^2 = 79%; Q-*df*= 67.8, P < .01). TRG: No significant difference HDL-C: No significant difference Intensity: No significant difference for TC, TRG, HDL or LDL. Greater improvement in total cholesterol, triglycerides, high-density lipoproteins, and low-density lipoproteins existed in women with obesity.

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Author (date)	Focus of the Review	Articles Included (participants)	Population	Intervention	Outcome
5. Berry et al. (2021)	Digital self-monitoring of diet & PA	12	Adults with OW (BMI: ≥ 25 kg/m^2) & obesity (BMI: ≥30 kg/m^2)	Self-monitoring PA and eating behaviour using digital technology including wearable sensors. Supplementary components such as coaching were eligible 2 = mobile phone application, 3 = website, 7 = Combination (telephone call/website/emails) 3-12 months duration	Digital self-monitoring had a statistically significant effect on: Weight loss (MD= -2.87kg [95% CI -3.78, -1.96kg], P < 0.001, I^2 = 69%), ↑ MPA (SMD = 0.44 [95% CI 0.26, 0.62], P < 0.001, I^2 = 0%), ↓ calorie intake (MD = -181.71kcal [95% CI -304.72, -58.70kcal], P < 0.01, I^2 = 0%). Tailored interventions were significantly more effective than nontailored interventions ($x2$ = 12.92, P < 0.001). tailored advice to participants (Tailored interventions: MD = -4.49 [95% CI -5.36, -3.62] nontailored interventions: MD = -2.10 [95% CI -3.07, -1.13], $x2$ = 12.92, P < 0.001).

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Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
				BCT: Social support, goal setting (behvaiour), feedback on behaviour, self-monitoring of outcome (4 studies), goal setting (3 studies) Tailored advice: 4 studies Additional advice: 5 studies	
6. E. Carraca et al. (2021)	Identify the most effective BCT for PA	62	Adults with OW (BMI: ≥ 25 kg/m^2) & obesity (BMI: ≥30 kg/m^2)	Settings: leisure centres, health clubs, primary care Delivery: Group, individual, F2F, digital Target: PA = 11 (6 digital); PA and diet= 49 (26 digital,	Five BCTs showed significant moderator effects on PA in digital interventions: 1) goal setting behaviour, 2) goal setting outcome, 3) graded tasks, 4) social incentive, 5) self-monitoring of behaviour (adjusted R^2's = 0.15–0.51).

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Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
				23 F2F); PA and SB = 2, PA and weight = 1 Duration: 2-78 weeks (Mdn: 2 weeks) Follow up: Mdn = 39 weeks (23 studies)	Behavioural practice and rehearsal (adjusted R^2 = 0.22) had a moderator effect on PA in face-to-face interventions
7. E. V. Carraca et al. (2021)	The effects of exercise on psychological outcomes among adults with overweight/obesity	36 (3536)	Adults with OW (BMI: ≥ 25 kg/m^2) & obesity (BMI: ≥30 kg/m^2)	Frequency: 1-6/week Intensity: Varied HRpeak, HRR, HRmax, VO2peak 11 = DNR Time: 12-90 min (mdn: 60) Type: 13= AT, 8 = RT, 6 = CT. Duration: 6-76 weeks (mdn: 12) Supervised: 65%	Quality of Life: Exercise had significant positive effects, representing a large effect size, on quality of life overall physical component (SMD 0.90, 95% CI 0.29–1.51). CT was more effective in improving physical subcomponents (Physical functioning: 0.77, 95% CI 0.53–1.00; Role-physical: 0.73, 95% CI 0.41–1.05; Bodily pain: 0.51, 95% CI 0.28–0.74; General health:

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Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
					0.44, 95% CI 0.14–0.73). AT and RT showed non-significant effects. CT only impacted social functioning and role-emotional subcomponents (0.67, 95% CI 0.28–1.06 and 0.47, 95% CI 0.24–0.70, respectively). The overall mental component was significantly improved by exercise in adults 40–65 years (0.34, 95% CI 0.02–0.77) and above 65 years (1.41, 95% CI 0.21–2.61). The role-emotional subcomponent improved significantly in younger (<40 years) and older (>65 years) following exercise (0.59, 95% CI 0.17–1.01 and 0.34, 95% CI 0.06–0.62, respectively).
8. Clark (2015)	The difference in response between various methods in (effect size for) loss of body	66	Adults with OW & obesity (BMI: ≥ 25 kg/m^2 or WHO	CT, RT, AT	Diet + ET > diet alone for changes to BM, but not statistically significant ($\chi2 = 3.09$, $p = 0.055$).

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	mass, fat mass and fat-free mass along with changes in blood lipid profiles and hormonal levels		levels of %BF for classification based on age and gender)		Diet + RT favoured for ↓ in FM ($\chi2 = 3.8$, $p < 0.05$) and maintenance of FFM ($\chi2 = 6.7$, $p < 0.0001$). No significant difference between diet + ET or diet + RT for changes to BM, but diet + RT > diet + ET for maintenance of FFM ($\chi2 = 10.15$, $p < 0.01$) All interventions were equivalent in changing TC, HDL-C, LDL-C, TRG. RT or diet + RT showed a greater effectiveness compared to diet only for TC and LDL-C ($\chi2$ = 7.18, 4.95, respectively). Gender Differences: Males tend to have a larger pooled ES for responses to diet + RT regarding retention of FFM ($\chi2 = 3.94$) and reduction in FM relative to female groups ($\chi2 = 3.64$, $p < 0.05$).

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Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
					Males showed a greater level of effectiveness for loss of FM and retention of FFM following an intervention of diet + CT ($\chi2 = 3.64$, $p < 0.05$). Females had a larger pooled ES for responses to diet alone, ($\chi2 = 2.09$, $p = 0.11$), and diet + ET for reduction in total body mass ($\chi2 = 1.94$, $p = 0.12$), and FM ($\chi2 = 3.1$, $p = 0.09$), but not FFM. Females showed a greater effect in changes to HDL-C utilizing diet + ET compared to men ($\chi2 = 2.0$, $p = 0.12$).
9. de Vries et al. (2016)	Behavioural physical activity interventions with or without activity monitors	14 (1157)	Adults with OW or obesity (BMI ≥27.0 kg/m^2 for Caucasians or	Behavioural physical activity intervention either with (BPAI+) or without (BPAI-) a PA monitor	BPAI+ v. usual care: • Significant ($P < 0.00001$) positive (SMD 0.90, 95% CI 0.61-1.19) intervention effect estimate for steps per day

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Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
			≥25.0 kg/m^2 for Asians)		• Significant (P = 0.01) positive (SMD 0.50, 95% CI 0.11-0.88) intervention effect estimate for MVPA BPAI+ v. BPAI-: • positive (SMD 0.43, 95% CI 0.00-0.87) but not significant (P = 0.05) intervention effect estimate for MVPA. • significant (P = 0.002) positive (MD 282.00 MET-minutes per week, 95% CI 103.82-460.18) intervention effect estimate for walking (100% female sample) • significant (P = 0.02) positive (SMD 0.45, 95% CI 0.07-0.83) intervention effect estimate for PA kilocalories/week • All analyses found a positive but not significant intervention effect estimate for weight variables.

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Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
10. Johns et al. (2014)	Diet or exercise interventions vs combined behavioural weight management programs	8 (1022)		Frequency: 4 = weekly, 1 = fortnightly, 1 = monthly, 1= bimonthly Intensity: Moderate to high (variable), 3-5 x/week Time: Varied Type: Varied BWMP interventions had to include diet + PA and a clearly described behaviour strategy	No significant difference in weight loss from baseline or at 3 to 6 months between the BWMPs and diet-only arms (-0.62 kg; 95% CI -1.67 to 0.44). At 12 months, a significantly greater weight-loss was detected in the combined BWMPs compared to diet-only (-1.72 kg; 95% CI -2.80 to -0.64). Compared to PA-only the combined BWMPs showed significantly greater weight loss at 3 to 6 months (-5.33 kg; 95% CI -7.61 to -3.04) and 12 to 18 months (-6.29 kg; 95% CI -7.33 to -5.25). Weight loss is similar in the short-term for diet-only and combined BWMPs In the longer-term weight loss is increased when diet and physical activity are combined.

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Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
					Programs based on physical activity alone are less effective than combined BWMPs in both the short and long term
11. Kim and Seo (2020)	Effects of mobile smartphone-based health programs on PA and obesity outcomes in young adults	5 (1830)	Adults with a BMI of ≥23.0 kg/m^2, 25.0 – 31.9 kg/m^2, or weight gain of ≥2kg in the previous 12 months.	Theories applied: Health behaviour change, transtheoretical model, theory of planned behaviour. Intervention: lifestyle, education, coaching (PA, dietary, health behaviour) and feedback provided 5-24 times over 2-6 months. PA assessed: IPAQ	significant ↑ in physical activity in the intervention groups. (SMD: 2.59, 95% CI: 1.00, 4.18, I^2 = 99%, p = 0.001). Significant weight loss in the intervention groups (combined MD: −2.80, I^2 = 0%, p = 0.002, CI: −4.54, −1.06) however not on BMI. Combined MD of the four papers on BMI change was −0.14 (I^2 = 41%, p = 0.45, CI: −0.51, 0.23) Smart-phone based interventions ↑PA and weight loss but no effects on BMI.
12. Mabire et al. (2017)	Influence of Age, Sex and Body Mass Index on the	22 (1524)		Average Values: Frequency: 4/week	Brisk walking had a significant impact on weight loss.

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	Effectiveness of Brisk Walking			Intensity: 73% HRmax 9 = HRmax 7 = VO2max 2= VO2peak 2 = HRR 2 = set pace 1 = 70% 6MWT pace Time: 46 minutes Type: Walking based; 11 = treadmill, 4 = track walking 3= unsupervised, home-based walking, 4 = DNR Duration: 12-16 weeks	Overall pooled weight loss was a statistically significant 2.13 kg (95% CI -3.20 to -1.06; I^2 = 88%) BMI was a statistically significant 0.96 kg/m2 (95% CI -1.44 to -0.48; I^2 = 94%), WC was a statistically significant 2.83 cm (95% CI -4.13 to -1.53, I^2 = 93%) BF% was a clinically and statistically significant 7.5% reduction in fat mass (-2.59 kg, 95% CI -4.13 to -1.06, I^2 = 92%), Adherence: DNR

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				Supervision: 15 = supervised, 3 = unsupervised, 4 = DNR Adherence: DNR	
13. Rugbeer et al. (2021)	To compare HIIT v. MICT on CRF and BF%	26 (784)	Adults with OW (BMI: ≥ 25 kg/m^2) & obesity (BMI: ≥30 kg/m^2)	Frequency: 2-5 /week Intensity: HIIT: >60% HRR or > 77% HRmax SIT: all out perceived effort MICT: 64-76% HRR or 64-76%HRmax Time: HIIT: 20-30mins MICT: 20-40mins SIT: 17-30mins	MICT was significantly better at improving CRF compared with SIT (MD= −0.92; 95% CI, −1.63 to −0.21; P = .01; I2 = 10%). There was no significant difference between MICT versus HIIT on CRF (MD = −0.52; 95% CI, −1.18 to 0.13; P = .12; I2 = 23%). There was no significant difference in BF% between MICT versus HIIT and MICT versus SIT.

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Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
				Type: Cycling most common. 2 = walking, 1 = boxing, 4 = combination Duration: 6-12 weeks (8 > 6 weeks, 3 >12 weeks)	
14. Samdal et al. (2017)	To explore the differential effects of BCTs and other intervention characteristics	82 reports [48 studies] (11183)		Duration: PA: 12 – 240 weeks; Diet: 12-72 weeks; 73% lasted 3-6 months Follow up: 24 = 12 months or later	Short Term: Goal-setting of behaviour (b =0.480, 95% CI: 0.257 to 0.705, p<0.001) and self-monitoring of behaviour associated with positive intervention effect at short term (b =0.398, 95% CI: 0.164 to 0.632, p=0.001) Long term: Goal-setting behaviour (b =0.228, 95% CI: 0.056 to 0.400, p=0.011) , goal-setting outcome (b =0.256, 95% CI:0.095 to 0.416, p=.003) , self-monitoring of behaviour (b =0.184, 95% CI: 0.009 to 0.360, p=0.040), feedback on outcome of behaviour (b =0.249, 95% CI: 0.085 to 0.412, p=0.004), setting graded tasks (b =0.203, 95% CI: 0.043 to 0.363,

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					p=0.014) , and adding objects to the environment (b = 0.182, 95% CI: 0.010 to 0.354, p=0.039) Autonomy supportive communication style, goalsetting of behaviour and receiving feedback on the outcome of the behaviour were all associated with trial effects, explaining 100% of between study variation. No evidence that theory/model-based interventions were superior to other trials at short- or long-term behaviour outcomes. No evidence that method of data collection (objective/self-report), setting (community/workplace/primary care/hospital), individual or group-based had any impact on outcomes.

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					Self-monitoring of behaviour was significantly associated with intervention effect (b = 0.355; 95% CI: 0.128 to 0.582), but this model only explained 46.7% of the variance.

Table 2: Review Characteristics and Summary Findings- Type II Diabetes Mellitus					
Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
1. Avery et al. (2012)	Effectiveness of behavioural interventions compared to standard clinical care for improving "free-living" PA and exercise and HbA1c in adults with type 2 diabetes in clinical or community settings, What behaviour change theories, techniques and other features of behavioural interventions are associated with clinically significant improvements in HbA1c	17	Adults with T2DM	4 used multiple theories models Theories/models: TTM, SCT, Precede/Proceed Model, CBT, MI	Behavioural interventions showed statistically significant increases in objective (standardized mean difference [SMD] 0.45, 95%CI 0.21–0.68) and self-reported PA/exercise (SMD 0.79, 95% CI 0.59–0.98). This was upheld at <1 month to >6months (SMD= 0.70, CI = 0.36–1.04, I2=0%) and12 months (SMD =0.42, CI =0.04–0.80, I2 = 57%). Self-reported PA and exercise data showed an overall significant positive intervention effect (SMD = 0.79, 95% CI = 0.59–0.98, I2 = 74%). These effects were maintained across all follow-up periods, except for 24 months. Clinically significant improvements in HbA1c (WMD: –0.32%, 95%CI –0.44% to –0.21%) and BMI (WMD: –1.05 kg/m2,95% CI –1.31 to –0.80).

Table 2: Review Characteristics and Summary Findings- Type II Diabetes Mellitus					
Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
					Intervention features (e.g., specific BCTs, interventions underpinned by behaviour change theories/ models, and use of >10 behaviour change techniques) moderated effectiveness of behavioural interventions.
2. Baskerville et al. (2017)	The impact of PA activity monitoring devices (pedometers and PA and HbA1c levels in people with T2DM	12 (1458)	Adults with T2DM	9 = pedometers, 3= accelerometers Duration: Mean= 8 months (5 weeks – 18 months incl. follow up) Five studies comprised monitors alone, the remainder included additional intervention e.g., BCT, individual or group-based sessions.	Overall increase in physical activity (standardized mean difference 0.57, 95% CI 0.24, 0.91) in the intervention groups compared to control groups. Possible increased effect in those with a diagnosis of T2DM within 5 years (SMD: 0.82, 95% CI 0.11; 1.54 vs 0.58, 95% CI --0.12; 1.28) No significant differences were observed in HbA1c, BMI, blood pressure or lipid profile.

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Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
				Adherence: 6 = DNR, 6 = 50-90%	
3. Cradock et al. (2017)	Identify BCTs and intervention features of dietary and physical activity interventions for patients T2DM that are associated with changes in HbA1c and body weight	13	Adults with T2DM	Frequency: varied. 5 = target time per week, 5= target time x days/week, 3= other Intensity: varied. 10 = DNR. Remainder: 110-140bpm, <120bpm, 50-70% HRmax Time: varied Type: walking, AT, AT + RT Three did not specify kcal goal	Significant reductions in HbA1c: 3 months: 1.11 % (12 mmol/mol [95 % CI -1.57 to -0.66, P< 0.00001]) 6 months: -0.67 % (7 mmol/mol [95 % CI -1.09 to -0.24 P= 0.002]) 12 months: -0.28 % (3 mmol/mol [95 % CI -0.52 to -0.03, P= 0.03]) 24 months: -0.26 % (2 mmol/mol [95 % CI -0.39 to -0.14, P< 0.001]). Differences were only clinically significant at 3 and 6 months. Significant ↓in HbA1c when all time points were included (0.53 %, 6 mmol/ mol, 95 % CI -0.74 to -0.32, P< 0.00001) Significant reductions in body weight:

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Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
				Setting: 1= community, 12 = clinical	3 months: 2.7 kg (-4.14 -1.26, P= 0.06) 6 months: -3.64 kg (-6.05 to -1.23, P= 0.003) 12 months: 3.77 kg (-7.77 to 0.22, P= 0.06) 24 months: -3.18 kg (-7.67 to 1.32, P= 0.17) Overall body mass reduction of -3.73 kg (-6.09 to -1.37, P= 0.002), Four of 46 BCTs identified were associated with >0.3 % reduction in HbA1c: *'instruction on how to perform a behaviour', 'behavioural practice/rehearsal', 'demonstration of the behaviour' and 'action planning', as were intervention features 'supervised physical activity', 'group sessions', 'contact with an exercise physiologist', 'contact with an exercise physiologist and a dietitian'*
4. Figueira et al. (2014)	The effects of structured exercise training (AT, RT, or	51 (9540)	Adults with T2DM	30 = exercise training (21 = AT, 10 =RT)	Structured exercise was associated with reductions in SBP (WMD -4.22 mmHg; 95 % CI -

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Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
	CT) and PA advice only on BP changes in patients with type 2 diabetes			Frequency mean: 3/week (2-5) Duration mean: 20 weeks (6-48) Time: 30-75mins 21 = PA advice only Frequency mean: 4/week (3-5) Duration mean: 32 (6-48) Time: 30-60mins. One study = 175mins/week	5.89 to -2.56) and DBP (WMD -2.07 mmHg; 95 % CI -3.03 to -1.11) versus controls. AT and RT were associated with ↓ SBP and DBP whilst CT was not unless of HI. Structured exercise >150 mins/week was associated with↓ BP PA advice only was associated with reduction in SBP (WMD -2.97 mmHg; 95 % CI -4.52 to -1.43) and DBP (WMD -1.41 mmHg; 95 % CI -1.94 to -0.88) versus controls. Higher-intensity AT (8 interventions) was associated with ↓ in SBP (WMD -5.47 mmHg; 95 % CI -7.94 to -3.00; I2, 67.9 %; P for heterogeneity = 0.003),

Table 2: Review Characteristics and Summary Findings- Type II Diabetes Mellitus					
Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
					Higher intensity RT (5 interventions) was associated with ↓ in SBP (WMD -3.99 mmHg; 95 % CI -6.66 to -1.32; I2, 0.0 %; P for heterogeneity = 0.644) Higher intensity CT (2 interventions) was associated with ↓ in SBP (WMD -3.30 mmHg; 95 % CI -4.71 to -1.89; I2,0 %; P for heterogeneity = 0.331) compared with control. Multivariate meta-regression using BMI change and weekly volume as co-variates explained the between-studies variance of aerobic exercise training (overall, R2 = 91.25 %; P\0.001). Baseline SBP and aerobic volume explained the between-studies variance of CT (overall, R2 = 100 %; P\0.001).

Table 2: Review Characteristics and Summary Findings- Type II Diabetes Mellitus					
Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
					For physical activity advice only, baseline SBP, encouragement by phone, and recommended duration as co-variates explained the between-studies variance (overall, R2 = 97.42 %; P = 0.007)
5. Haghighi et al. (2018)	Effects of structured exercise and behavioural intervention (PA alone/ PA + diet) on long-term PA in T2DM	23 (9640)	Adults with T2DM	18 = behavioural (9 = PA, 9 = diet + PA), 5 = structured exercise Behavioural Interventions: 12 = steps or 150 mins/week, 3= CT, 3= DNR. 12= individual, 4= individual + group, 2 = group only. 14 = intervention + pedometers Frequency: 22 = 3/week; 1 = 2/week	All 5 exercise trials demonstrated ↑total PA relative to control. Two exercise trials reported no significant change in habitual PA (outside of intervention sessions). Three exercise trials reported moderate to large ↑ in total PA (relative ESs = 0.6 to 1.5), inclusive of both supervised training sessions and habitual PA and home-based exercise. 10/18 behavioural interventions significantly ↑ PA (ES: 0.2 to 6.6, I^2 = 96%).

Table 2: Review Characteristics and Summary Findings- Type II Diabetes Mellitus					
Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
				Intensity: AT = moderate; RT = moderate to high or moderate RT: moderate = 10-12RM, moderate to high = 50-85% 1RM AT: 50% to 80% of $VO2_{peak}$ or 55% to 75% of HR_{max} Type: 2 = AT, 1 = RT, 2 = CT Duration: 6-12 months	After removing 1 outlier, 17 studies significantly ↑ PA (pooled ES = 0.34), although smaller compared with structured exercise. After removing the outlier, meta-regression revealed significant direct relationships between total contacts (r = .50, P < .01) and more face-to-face counselling (r = .75, P < .001) and increased PA. For the 9 trials of PA counselling, a small but significant ↑in PA was observed (SMD = 0.25; 95% CI, 0.03 to 0.47; I2 = 66.2%; P < .001) Long-term changes in PA and HbA1c were not related.
6. Hayashino et al. (2012)	The effect of supervised exercise interventions on lipid	42 (2808)	Adults with T2DM	8 included a dietary co-intervention	Structured exercise was associated with a change in:

Table 2: Review Characteristics and Summary Findings- Type II Diabetes Mellitus					
Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
	profiles and blood pressure control.			Frequency: DNR Intensity: 292 (43-1296) METs Time: DNR Type: AT = 32, RT = 12, CT = 14 Duration: 22 (8-108) weeks	SBP (-2.42 mmHg, 95% CI, -4.39 to -0.45 mmHg), DBP (-2.23 mmHg, 95% CI, -3.21 to -1.25 mmHg), HDL-C (0.04 mmol/L, 95% CI, 0.02–0.07 mmol/L), LDL-C (-0.16 mmol/L, 95% CI, -0.30 to -0.01 mmol/L). HbA1c (WMD -0.51%; 95% CI, -0.68 to -0.34%; I2 = 88.5%; p for heterogeneity < 0.001) FPG (WMD -0.70 mmol/L; 95% CI, -1.09 to -0.31 mmol/L; I2 = 76.1%; p for heterogeneity < 0.001), WC (WMD -0.57 cm; 95% CI, -0.81 to -0.32 cm; I2 = 87.4%; p for heterogeneity < 0.001),

Table 2: Review Characteristics and Summary Findings- Type II Diabetes Mellitus					
Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
					BM or BMI (SMD -0.42; 95% CI, -0.59 to -0.26; I2 = 73.0%; p for heterogeneity < 0.001). Heterogeneity was partially explained by age, dietary cointervention and the duration and intensity of the exercise.
7. Igarashi et al. (2021)	Evaluate the relationship between changes in HbA1c (HbA1c) and exercise levels when performing various types of exercise.	48 (2395)	Adults with T2DM	Frequency: 3.2 (±0.9) sessions/week Intensity: 5.1 (±1.4) METs Time: 52 (± 17) min/session Type: Varied	Pooled WMB in BMI decreased significantly (−0.55 kg/m2; 95% CI, −0.58 to −0.51) and did not contain heterogeneity (Q=25.8, P= 0.99; I2 = 0.0% Pooled WMD in HbA1c decreased significantly (−0.5% [95% confidence intervals: −0.6 to −0.4]) but contained significant heterogeneity (Q= 103.8, P < 0.01; I2 = 36.6%). Intensity (METs), time (min/session), nor frequency (sessions/week) of the exercise was not associated with the HbA1c.

Table 2: Review Characteristics and Summary Findings- Type II Diabetes Mellitus					
Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
					Overall duration of exercise (weeks) was significantly associated with the WMD in HbA1c (meta-regression coefficient: 0.01 [95% confidence intervals: 0.002 −0.016]; R2 = 70.0%), and that result did not contain significant heterogeneity (P > 0.05; I2 = 14.7%).
8. Jabardo-Camprubi et al. (2020)	the extent to which exercise interventions impact dropout risk in patients with, or at risk of, T2DM	23 (1684)	Adults with, or at risk of, T2DM	HIIT = 14 (of which HICT = 8) Frequency: 3-5 days/week Intensity: HIIT-HICT = >75and <95% HR, >65% to <95% VO2max or 13-17 RPE MICT: >50 and <75% HR, >40 to <85%, 10-12 RPE Time: HIIT: 20-40mins (4 x 4 protocol most common) MICT: 40-55mins	No difference between intensities groups have been seen (OR 1,12 [CI95% 0,85–1,47] p = 0,41) High intensity exercise training has a higher dropout risk than moderate exercise when both are conducted over a similar time period as MICT (OR 1,81 [CI95% 1,12-2,91] p=0,01).

Table 2: Review Characteristics and Summary Findings- Type II Diabetes Mellitus					
Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
				Type: Treadmill, cycle ergometer, walking/running outdoors	
9. Jayawardena et al. (2018).	the effects of yoga practice compared to physical exercise in the management of T2DM	8 (842)	Adults with T2DM	Yoga: 5 = breathing exercises, loosening exercises, yogic asanas (postures) and/or relaxation methods including meditation. 2 = yogic asanas were practiced in the interventional group, 1= breathing exercises only. Control (Exercise):	A significant reduction in the yoga group for: FBG (15.16 mg/dl), PPBG (28.66 mg/dl), HbA1c (0.39%) and BMI (0.71 kg/m2) No significant difference between the groups for lipid parameters, other body composition measures (WC and WHR) and Blood Pressure. However, individual studies showed considerable heterogeneity hence caution advised in interpretation/drawing conclusions from this research.

Table 2: Review Characteristics and Summary Findings- Type II Diabetes Mellitus					
Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
				4= walking as the intervention in the control group 3=participants were only given information (verbal and/or written) regarding exercise with or without encouragement to exercise. 4 = clearly defined exercise programme	
10. Jayedi et al. (2022)	Examine the dose-dependent effect of supervised aerobic training on HbA1c	26 (1253)	Adults with T2DM	Frequency: 3 x week most common, 1 = 1-2/week, 1 = 3-4/week Intensity: 12 = MI, 10 = MVPA, 4 = vigorous. (1 = HIIT)	Each 30-min/week SAT ↓ HbA1c by − 0.22 percentage point (95% CI − 0.29 to − 0.15; GRADE = strong). Levels of HbA1c ↓ proportionally with the increase in the duration of moderate to vigorous-intensity SAT to 100 min/week (mean

Table 2: Review Characteristics and Summary Findings- Type II Diabetes Mellitus					
Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
				Time: Type: 14 = non-progressive AT, 12 = progressive (FITT) Duration: 12-52 weeks (22= 12-24 weeks, 12 >24 weeks) 4= dietary co-intervention	difference100 min/week: − 0.96 percentage point, 95% CI − 1.25 to − 0.67), with flattening of the curve at higher duration. AT ↓ antidiabetic medications by 13 per 100 patients (risk difference 0.13, 95% CI 0.02–0.23; 7 trials, n = 375; GRADE = moderate), AT ↑ hypoglycemic reactions by 10 per 100 patients (risk difference: 0.10, 95% CI 0.03–0.17; 4 trials, n = 263; GRADE = low) and adverse events by 4 per 100 patients (risk difference: 0.04, 95% CI − 0.02 to 0.11; 2 trials, n = 236; GRADE = low).
11. Kongstad et al. (2019)	Effectiveness of remote feedback intervention on PA Investigate the influence of the length of intervention,	27 (4215)	Adults with T2DM	Remote feedback: 25 = telephone calls, 7 = text-based feedback via webpage, email or SMS	Overall effect size in favour of remote feedback interventions compared to standardized treatment, SMD=0.33 (95% CI: 0.17 to 0.49), I2 =81.7%).

Table 2: Review Characteristics and Summary Findings- Type II Diabetes Mellitus					
Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
	number of contacts, study size, delivery of feedback, and preliminary face-to-face sessions.			Planned, structured contact: 0.3-5.3 per month (mean: 2.2). 2 = daily feedback via SMS Control = access to diabetes education Duration: 6-104 weeks (mean: 26)	Analyses on study characteristics found that the effect on physical activity was only influenced by study size, with a larger effect in small studies.
12. Y. B. Liu et al. (2019)	The effect of different intensity RT on HbA1c, insulin and BG	24 (962)	Adults with T2DM	Low-mod intensity: %1RM, reps x sets x times per week • 65-75%, 12 x 2 x 3 • 67%, 10-12 x 2-3 x 3 • 50-75%, 10-15 x 3 x 3 • 65-70%, 10 x 3 x 2-3	↓HbA1c (p = 0.006) and insulin (p = 0.015) after RT was correlated with intensity. Insulin levels were significantly ↓ only with high intensity (−4.60; 95% CI −7.53, −1.67), not with low-to-moderate intensity (0.07; 95% CI −3.28, 3.42).

Table 2: Review Characteristics and Summary Findings- Type II Diabetes Mellitus					
Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
				• 50-60%, 15 x 1-2 x 3.5 • 75%, 8-12 x 3 x 3 • 40-50%, 10-20, x 2 x 5 • 40-50%, 10-15 x 3 x 3 High Intensity: • 60-100%, 10 x 3 x 2 • 60-80%, 8 x 3 x 3 • 60-80%, 8 x 3 x 3 • 60-80%, 6-8 x 2-3 x 3 • 50-80%, 8-15, 3 x 3 • 80%, 8 x 2-3 x 3 • 50-85%, 8-12 x 2-3 x 3 • 60-100%, 10x 3 x 2 • 70-85%, 8-12 x 2 x 3	Notably, values between the subgroups were statistically significant for both HbA1c ($p = 0.03$) and insulin ($p = 0.04$), indicative of profound benefits of high-intensity RE. Pooled outcomes of 15 trials showed only a non-significant ↓ trend in BG with RE ($p = 0.09$), and this tendency was not associated with intensity.

Table 2: Review Characteristics and Summary Findings- Type II Diabetes Mellitus					
Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
				• 75-80%, 8-10 x 3 x 3 Duration: 6-52 weeks	
13. McGinley et al. (2015)	Effect of resistance band training on HbA1c and strength	7 (179)	Adults with T2DM	Frequency: 5 ± 3/week (median 3 times per week, range 3–10) Intensity: varied. %1RM, 1=METs, 1 = DNR 7 and 11 exercises, 2–3 sets, and 8–20 repetitions. Time: 54 ± 11 min (incl. warm-up and cool-down) Duration: 13 ± 2 weeks	HbA1c was non significantly ↓ in RB groups compared to control groups [weighted mean difference (WMD) =-0.18 percentage points (-1.91 mmol/mol); P = 0.27]. Post-intervention strength was significantly ↑ in the RB groups compared to the control groups in the lower extremities (WMD = 21.90 kg; P<0.0001). There was no significant difference in the upper extremities (WMD = 2.27 kg; P = 0.13) or handgrip (WMD = 1.98 kg; P = 0.46). Secondary analyses which assessed within-group differences showed a significantly higher absolute change in upper extremity strength in

Table 2: Review Characteristics and Summary Findings- Type II Diabetes Mellitus					
Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
					RB compared to control group (WMD = 3.53 kg; P<0.00001). The same was found for lower extremity strength (WMD = 21.21 kg; P<0.00001).
14. Munan et al. (2020)	Examine the acute and chronic effects of structured exercise on glucose outcomes assessed by CGM	28 (373)	Adults with T2DM	23 = short term Low, moderate and high intensity AT, HIIT	Short term (≤ 2 weeks): • Within participant comparison: exercise ↓ mean 24-h glucose concentrations in (−0.5 mmol/L, [−0.7, −0.3]; p < 0.001). • There was a high degree of heterogeneity among trials (Chi2 = 140.8, p < 0.001); I2 = 73%). • There were significant ↓in mean 24-h glucose when exercise was performed in the fasted state (−0.7 mmol/L [−1.1, −0.2], p = 0.004) and in the morning (−0.6 mmol/L [−0.9, −0.4], p < 0.001) but not in the afternoon (−0.1 mmol/L [−0.2, 0.1], p = 0.54).

Table 2: Review Characteristics and Summary Findings- Type II Diabetes Mellitus					
Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
					• ↑mean 24-h glucose concentration in the control condition predicted a greater ↓in 24-h glucose concentrations following exercise (r = −0.61, p < 0.001) • There was a significant ↓ in the daily time spent in hyperglycemia (−94min [−115, −72], I2 = 53%). Long-term: • Between groups: mean 24-h glucose was not significantly ↓compared to control (−0.9 mmol/L [−2.2, 0.3], p = 0.14) • Mean 24-h glucose was significantly reduced ↓ to pre-exercise values (−0.5 mmol/L, [−0.7 to −0.2] p < 0.001).
15. Nery et al. (2017)	Effect of resistance exercise when compared to aerobic exercise without insulin	8 (336)	Adults with T2DM	AT: walking was most common, followed by cycle ergometer	Evidence was deemed to be of very-low quality

Table 2: Review Characteristics and Summary Findings- Type II Diabetes Mellitus					
Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
	therapy on metabolic and clinical outcome			RT: major muscle groups Duration: 8-48 weeks Time: 20-60mins/day Frequency: 2-5 x week All but one compared between RT and AT	Significant ↑in VO2max (MD: −2.86; 95% CI: −3.90 to −1.81; random effect) for the RT No difference was found in HbA1c, BMI, HDL-C, LDL-C, TRG and TC.
16. Pan et al. (2018)	Compare the impact of different exercise training modalities on glycaemic control, CV risk factors, and weight loss	37 (2208)	Adults with T2DM	supervised aerobic, unsupervised aerobic, anaerobic, supervised resistance, unsupervised resistance, combined exercise, flexibility training, and no exercise.	Significant ↓ in HbA1c compared to no exercise: • CT (− 0.53, 95%CI: -0.68% to − 0.45%) • Supervised aerobic (− 0.30, 95%CI: -0.60% to − 0.45%) • Supervised resistance (− 0.30, 95%CI: -0.38% to − 0.15%) • Flexibility training (− 0.60, 95%CI: -1.05% to − 0.15%)

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Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
				Intensity: %1RM, $\%VO_{2peak}$, % maximum capacity, %HR	Supervised AT and RT showed greater benefit to HbA1c than unsupervised AT and RT (− 0.60, 95%CI: -0.83% to − 0.30%; − 0.60, 95%CI: -0.83% to − 0.20% and − 0.53% lower, 95%CI: -0.75% to − 0.30%; − 0.53, 95%CI: -0.83% to − 0.23%; respectively). This was not the case when duration was <6 months ($P_{interaction}$ <0.05) CT showed the most significant ↓in HbA1c when compared with: • supervised AT (− 0.23, 95%CI: -0.30% to − 0.08%), • unsupervised AT (− 0.75, 95%CI: -0.98% to − 0.53%), • supervised RT (− 0.23, 95%CI: -0.38% to − 0.15%), • unsupervised RT (− 0.75, 95%CI: -0.98% to − 0.45%)

Table 2: Review Characteristics and Summary Findings- Type II Diabetes Mellitus

Author (date)	Focus of the Review	Articles Included (participants)	Population	Intervention	Outcome
					Supervised AT also presented more significant improvement than no exercise in FPG (9.38 mg/dl lower), TC (20.24 mg/dl lower), triacylglycerol (19.34 mg/dl lower), and LDL-C (11.88 mg/dl lower). Greater weight reduction compared to unsupervised AT: • CT (− 8.37 kg, 95%CI: -13.39 kg to − 3.35 kg), • supervised AT (− 5.02 kg, 95%CI: -8.37 kg to − 1.67 kg), • supervised RT (− 5.02 kg, 95%CI: -9.21 kg to − 0.84 kg), and • anaerobic (− 8.37 kg, 95%CI: -15.07 kg to − 1.67 kg) Supervised AT was more powerful in improving HbA1c and weight loss than unsupervised

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Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
					aerobic (HbA1c: 0.60% lower; weight loss: 5.02 kg lower) and unsupervised resistance (HbA1c: 0.53% lower) exercises. Compared to no exercise, SBP, TC, TG and LDL were better improved by: • supervised AT (TC: 20.24 mg/dl, 95%CI: -27.60 mg/dl to − 11.04 mg/dl; TG: − 19.34 mg/dl, 95%CI: -29.76 mg/dl to − 5.95 mg/ dl; LDL: − 11.88 mg/dl, 95%CI: -21.60 mg/dl to − 1.08 mg/dl; HDL: − 3.66 mg/dl, 95%CI: -5.04 mg/dl to − 1.83 mg/dl), • supervised RT (SBP: − 5.20 mmHg, 95%CI: -9.10 mmHg to − 1.30 mmHg; TC: − 22.08 mg/dl, 95%CI: -31.28 mg/dl to − 11.04 mg/dl; TG: − 16.37 mg/dl, 95%CI: -28.27 mg/dl to − 4.46 mg/dl;

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Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
					HDL: − 4.58 mg/dl, 95%CI: -6.87 mg/dl to 2.75 mg/dl) and • CT (TG: − 37.20 mg/dl, 95%CI: -49.10 mg/dl to − 23.81 mg/dl) Supervised RT showed more benefit than no exercise in improving SBP (3.90 mmHg lower]) and TC (22.08 mg/dl lower]. Supervised AT (− 23.92 mg/dl, 95%CI: -33.12 mg/dl to − 12.88 mg/dl) and supervised RT (− 25.76 mg/dl, 95%CI: -36.80 mg/dl to − 14.72 mg/dl) exercise showed greater improvement in TC and HDL compared CT CT induced a greater reduction in TG than supervised AT (− 25.76 mg/dl, 95%CI: -46.00 mg/dl to − 3.68 mg/dl) and supervised RT (− 29.44

Table 2: Review Characteristics and Summary Findings- Type II Diabetes Mellitus

Author (date)	Focus of the Review	Articles Included (participants)	Population	Intervention	Outcome
					mg/dl, 95%CI: -47.84 mg/dl to − 7.36 mg/dl) exercises
17. Qin et al. (2021)	Effect of exercise intervention on balance capacity	14 (883)	Adults (≥ 50 years) with T2DM	Frequency: 1-7/week Intensity: Time: 30min-2-h Type: strengthening, balance training, Yoga, Tai Chi, treadmill exercise, interactive training, VR, and CT. Duration: 8 to 16 weeks (1 = 1 year)	Exercise intervention significantly ↑ compared to control group: • Berg Balance Scale (BBS) (MD = 2.56; 95%CI [0.35, 4.77]; P = .02), • SLST (Single Leg Stance Test) under the eyes-open (EO) condition (MD = 3.63; 95%CI [1.79, 5.47]; P = .0001) and eyes-close (EC) condition (MD = 0.41; 95%CI [0.10, 0.72]; P = .01). There was no significant difference in: • Time Up and Go Test (TUGT) (MD = −0.75; 95%CI [−1.69, 0.19]; P = .12) • Fall efficacy (SMD = −0.44; 95%CI [−0.86, −0.01]; P = .05).

Table 2: Review Characteristics and Summary Findings- Type II Diabetes Mellitus					
Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
18. Wen et al. (2017)	Effects of Baduanjin exercise for type 2 diabetes mellitus.	13 (782)		Duration: 6 weeks- 6 months FIT: DNR Type: Baduanjin (form of Chinese Qigong [postures, breathing and relaxation]) + conventional therapy	HbA1c: 3 months of Baduanjin exercise ↓HbA1c compared with patients in control group (WMD = −0.61; 95% CI: −0.99 to −0.23; P = 0.002), but not a favorable effect compared with 4 months (WMD = −0.76; 95% CI: −1.26 to −0.26; P = 0.003). The combined effect showed that Baduanjin therapy for 6 months (WMD = −1.34; 95% CI: −1.74 to −0.93; P < 0.00001) had a significantly better effect on HbA1c than the duration of 3 or 4 months FBG: 3, 4 and 6 months of Baduanjin exercise had a better effect on FBG than that of conventional therapy (WMD= −0.97; 95% CI: −1.70 to −0.23; P = 0.01; WMD=−0.47; 95% CI: −0.98 to 0.04, P =

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Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
					0.07; WMD = −1.86; 95% CI: −2.66 to −1.06; P < 0.00001 respectively) PPPG: 3, 4 and 6 months pooled analysis revealed significant effects favouring Baduanjin exercise (WMD = −0.35; 95% CI: −0.62 to −0.08, P = 0.01; WMD = −1.99; 95% CI: −2.92 to −1.06, P < 0.00001; WMD = −2.07; 95% CI: −3.16 to −0.98, P = 0.0002 respectively). TC: 4 and 6 months pooled analysis showed significant ↓ in TC commpared with conventional control (WMD = −0.83; 95% CI: −1.36 to −0.30, P = 0.002, WMD = −0.45; 95% CI: −0.82 to −0.08, P = 0.02). TG:

Table 2: Review Characteristics and Summary Findings- Type II Diabetes Mellitus					
Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
					3 months clinical but not statistically significant ↓ (WMD= −0.89; 95% CI: −1.89 to 0.10, P= 0.08) HDL-C: 3 & months significantly ↑ (WMD = 0.07; 95% CI: −0.10 to 0.24, P = 0.40; WMD = 2.36; 95% CI: −1.76 to 6.48, P = 0.26 respectively).
19. Yang et al. (2014)	Effectiveness and safety of AT and RT in people with type 2 diabetes	12 (626)	Adults with T2DM	Duration: 8 weeks- 12 months (mdn: 4 months) RT: Frequency: 3 RT/week Time: 30-60min. 5-10 muscle groups Intensity: 2-6 sets (2-3 most common), 6-20 reps (8-12 most common) AT:	Greater ↓ in within-group change in HbA1c with AT compared to RT (difference 0.18 % (1.97 mmol/mol), 95 % confidence interval (CI) 0.01, 0.36). This difference became non-significant with sensitivity analysis (p = 0.14). Change was also significant for: • BMI (difference 0.22, 95 % CI 0.06, 0.39, p=0.008), • VO_{2peak} (difference -1.84 mL/ kg/min, 95 % CI -3.07, -0.62, p= 0.003)

Table 2: Review Characteristics and Summary Findings- Type II Diabetes Mellitus					
Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
				Frequency: 3/week Intensity 60-85% HRR, 50-85% VO2peak, 3.6-5.2METs, HR at LT Time: 15-60 min (40-60 most common) Type: cycling, walking and treadmill l 1 = unsupervised AT	• HRmax (difference 3.44 beats per minute, 95 % CI 2.49, 4.39, p<0.001) The difference in within-group change in fasting blood glucose between RT and AT groups was -0.16 mmol/L (-0.75, 1.06), with substantial statistical heterogeneity (I^2 = 76 %, p<0.001).

Table 3: Review Characteristics and Summary Findings - Hypertension					
Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
1. Dassanayake et al. (2022)	Effectiveness of PA and exercise and the change of magnitude of 24hABP	4 (178)	Adults with resistant HTN	AT and/or PA interventions Frequency: 3/week Intensity: DNR Time: DNR Type: 3= AT, 1= PA Duration: 8-16 weeks	PA and exercise had a greater MD in 24h ABP than the control group: • − 9.88 mmHg (95% CI: − 17.62, − 2.14, z = 2.50; p < 0.01) for SBP • − 6.24 mmHg (95% CI: − 12.65, 0.17, z = 1.91; p < 0.06) for DBP at follow up. AT (land or water based) had greater ↓ in 24h ABP than controls: • − 12.06 mmHg in SBP (z = 2.60, p < 0.009) • − 8.19 mmHg in DPB (z = 2.42, p < 0.02.)
2. Kazeminia et al. (2020)	Impact of exercise on blood pressure	69 (2272)	Older adults (>60 yrs) with diagnosed HTN	AT & RT FITT: DNR	SMD: • SBP: pre-intervention 137.8 ± 1.09mmHg and post-intervention 132.08 ± 0.96 mmHg,

Table 3: Review Characteristics and Summary Findings - Hypertension					
Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
					• DBP: pre-intervention 80.3 ± 0.85 mmHg and post-intervention 76.6 ± 0.56 mmHg • Subgroup analysis shows that RT reduces systolic (0.69 ± 0.1) and diastolic blood pressure (0.73 ± 0.16) more than AT
3. S. H. Lee and Chae (2020)	Effects of AT on blood pressure (BP) and heart rate (HR)	337 (1813)	Adults with HTN	Frequency: 23 = 3/week Intensity: 6 = DNR. Remainder, various. Time: DNR Type: 20= walking, 6 = water based, 5= cycling, 5= dance Duration: 4-37 weeks. 17= 12 weeks, 6 = ≥6months	AT Sig ↓: • SBP; WMD, - 8.29 mmHg; 95% CI, - 10.12 to - 6.46, z= - 8.86, p < .001 • DBP: WMD, - 5.19 mmHg; 95% CI, - 6.24 to - 4.14, z = - 9.69, p < .001 • HR: WMD, - 4.22 beats/min; 95% CI, - 5.36 to –3.09, z = - 7.28, p < .001 Water-based, moderate-intensity AT, 3 times a week for 8 to 11 weeks had the greatest benefit to SBP.

Table 3: Review Characteristics and Summary Findings - Hypertension					
Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
					In diastolic BP, the greatest effect size was over 24 weeks of exercise. Insufficient evidence for LI-AT
L. L. Lee et al. (2021)	Effect of walking as a physical activity intervention on blood pressure and heart rate	73 (5763)	Hypertensive and normotensive adults	Frequency: 3-5/week Time: 20-40 minutes per session Type: Treadmill walking (n = 18), outdoor walking (n = 17), brisk walking (n = 16), and Nordic walking (n = 6). 50 = home-based (36= supervised) Duration: mean = 15 weeks 153minutes/week at moderate intensity Intensity: HR, VO2max, distance/hour, distance per day, distance per second, RPE, %HRR	Walking ↓: • SBP: MD -4.11 mmHg, 95% CI -5.22 to -3.01 • DBP: MD -1.79 mmHg, 95% CI -2.51 to -1.07 • HR: MD -2.76 bpm, 95% CI -4.57 to -0.95

Table 3: Review Characteristics and Summary Findings - Hypertension					
Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
4. Liang et al. (2020)	Effects of Tai Chi exercise on the risk factors for CVD including BP, BG and lipid profile) and QOL	15 (1543)	Adults with essential hypertension	Frequency: 2-8/week Intensity: DNR Time: 30-60 minutes Type: Tai Chi Duration: 6 weeks to 18 months	Tai Chi exercise was associated with: • ↓SBP (WM -12.47, 95%CI -16.00 to -8.94, P < 0.001) • ↓DBP (WMD -6.46, 95%CI -8.28 to -4.64, P < 0.001) • ↑QoL (SMD 0.62, 95% CI 0.35 to 0.90, P < 0.001) • ↓ TC (WMD -0.49, 95% CI -0.62 to -0.37, P < 0.001), • ↓TRG (WMD -0.49, 95% CI -0.92 to -0.07, P = 0.02), • ↓LDL-C (WMD -0.86, 95% CI -1.30 to -0.43, P < 0.001); • ↓ BG (WMD -0.91, 95% CI -1.59 to -0.23, P = 0.009). No significant effect on HDL-C.
5. Lopes et al. (2021)	Effects of exercise on PWV in patients with hypertension	14 (642)		5= AT, 2= dynamic RT, 6= CT, 2= isometric RT	PWV was significantly ↓ by exercise training [(WMD (95% CI)=-0.76 m/s (-1.05 to -0.47)].

Table 3: Review Characteristics and Summary Findings - Hypertension					
Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
	Identify the possible moderator variables (e.g. type of exercise) of the effect of exercise on PWV			Frequency: 1= 4/week. Remainder = 3/week Duration: 4-26 weeks (majority 12 weeks)	Analysis of moderator variables showed that PWV was significantly improved by: • AT: [WMD (95% CI)=-0.70 m/s -1.20 to -0.19)], • CT: [WMD (95% CI)=-0.74 m/s (-1.41 to -0.08)] and • Isometric RT [WMD (95% CI)=-0.98 m/s (-1.24 to -0.73)] There was no significant reduction in PWV in participants undertaking dynamic resistance training [WMD (95% CI)=-0.58 (-1.58 to 0.42)]
6. Lu et al. (2022)	Effects of the type of exercise training on SBP, DBP, BMI and RHR	12 (846)	Patients with HTN (SBP >130 mmHg and/or DBP >80 mmHg)	HV-HIIT: ≥80% maximum heart rate (max HR), and the total duration is more than 30min; ≥80% VO2max and duration is more than 30min; ≥80% peak power, and the total duration is more than 30min; and (4) The authors of the study classified it as HVHIIT.	MIT is best in improving SBP and DBP HVHIIT is better in ↓ body mass and RHR HVHIIT had a better impact on exercise capacity.

Table 3: Review Characteristics and Summary Findings - Hypertension					
Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
				LV-HIIT: HR ≥80% maximum heart rate (max HR), and the total duration is not more than 30min; ≥80% peak power, and the total duration does not exceed 30min; ≥80% VO_{2max}, and the total duration is not more than 30min; and the authors classified it as LV-HIIT. MIT: 55 - 80% HRmax; 55 - 80% maximum VO2max; 50–60% peak power; and the authors of the study specified it as MIT.	
7. Saco-Ledo et al. (2020)	Effects of exercise training on ABP	15 (910)	Patients with HTN	Duration: 8-24 weeks Frequency: 3-5/week Type: MICT, AIT, RT, CT Time: 24-60mins/session	Sig. ↓: • 24-hour SBP: −5.4 mm Hg; [95% CI, −9.2 to −1.6], • 24-hour DBP: −3.0 mm Hg [−5.4 to −0.6]),

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Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
					• Daytime SBP: −4.5 mm Hg [−6.6 to −2.3], • Daytime DBP, −3.2 mm Hg [−4.8 to −1.5]), • Night-time ABP (systolic BP, −4.7 mm Hg [−8.4 to −1.0]; diastolic BP, −3.1 mm Hg [−5.3 to −0.9]). In separate analyses, exercise benefits on all ABP measures were significant for patients taking medication (all P<0.05) but not for untreated patients Only aerobic exercise provided significant benefits (P<0.05).
8. Song et al. (2021)	Effects of traditional Chinese exercises (TCE) on QOL	13 (1361)	Patients with essential HTN	10= Tai-Chi, 3 = Qigong. Most common intervention: 24-form Tai-Chi, 30-50min, 5-8/week.	Large heterogeneity between studies

Table 3: Review Characteristics and Summary Findings - Hypertension					
Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
					Tai-Chi: ↑ physical and mental component of the 36-item short-form health survey (SF-36) QOL scale Physical: physical function (MD = 7.54; 95% CI: 5.65–9.43; p<0.00001; I2 =65%), role physical (MD=10.07; 95% CI: 6.64 to 13.49; p < 0.00001; I2 = 80%), bodily pain (MD = 9.40; 95% CI: 4.67–14.13; p < 0.0001; I2 = 83%), and general health (MD = 6.95; 95% CI: 2.51–11.39; p = 0.002; I2 =88%)] Mental: vitality (MD=9.40; 95% CI: 7.87–10.93; p < 0.00001; I2 = 0%), social function (MD = 9.56; 95% CI: 2.84–16.28; p = 0.005; I2 = 91%), role emotional (MD=9.09; 95%CI: 3.62–14.55; p=0.001; I2 =86%), and mental health domains (MD = 9.85; 95% CI: 7.08–12.61; p < 0.00001; I2 = 64%)]

Table 3: Review Characteristics and Summary Findings - Hypertension					
Author (date)	**Focus of the Review**	**Articles Included (participants)**	**Population**	**Intervention**	**Outcome**
9. Williamson et al. (2016)		14 (3614)	Adults (at least 25% 18-40 years) with HTN/pre-HTN.	Combined behavioural and PA intervention. Intervention arms: 18 = MVPA, 12 = structured AT in gym/group with set intensity based on baseline testing, 7= self-directed PA with group and individual counselling sessions Contact time for first 3 months; mean = 25 (5-48) hours	3 to 6 months, exercise was associated with: ↓ SBP (−4.40 mm Hg, 95% confidence interval, −5.78 to −3.01) ↓ DBP (−4.17 mm Hg, 95% confidence interval, −5.42 to −2.93). Intervention effect was not significantly influenced by baseline BP. BM, subsequent weight loss. Observed intervention effect was lost after 12 months of follow-up with no reported benefit over control.