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Effect of physical exercise on adults with type 2 diabetes and low physical functioning

Submission date
02/12/2019

Recruitment status
No longer recruiting

Registration date
09/12/2019

Overall study status
Completed

Last Edited
19/10/2022

Condition category
Nutritional, Metabolic, Endocrine

[X] Prospectively registered
[ ] Protocol
[ ] Statistical analysis plan
[ ] Results
[ ] Individual participant data
[ ] Record updated in last year

Plain English summary of protocol

Background and study aims
Adults with type 2 diabetes mellitus (T2DM) have physiologic exercise limitations and decreased cardiorespiratory fitness which may contribute to frailty. Frailty is a pre-disability condition linked to reduced physical function. While frailty and physical impairment is more prevalent in an older population, it has been shown that it is also common in middle-aged people with T2DM. Poor physical function and frailty is independently associated with increased risk of hospitalisation, disability and morbidity. Exercise is highly effective at counteracting the decline in physical functioning related to T2DM. Exercise has multiple benefits for patients with T2DM including reduced risk of chronic diseases, such as cardiovascular diseases, and increased life expectancy and quality of life. While frailty is considered as a predictor of future disability, it might be modifiable, particularly at early stages of functional decline. Nevertheless, there is a significant lack of intervention studies aimed to reduce functional decline in patients with T2DM. Therefore, this study aims to investigate the effect of a multi-modal exercise intervention on people with T2DM and impaired physical function.

Who can participate?
Adults with or at risk of T2DM, aged between 40 and 70 years with low physical function

What does the study involve?
Participants will be randomised to either the exercise group or the control group with no exercise intervention. Participants in the exercise group attend two supervised exercise sessions per week in Leicester Diabetes Centre for eight weeks. Each session lasts up to 60 minutes and incorporates resistance exercise and moderate-intensity aerobic exercise together with balance and stretching exercises. Alongside the two weekly supervised exercise sessions, participants are prescribed an additional home-based exercise session. These sessions are tailored to the needs of the individual and their ability to perform the exercise.

COVID-19 adaptations
This study was changed to a single-arm “before and after” design to examine the feasibility and efficacy of a home-based remotely supervised multi-modal exercise intervention for people with or at risk of T2D and physical function impairment. The change of design ensured all available resources were focused on the intervention and participants were not disadvantaged during the

pandemic by being asked not to change their routine health behaviours under conditions of a continued standard care control group.

What are the possible benefits and risks of participating?
Participants allocated to the exercise intervention group will be prescribed an exercise programme tailored to their needs by an exercise physiologist. Participants will receive their results from each assessment visit about their health profile and fitness that would be expensive if done privately. This study is a non-invasive lifestyle modification study based on exercise in type 2 diabetes, therefore there is a small possibility that episodes of hypoglycaemia (low blood sugar) may occur during or after exercise training. Glucose levels will be checked before all exercise sessions in those taking insulin and sulphonylureas, Additionally, a warm-up and cool-down period will be also performed before and after each exercise session to avoid the risk of injury.

Where is the study run from?
University Hospitals of Leicester NHS Trust (UK)

When is the study starting and how long is it expected to run for?
July 2019 to December 2021

Who is funding the study?
Leicester NIHR Biomedical Research Centre and NIHR Senior Investigator Funds

Who is the main contact?
Miss Monika Mickute
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Contact information

Type(s)
Scientific

Contact name
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Additional identifiers

Clinical Trials Information System (CTIS)
Nil known

Integrated Research Application System (IRAS)

261435

ClinicalTrials.gov (NCT)
Nil known

Protocol serial number
CPMS 43022, IRAS 261435

Study information

Scientific Title
The effect of a multi-modal exercise intervention on patients with or at risk of type 2 diabetes and impaired physical functioning

Acronym
RESET

Study objectives
Adults with type 2 diabetes mellitus (T2DM) have physiologic exercise limitations and decreased cardiorespiratory fitness which may contribute to frailty. Frailty is a pre-disability condition linked to reduced physical function. While frailty and physical impairment is more prevalent in an older population, it has been shown that it is also common in middle-aged people with T2DM. Poor physical function and frailty is independently associated with increased risk of hospitalisation, disability and morbidity. Exercise is highly effective at counteracting the decline in physical functioning related to T2DM. Exercise has multidimensional benefits for patients with T2DM including reduced risk of chronic diseases, such as cardiovascular diseases, increased life expectancy and quality of life. While frailty is considered as a predictor of future disability, it might be modifiable, particularly at early stages of functional decline. Nevertheless, there is a significant lack of intervention studies aimed to reduce the functional decline in patients with T2DM. Therefore, this study aims to investigate the effect of a multi-modal exercise intervention on people with T2DM and impaired physical function.

Ethics approval required
Old ethics approval format

Ethics approval(s)
Approved 24/09/2019, South Central - Berkshire B Research Ethics Committee (The Old Chapel Royal Standard Place, Nottingham, NG1 6FS, UK; Tel: +44 (0)207 104 8310, +44 (0)207 104 8199; Email: nrescommittee.southcentral-berkshireb@nhs.net), REC ref: 19/SC/0418

Study design
Single-arm, before-after study

Primary study design
Interventional

Study type(s)
Prevention

Health condition(s) or problem(s) studied

Type 2 diabetes mellitus

Interventions
Current interventions as of 19/10/2022:
Participants will be randomised to either the exercise group or the control group with no exercise intervention. Participants in the exercise group will attend two supervised exercise sessions per week at Leicester Diabetes Centre for eight weeks. Each session will last up to 60 minutes and incorporate resistance exercise and moderate-intensity aerobic exercise together with balance and stretching exercises. Alongside the two weekly supervised exercise sessions, participants will be prescribed an additional home-based exercise session. These sessions will be tailored to the needs of the individual and the ability to perform the exercise.

Amendments due to the COVID-19 pandemic
This study was developed before the COVID-19 pandemic. Whilst the research aims remain valid, the study design and intervention have had to be adapted in response to COVID-19. This study intervention has been changed to home-based exercise only.

Previous interventions:
Participants will be randomised to either the exercise group or the control group with no exercise intervention. Participants in the exercise group will attend two supervised exercise sessions per week at Leicester Diabetes Centre for eight weeks. Each session will last up to 60 minutes and incorporate resistance exercise and moderate-intensity aerobic exercise together with balance and stretching exercises. Alongside the two weekly supervised exercise sessions, participants will be prescribed an additional home-based exercise session. These sessions will be tailored to the needs of the individual and the ability to perform the exercise.

Intervention Type
Behavioural

Primary outcome(s)
Current primary outcome measure as of 19/10/2022:
Physical function assessed by the incremental shuttle walk test (ISWT) and sit-to-stand 60 (STS 60) pre and post the 8-week intervention

Previous primary outcome measure:
Physical function assessed by the incremental shuttle walk test (ISWT) and the modified physical performance test (PPT) pre and post the 8-week intervention

Key secondary outcome(s))
Current secondary outcome measures as of 19/10/2022:
1. Lower body endurance assessed with the short physical performance battery (SPPB) test which involves balance, walking seed and ability to sit and stand from a chair. These assessments will be done pre and post the 8-week intervention
2. Postural stability ((pressure path area (mm2) and sway velocity (mm/s)) assessed with Fysiometer force plate pre and post the 8-week intervention.
3. Lower limbs muscle strength (isometric and isokinetic quadriceps strength) measured using a fixed dynamometer (Biodex) pre and post the 8-week intervention
4. Handgrip strength measured using a digital handheld dynamometer pre and post the 8-week intervention
5. Cross-sectional area of muscle, echo intensity (indication of intermuscular adipose tissue), fibre pennation angle, muscle, and subcutaneous fat thickness, and volume of lower limb

muscles such as the rectus femoris (quadriceps) assessed with ultrasound imaging pre and post the 8-week intervention
6. Mechanical and viscoelastic (tone, elasticity and stiffness) characteristics of the quadriceps muscle assessed using myotonometery (MyotonPRO) pre and post the 8-week intervention
7. Bodyweight, height, waist circumference will be also measured both pre and post the 8-week intervention
8. Objectively measured habitual physical activity assessed with accelerometers throughout the duration of the intervention. Accelerometers will capture various measures, including time being sedentary, time in high-intensity exercise, etc
9. Dietary intake assessed with UK Diabetes and Diet Questionnaire (UKDDQ) both pre and post the 8-week intervention
10. Physical activity assessed using Recent Physical Activity Questionnaire (RPAQ) pre and post the 8-week intervention
11. Quality of life assessed through a number of health-related quality of life questionnaires (the EQ5D-5L instrument, the Hospital Anxiety and Depression scale and the Diabetes Distress Scale -17, The World Health Organization Disability Assessment Scale II, Exercise Self-Efficacy) pre and post the 8-week intervention
12. The effect of breathlessness on daily activities assessed using the MRC breathlessness scale pre and post the 8-week intervention
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1. Lower body endurance assessed with the short physical performance battery (SPPB) test which involves balance, walking seed and ability to sit and stand from a chair. These assessments will be done pre and post the 8-week intervention
2. Postural stability ((pressure path area (mm2) and sway velocity (mm/s)) assessed with Fysiometer force plate pre and post the 8-week intervention
3. Sit-to-stand-60 test (STS-60) will be used to measure how many times the participant can stand from a chair in 60 seconds pre and post the 8-week intervention
4. Lower limbs muscle strength (isometric and isokinetic quadriceps strength) measured using a fixed dynamometer (Biodex) pre and post the 8-week intervention
5. Handgrip strength measured using a digital handheld dynamometer pre and post the 8-week intervention
6. Cross-sectional area of muscle, echo intensity (indication of intermuscular adipose tissue), fibre pennation angle, muscle, and subcutaneous fat thickness, and volume of lower limb muscles such as the rectus femoris (quadriceps) assessed with ultrasound imaging pre and post the 8-week intervention
7. Mechanical and viscoelastic (tone, elasticity and stiffness) characteristics of the quadriceps muscle assessed using myotonometery (MyotonPRO) pre and post the 8-week intervention
8. Cardio-metabolic health and renal status assessed by a blood sample analysed for HbA1c, glucose, insulin and blood lipids (total cholesterol, high-density lipoprotein cholesterol, non-esterified fatty acids and triglycerides) and creatinine. Markers of inflammation also assessed by a blood sample analysed for C-reactive protein. These will be taken from venous blood while under fasting conditions both pre and post the 8-week intervention
9. Body composition assessed with dual-energy X-ray absorptiometry (DEXA) scanning which will derive a breakdown of body fat, muscle mass and bone density. Bodyweight, height, waist circumference will be also measured both pre and post the 8-week intervention
10. Glycaemic variability, such as time in hypoglycaemia assessed with flash glucose monitoring (FGM) two weeks before the intervention and two weeks after the 8-week intervention
11. Resting metabolic rate (RMR) measured with indirect calorimetry under fasted and resting conditions pre and post the 8-week intervention

12. Objectively measured habitual physical activity assessed with accelerometers throughout the duration of the intervention. Accelerometers will capture various measures, including time being sedentary, time in high-intensity exercise, etc
13. Dietary intake assessed with UK Diabetes and Diet Questionnaire (UKDDQ) both pre and post the 8-week intervention
14. Physical activity assessed using Recent Physical Activity Questionnaire (RPAQ) pre and post the 8-week intervention
15. Quality of life assessed through a number of health-related quality of life questionnaires (the EQ5D-5L instrument, the Hospital Anxiety and Depression scale and the Diabetes Distress Scale -17, The World Health Organization Disability Assessment Scale II) pre and post the 8-week intervention
16. The effect of breathlessness on daily activities assessed using the MRC breathlessness scale pre and post the 8-week intervention

Completion date
22/12/2021

Eligibility

Key inclusion criteria
Current participant inclusion criteria as of 19/10/2022:
1. Males and females aged 40-70 years
2. BMI 25 to 40 kg/m2 (23 to 40 kg/m2 in individuals of south Asian ethnicity)
3. Patients with established T2DM (> 6 months since diagnosis) or with elevated blood glucose or HbA1c levels meeting criteria for pre-diabetes or at-risk status (impaired fasting glucose [fasting glucose ≥ 5.5 mmol/l]), impaired glucose tolerance [2-hour post challenge glucose ≥ 7.8 mmol/l] or HbA1C ≥ 38.8 mmol/mol) reported within the preceding five years
4. Historical evidence or risk of functional limitation or frailty defined as at least one of:
4.1. Impaired physical function or frailty; SPPB score 1 to 10 (inclusive) recorded within the preceding 5 years
4.2. A coding of mild-to-moderate frailty based on the Electronic Frailty Index (eFI) within primary care
4.3. VO2peak ≤ 18 ml/kg recorded within the preceding 5 years
4.4. SARC-F questionnaire score of 4 or more
4.5. Inactive – defined as ≤ 7 500 steps per day as measured by a pedometer or undertaking less than 30 minutes of moderate or 15 minutes of vigorous physical activity per day as measured by an accelerometer or self-report. Objectively measured physical activity data will be included from within the preceding five years and self-reported data confirmed at baseline.
5. No severe hearing or vision deficits that would inhibit communication with the research team via videoconferencing
6. Willing to use a computer and videoconferencing software to communicate with a study team member during the assessments
7. Enough space to safely exercise

Previous participant inclusion criteria:
1. Males and females aged 40-70 years
2. BMI 25 to 40 kg/m2 (23 to 40 kg/m2 in individuals of south Asian ethnicity)
3. Patients with established T2DM (> 6 months since diagnosis)
4. SPPB 1 to 9

Participant type(s)

Patient

Healthy volunteers allowed
No

Age group
Adult

Lower age limit
18 years

Sex
All

Total final enrolment
25

Key exclusion criteria
1. Unable to consent
2. Persons unable to understand written and spoken English sufficiently to consent and participate fully in the study
3. Participating in other interventional studies
4. Recent history of stroke, myocardial infarction, unstable angina, congestive heart failure within 12 months
5. Uncontrolled hyperglycaemia (HbA1c > 10% - established through medical notes or confirmed through baseline blood sample results)
6. Stage 4 or 5 chronic kidney disease (eGFR < 30ml/min/1.73m2)
7. Chronic obstructive pulmonary disease
8. Heart failure
9. Terminal illness (life expectancy less than 1 year)
10. Patients with type 1 diabetes
11. Current smokers (having quit less than 1 year before entering the study)
12. Weight unstable within the past 6 months (> = 10 kg)
13. Unable to perform exercise testing/training
14. Taking part in regular (at least once a week) strenuous sport or activities (> 120 minutes self-reported exercise per week)

Date of first enrolment
01/01/2020

Date of final enrolment
01/11/2021

Locations

Countries of recruitment
United Kingdom

England

Study participating centre
University Hospitals Of Leicester NHS Trust
Leicester Royal Infirmary
Infirmary Square
Leicester
United Kingdom
LE1 5WW

Sponsor information

Organisation
University of Leicester

Funder(s)

Funder type
Government

Funder Name
NIHR Central Commissioning Facility (CCF); NIHR Leicester Biomedical Research Centre

Results and Publications

Individual participant data (IPD) sharing plan
The datasets generated and/or analysed during the current study during this study will be included in the subsequent results publication.

IPD sharing plan summary
Other

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
HRA research summary			28/06/2023	No	No
Participant information sheet	Participant information sheet	11/11/2025	11/11/2025	No	Yes