



## **BE-NEW**

# **Exercise for diabetes: beneficial effect of new educational and physical activity programs**

## **ERASMUS+ SPORT PROJECT**

Collaborative Partnerships

Grant Agreement n. 622371-EPP-1-2020-1-IT-SPO-SCP

## **IO-04 REPORT**

### **BE-NEW Evaluation Report**

**October 2023 – M34**





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# 1. Introduction

The diabetes is a serious disease, which can lead to various types of complications such as cardiovascular complication, nephropathy leading to renal failure, retinopathy with a potential loss of vision, and peripheral neuropathy. This project aims at uncovering the BEneficial effect of NEW educational and physical activity programs. Thus, the acronym BE-NEW indicates the need of pursuing a novel style of life incorporating the practice of physical exercise into the daily routine. The BE-NEW project targets voluntary aspects in training, sport inclusion of poor social classes more affected by the diabetes, and give opportunities to such people to access personalized sports programs.

The project specifically targets the objective pursued by the Erasmus + program related to “promote voluntary activities in sport, together with social inclusion, equal opportunities and awareness of the importance of health-enhancing physical activity, through increased participation in, and equal access to sport for all”.

## General Objective

Improvement of the physiological condition of people suffering from diabetes through the constant practice of sport activity.

The BE-NEW project is aimed at promoting the practice of physical activity in people with diabetes. The subjects who participate in the project can chose one of three types of physical activity: 1) activity in a gym, 2) swimming activity, 2) walking activity. Furthermore, the project promotes specific educational programs regarding teaching physical activity for children/adolescents with diabetes.

The role of each partner is to promote the different physical activity programs in its own country. The scientific team of the project collect all data, analyse them and provide the results for dissemination. Through the application of the sport protocols, we evaluate differences in efficacy and safety of a physical activity program specifically designed for improving physical function and, here in after, reducing glycated haemoglobin level in a diabetic population.



## 2. Implementation Phase

The objective of the Implementation Phase is to carry out the core implementation actions of the project addressed to target beneficiaries. After defining the test plan and recruiting target beneficiaries, the activities have been organized in two main streams: 1) to carry out courses either in schools or in universities for educating trainers according to BE-NEW protocols, and 2) to carry out exercise sessions for the recruited diabetic people in the project cities.

### 2.1 Teacher training courses

To carry out the teacher training courses we proceeded with the following activities:

- Needs Collection and Analysis

We evaluated the attitudes of physical education teachers in physical education, as well as to inform and train them towards the active participation of students with diabetes in physical activity through physical education.

- BE-NEW Effective strategies

We considered the results of the aforementioned task in order to outline the effective strategies concerning physical education and physical activity. Furthermore, best practices have been considered in order to create effective strategies of evaluating and promoting active participation and learning in physical activity through physical education.

- Educational Content for Teacher Training

The content includes multimedia education, presentations, notes, video-tutorials, quizzes and lesson plans related to effective teaching and active participation of learners with diabetes in physical activity, through the physical education lesson. Initial teacher (attitudes/behaviour) and student evaluation (health-related fitness, quality of life) takes place in this period. This phase is necessary for the development stage of the educational content in which researchers and experts of the participating organizations collaborate following a participatory and interdisciplinary design process.

- BE-NEW Online Course and Platform

Teacher training is based on the principles of adult learning, to enable the teacher to improve attitudes, knowledge and skills in order to promote active participation of students with diabetes in physical activity through physical education and acquire multiple health benefits. Final and Retention evaluation of teachers and students with diabetes has been conducted.

## 2.2 Deployment of sport practices in the 5 countries

The development of scientifically validated physical exercise protocols is a highly specialized subject aimed at personal health. The key to truly understanding the methodology is to follow the basic steps:

- Carry out an initial evaluation of each of the groups, in order to know the starting point of our work and formulate the specific objectives to be achieved with each of these groups.
- Begin the work sessions of each group.
- When approximately 50% of the work plan has been carried out, carry out a follow up evaluation, to check whether the line of action is appropriate, or requires revision.
- Once the action program is completed, carry out a final evaluation that allows us to know what the achievements have been and extract the appropriate conclusions on the related work.

## 3. Evaluation Plan

In the BE-NEW study, we evaluate the modifications of glycated haemoglobin level, which is a useful parameter for monitor diabetic patients and for glycaemic control. We used the questionnaires -Brief Disability Questionnaire, Adherence to Exercise Scale for Diabetic People, Falls Efficacy Scale, International Physical Activity Questionnaire, Quality of Life for Diabetic People and the Walking Impairment Questionnaire- to evaluate the improvements induced by the exercise program. We also investigated Autonomic variables, Body Mass index and waist circumference.

The following type of data have been recorded:

1. Modifications of glycated haemoglobin level.
2. Quality of life questionnaire.



3. Adherence to Exercise Scale for Diabetic Patients - AESDP.
4. Electromyographic activity.
5. Stabilometric analysis for standing balance.
6. Autonomic variables (blood pressure, heart rate variability, baroreflex sensitivity).
7. Perception of disabilities.
8. Fear of falls.
9. Quality/range of walking.
10. Body mass index.
11. Waist circumference.
12. Muscle force (hand grip).
13. Joint mobility.
14. Signature sheets to the training course.
15. Evaluation form for trainees.
16. Questionnaires filled-in and interviews realized within the satisfaction survey.
17. Teacher attitudes.
18. Student evaluation.
19. Health-related fitness evaluation.

All these data have been recorded 5 different times through the 22 months of the recording period, as explained here:

- Baseline activity of all aforementioned type of data will be recorded before the beginning of the program.
- All data will be recorded after 6 months from the beginning of the program.
- All data will be recorded after 12 months from the beginning of the program
- All data will be recorded after 18 months from the beginning of the program, which is also the end of the exercise program.
- All data will be recorded after 4 months from the end of the program (follow up).

### 3.1. Evaluation phase

This module implemented the overall evaluation methodology for assessing the impact generated by BE-NEW innovations within the project's objectives. Impact evaluation is performed to assess impacts in the health of diabetic people, comparing ex-ante and ex-post situation. The assessment relied on a common evaluation methodology based on previously determined KPIs (see below) to measure the impacts of BE-NEW methodology on health.

The methodology for producing the evaluation framework have been designed around three main elements:

1. Observational system: defining actors affected by the effects brought by the BE-NEW actions.
2. Process analysis: assessing how the works are performed in each project activity and identifying which key factors (e.g. recruitment, training etc.) will be affected by BE-NEW innovations.
3. Outcome measurement: outlining unbiased procedures for collecting, analysing and validating measurements of the selected indicators as well as defining methods for identifying thresholds and normalisation procedures allowing effective comparison of composite indicators.

### 3.2 KPIs of the Project

KPIs were defined based on:

- a. literature review,
- b. direct inputs from stakeholders' experience related sport performances,
- c. the know-how of all task partners, based on previous pioneering from past projects.

We thus refer to the analysis of the following indicators:

- Signature sheets to the training course
- Evaluation form for trainees
- N. and results of questionnaires filled - in and interviews realized within the satisfaction survey (all participants have to fill in questionnaires and give interview)

- N. and quality of contacts between participating organizations and / or between them and other stakeholders
- N. and significance of articles published on the project by third parties
- N. of participants to the BE-NEW project (we expect to recruit about 180 - 200 people, based on the experience in previous projects)
- Size of teams of different activities - gym, walking or swimming
- List of enrolment in various teams
- N. of researchers / speakers invited to the dissemination events (300 people considering all multiplier events)
- N. of presentation at scientific meetings (at least 10 in three years).

To measure the effectiveness of the exercise training we refer to the analysis of the following scientific data:

- Modifications of glycated haemoglobin level
- Quality of life questionnaire
- Electromyographic activity
- Stabilometric analysis for standing balance
- Autonomic variables (bloodpressure, heart rate variability, baroreflex sensitivity)
- Perception of disabilities
- Fear of falls
- Quality / range of walking
- Body mass index
- Waist circumference
- Postural alignment (occiput-wall distance)
- Muscle force (handgrip)
- Joint mobility
- N. and impact of scientific articles published



To measure the effectiveness of the educational programs for teachers, students and school pupils, we refer to the analysis of the following data:

- Signature sheets to the educational course
- Evaluation form for teachers
- N. of university students attending the courses (we expect about 30-40 students in three years)
- N. of school teachers involved (we expect about 40-50 teachers in three years)
- N. of school pupils beneficiary of the teacher training (we expect about 60 pupils in three years)

## 4. Implementation and evaluation at country level

For the realization of BE-NEW, the collaboration between partners has been crucial. In specific, the cooperation among universities in elaborating innovative exercise protocols, educational programs and the network effect activated by the collaboration among sport associations allowed the realization of validated sport and educational programs usable at European level.

The BE-NEW project was implemented in five EU countries with the collaboration of seven partners:

1. University of Bologna - UNIBO (Bologna, Italy)
2. Unione Italiana Sport per Tutti - UISP (Bologna, Italy)
3. Sport Union of Slovenia - SUS (Slovenia)
4. Radio Capodistria (Slovenia)
5. Association Sport for All Suceava - AJSPT (Suceava, Romania)
6. University of La Rioja - RIOJA (Logrono, Spain)
7. Democritus University of Thrace – DUTH (Komotini, Greece)

### 4.1 University of La Rioja (Spain) – RIOJA

The University of La Rioja, henceforth RIOJA, was created on May 14th 1992 and inaugurated in the academic year 1992-1993. It is the only public University in the autonomous community of La Rioja

in the north of Spain. As such, it belongs to the G9 group of Universities in Spain. It is also a founding member of the Excellence Campus Iberus.

#### 4.1.1 Identification of the target groups for sport activities

As indicated on the Project Proposal our initial target group where patients with DM2, but because of health reasons, we opened the possibility to enroll people with all type of DM and people with prediabetes on the sport practices, to encourage them to start a new and healthier lifestyle. Having said that, we contacted Diabetic Associations to inform them about the project and to invite them to participate voluntarily on it. After that, we started working with the cooperation of nurses and endocrinologists to reach the maximum number of people with diabetes and in a prediabetic range. Furthermore, we delivered a brochure with the information to participate on the project trough gyms and health centers. Some of the gyms were very opened to the project and ask for more information to send to their members, so that we did.



After having spoken with each of the volunteers individually and personally, we know the characteristics of each of them, their needs and their capacities, their interests and the sport(s) they are willing to do. So, having that in mind, we counsel them which is the best path for them to follow, how to change they routine (we try to change it the minimum and only we it is really a necessity), which is the most adequate training for each one of them, and how they can improve the sport practice. We started a walking group, but after a few sessions, due to the Easter vacation,

personal tasks, and timetable changes, it stopped because of the volunteer's impossibility of attendance. During the summer holidays will be very difficult or almost impossible to take time for it, so we will restart the group in September, when people come back from their holidays. Right after having a first and personal contact with each volunteer, having filled the questionnaires and having participate in the sport test, we explain them the three different kind of training that we have for them to choose. These are: the peripheral heart action training (PHA) or weigh training, the swimming protocol and the walking protocol. We translate them and prepared them in a chart, which we gave to the volunteers:

### PROGRAMA DE ENTRENAMIENTO CON PESO

Semana	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Frecuencia (sesión/semana)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Ciclos	2	2	2	2	3	3	3	3	4	4	4	4	4	4	4	4
Intensidad (% 1RM)	40-50	40-50	40-50	40-50	50-55	50-55	50-55	50-55	55-60	55-60	55-60	55-60	55-60	55-60	55-60	55-60
Repeticiones	10-13	10-13	14-15	14-15	12-13	12-13	14-15	14-15	12-13	12-13	14-15	14-15	14-15	14-15	14-15	14-15
Descanso	30 segundos entre ejercicios y de 3 a 5 minutos entre cada serie															

- 1RM será predicho utilizando la ecuación:  $1RM = \text{peso máximo utilizado en el primer test (con alrededor de 1 repetición al fallo)}$ .
- El ejercicio utilizado para cada grupo muscular se modificará después de los tres primeros meses de entrenamiento.

#### PROGRAMA DE ENTRENAMIENTO DE LA FUERZA MUSCULAR

##### 1ª semana de entrenamiento

- Objetivo: Aumento de la fuerza muscular
- Frecuencia: 2 sesiones a la semana
- Método de organización: Circuito de entrenamiento

CONTENIDO DEL ENTRENAMIENTO		VARIABLES DEL ENTRENAMIENTO			
		Duración			
<b>CALENTAMIENTO</b>					
Caminar rápido		6 min			
Estiramientos dinámicos y estáticos del tren superior e inferior		10 min			
Calentamiento específico (ejercicios de la parte principal)		1 ronda de 6 repeticiones con carga de 40% del fallo			
<b>PARTE PRINCIPAL</b>					
Ejercicios	Series (sets)	Repeticiones del ejercicio	Carga (% Fallo)	Descanso	
Press de banca	2	12	45	30 segundos entre ejercicios y de 3 a 5 minutos entre series.	
Extensión de pierna o extensión de rodilla	2	12	45		
Lat PullDown o Jalón al Pectoral	2	12	45		
Curl de piernas o isquiotibiales	2	12	45		
Press de hombro	2	12	45		
Elevación de pantomillas, flexión plantar o extensión de tobillos	2	12	45		
Crunches o abdominales cortos	2	12	45		
Extensión de espalda (en posición supina con las manos tras la cintura)	2	12	45		
<b>VUELTA A LA CALMA</b>					
		Duración			
Estiramientos estáticos de tren superior e inferior		10 min			



#### 6ª semana de entrenamiento

- Objetivo: Aumento de la fuerza muscular
- Frecuencia: 2 sesiones a la semana
- Método de organización: Circuito de entrenamiento

CONTENIDO DEL ENTRENAMIENTO		VARIABLES DEL ENTRENAMIENTO		
		Duración		
<b>CALENTAMIENTO</b>				
Caminar rápido		6 min		
Estiramientos dinámicos y estáticos del tren superior y el inferior		10 min		
Calentamiento específico (ejercicios de la parte principal)		1 ronda de 6 repeticiones con carga de 40% del fallo		
<b>PARTE PRINCIPAL</b>				
Ejercicios	Series (sets)	Repeticiones del ejercicio	Carga (% Fallo)	Descanso
Press de banca	3	12	55	30 segundos entre ejercicios y de 3 a 5 minutos entre series.
Extensión de pierna o extensión de rodilla	3	12	55	
Lat PullDown o Jalón al Pectoral	3	12	55	
Curl de piernas o isquiotibiales	3	12	55	
Press de hombro	3	12	55	
Elevación de pantomillas, flexión plantar o extensión de tobillos	3	12	55	
Crunches o abdominales cortos	3	12	55	
Extensión de espalda (en posición supina con las manos tras la cintura)	3	12	55	
<b>VUELTA A LA CALMA</b>				
		Duración		
Estiramientos estáticos de tren superior e inferior		10 min		

#### 12ª semana de entrenamiento

- Objetivo: Aumento de la fuerza muscular
- Frecuencia: 2 sesiones a la semana
- Método de organización: Circuito de entrenamiento

CONTENIDO DEL ENTRENAMIENTO		VARIABLES DEL ENTRENAMIENTO		
		Duración		
<b>CALENTAMIENTO</b>				
Caminar rápido		6 min		
Estiramientos dinámicos y estáticos del tren superior y el inferior		10 min		
Calentamiento específico (ejercicios de la parte principal)		1 ronda de 6 repeticiones con carga de 40% del fallo		
<b>PARTE PRINCIPAL</b>				
Ejercicios	Series (sets)	Repeticiones del ejercicio	Carga (% Fallo)	Descanso
Press de banca	4	15	60	30 segundos entre ejercicios y de 3 a 5 minutos entre series.
Extensión de pierna o extensión de rodilla	4	15	60	
Lat PullDown o Jalón al Pectoral	4	15	60	
Curl de piernas o isquiotibiales	4	15	60	
Press de hombro	4	15	60	
Elevación de pantomillas, flexión plantar o extensión de tobillos	4	15	60	
Crunches o abdominales cortos	4	15	60	
Extensión de espalda (en posición supina con las manos tras la cintura)	4	15	60	
<b>VUELTA A LA CALMA</b>				
		Duración		
Estiramientos estáticos de tren superior e inferior		10 min		

## PROGRAMA DE ENTRENAMIENTO CAMINANDO

Semana	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Frecuencia (sesión/semana)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Intensidad (% ppm)	30	30	30	30	35	35	35	35	40	40	40	40	45	45	45	45
Duración (minutos)	25	25	25	25	30	30	30	30	35	35	35	35	40	40	40	40

- Las pulsaciones por minuto se calcularán con la ecuación: 220 - edad.
- Durante algunas sesiones del entrenamiento, se podrá utilizar la bicicleta en sustitución a caminar.

### PROGRAMA DE ENTRENAMIENTO CAMINANDO

#### 1ª semana de entrenamiento

- Objetivo: Aumento de la capacidad aeróbica
- Frecuencia: 3 sesiones a la semana
- Método de organización: Cinta de correr o caminar al aire libre

CONTENIDO DEL ENTRENAMIENTO		
	Intensidad	Duración
<b>CALENTAMIENTO</b>		
Caminar en una cinta o al aire libre	30% ppm	5 min
Estiramientos dinámicos y estáticos del tren superior e inferior		10 min
<b>PARTE PRINCIPAL</b>		
Caminar en una cinta o al aire libre	30% ppm	25 min
<b>VUELTA A LA CALMA</b>		
Estiramientos estáticos de tren superior e inferior		10 min

#### 6ª semana de entrenamiento

- Objetivo: Aumento de la capacidad aeróbica
- Frecuencia: 3 sesiones a la semana
- Método de organización: Cinta de correr o caminar al aire libre

CONTENIDO DEL ENTRENAMIENTO		
	Intensidad	Duración
<b>CALENTAMIENTO</b>		
Caminar en una cinta o al aire libre	30% ppm	5 min
Estiramientos dinámicos y estáticos del tren superior e inferior		10 min
<b>PARTE PRINCIPAL</b>		
Caminar en una cinta o al aire libre	35% ppm	30 min
<b>VUELTA A LA CALMA</b>		
Estiramientos estáticos de tren superior e inferior		10 min

#### 12ª semana de entrenamiento

- Objetivo: Aumento de la capacidad aeróbica
- Frecuencia: 3 sesiones a la semana
- Método de organización: Cinta de correr o caminar al aire libre

CONTENIDO DEL ENTRENAMIENTO		
	Intensidad	Duración
<b>CALENTAMIENTO</b>		
Caminar en una cinta o al aire libre	30% ppm	5 min
Estiramientos dinámicos y estáticos del tren superior e inferior		10 min
<b>PARTE PRINCIPAL</b>		
Caminar en una cinta o al aire libre	45% ppm	40 min
<b>VUELTA A LA CALMA</b>		
Estiramientos estáticos de tren superior e inferior		10 min





## PROGRAMA DE ENTRENAMIENTO NATACIÓN

### 1ª semana de entrenamiento

- Objetivo: Aumento de la capacidad aeróbica
- Frecuencia: 3 sesiones a la semana
- Método de organización: Nadando

CONTENIDO DEL ENTRENAMIENTO	
	Duración
<b>CALENTAMIENTO</b>	
Estiramientos dinámicos y estáticos del tren superior e inferior	5 min
<b>PARTE PRINCIPAL</b>	
Nadar a crol	5 min
Nadar solo con patada	2.5 min
Nadar a braza	5 min
Nadar solo con brazos	2.5 min
Nadar a espalda	5 min
<b>VUELTA A LA CALMA</b>	
Estiramientos estáticos de tren superior e inferior	5 min

### 6ª semana de entrenamiento

- Objetivo: Aumento de la capacidad aeróbica
- Frecuencia: 3 sesiones a la semana
- Método de organización: Nadando

CONTENIDO DEL ENTRENAMIENTO	
	Duración
<b>CALENTAMIENTO</b>	
Estiramientos dinámicos y estáticos del tren superior e inferior	5 min
<b>PARTE PRINCIPAL</b>	
Nadar a crol	5 min
Nadar solo con patada	3 min
Nadar a braza	5 min
Nadar solo con brazos	3 min
Nadar a espalda	5 min
Nadar a crol	5 min
<b>VUELTA A LA CALMA</b>	
Estiramientos estáticos de tren superior e inferior	5 min

### 12ª semana de entrenamiento

- Objetivo: Aumento de la capacidad aeróbica
- Frecuencia: 3 sesiones a la semana
- Método de organización: Nadando

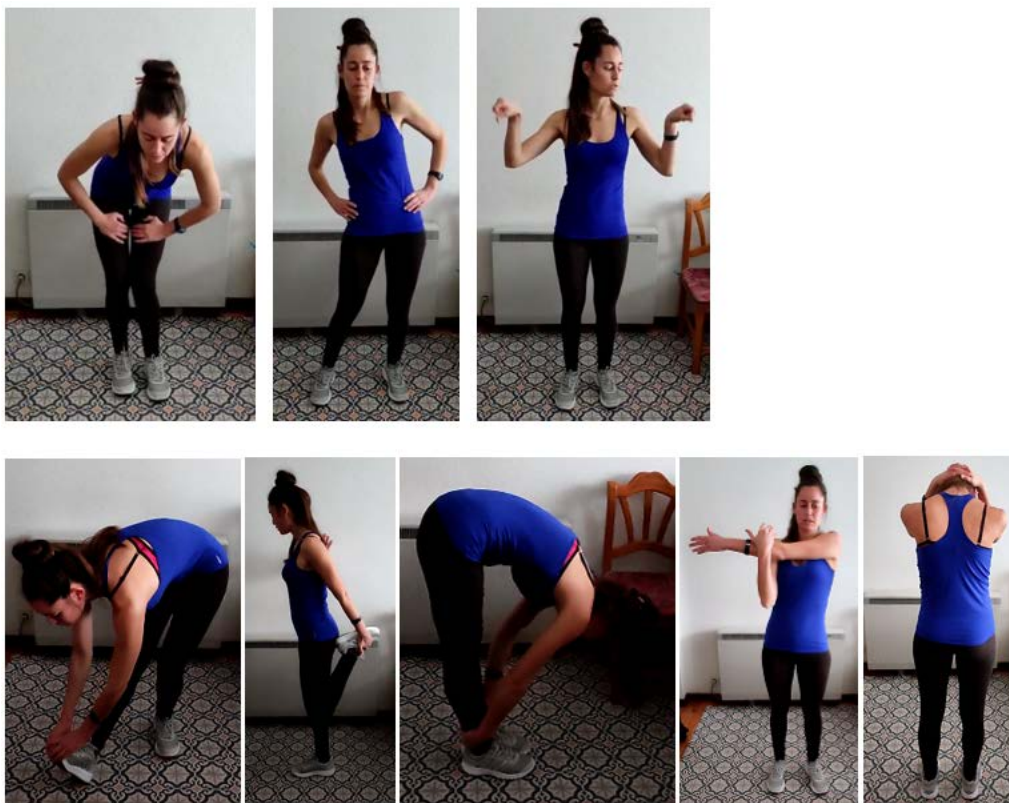
CONTENIDO DEL ENTRENAMIENTO	
	Duración
<b>CALENTAMIENTO</b>	
Estiramientos dinámicos y estáticos del tren superior e inferior	5 min
<b>PARTE PRINCIPAL</b>	
Nadar a crol	7 min
Nadar solo con patada	4 min
Nadar a braza	7 min
Nadar solo con brazos	4 min
Nadar a espalda	7 min
Nadar a braza	6 min
<b>VUELTA A LA CALMA</b>	
Estiramientos estáticos de tren superior e inferior	5 min

In the meeting with each volunteer, we work with the referred below questionnaires and the sport test:

1. QOLID (Quality of Life - Diabetic Version)
2. IPAQ (International Physical Activity Questionnaire)
3. IPAQ (Adls Brief Disability Questionnaire)
4. FES (Fear of Falling, Falls Efficacy Scale-International)
5. WIQ (Walking Impairment Questionnaire)
6. AESOP - Adherence to Exercise Scale for Older Patients. (Ending Questionnaire)

And before leaving, we speak about the time they want to dedicate to practicing sport, how they want to train, etc. and afterwards we explain them the protocols that suit them best.

Additionally, we prepared a pair of short videos on how to warm up and how to cool down by stretching, and distributed both videos to each and every volunteer.



## 4.1.2 Participant evaluation and feedback

We are in contact with all the volunteer through email, WhatsApp and phone calls, so they can reach us when they need, and we ask them about how are the trainings going, if they need something, if they have any doubts, etc.

We try to be in touch specially with the ones that need it most and with the ones that are so interested in practicing sports that they will have questions always, but we try to reach all of them.

To see if they are progressing properly and if they are focus on their trainings, we have the body measurements, which we will repeat in the second round, starting now in July, to see the variations in their weight, body mass index, waist, abdominal and hip perimeter, fat and non-fat percentage and biochemical parameters such glucose, glycosylated hemoglobin, cholesterol.

We believe that a guided free sessions of adapted sport 2 or 3 times a week, could be an important mechanism of help for people with difficulties going to the gym.

### TABLA ADAPTADA SIN MÁQUINAS

#### CIRCUITO DE FORTALECIMIENTO

EJERCICIO	Nº SERIES	REPETICIONES
Flexiones inclinado ( <a href="https://www.youtube.com/watch?v=otKqpv2D6hI">https://www.youtube.com/watch?v=otKqpv2D6hI</a> )	2	12
Extensión de rodilla con elástico (la goma se puede anclar en la otra pierna o a la pata de la silla, donde resulte más cómodo)	2	12
Press hombro con gomas(iniciación) Flexiones para hombros ( <a href="https://www.youtube.com/watch?v=otPyqyExD8M">https://www.youtube.com/watch?v=otPyqyExD8M</a> )	2	12
Extensión de tobillo unilateral ( <a href="https://youtu.be/MpE8Grg6Vw?i=20">https://youtu.be/MpE8Grg6Vw?i=20</a> )	2	12
Crunch ( <a href="https://www.youtube.com/watch?v=OsUz898onTE">https://www.youtube.com/watch?v=OsUz898onTE</a> )	2	12

Flexiones en posición supina: las flexiones de brazos se realizan con el cuerpo boca abajo, pero si nos colocamos tumbados boca arriba, con las rodillas flexionadas y los pies apoyados en el suelo, podremos realizar una flexión en posición invertida. Para ello, apoyaremos brazos y codos en el suelo, perpendiculares al tronco y empujaremos al suelo para elevar el tronco. ( <a href="https://www.youtube.com/watch?v=WwbgPB9Gb48">https://www.youtube.com/watch?v=WwbgPB9Gb48</a> )	2	12
Isiotibial en suelo (iniciación) (avanzado)	2	12
Isiotibial en banco	2	12
Las nalgas en cada descenso de la pelvis no deben tocar el suelo, para ello, debes descender de manera controlada y movilizarte durante todo el recorrido a un ritmo continuo, de manera de sentir la contracción constante de glúteos e isiotibiales. Para un buen movimiento, sólo las nalgas y por defecto la espalda baja se separará del suelo al elevar la pelvis con la fuerza de los glúteos e isiotibiales, pero la cabeza, espalda alta y hombros deben permanecer relajados sobre el suelo, y mantén los brazos relajados y estirados en el suelo, paralelos al cuerpo, mientras subes y bajas la pelvis.		

Extensión lumbar	2	12
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## 4.2 Democritus University of Thrace (Greece) – DUTH

Democritus University of Thrace (DUTH) was established by Legislative Decree No. 87 of 27 July 1973, and started operating during the academic year 1974-1975. The University is currently operating eight Schools and nineteen Departments in four cities of Thrace. Relying on the quality of teaching and research level, DUTH has secured a place among the best Greek Universities.

### 4.2.1 Identification of the target groups for sport activities

The project received approval by the Research Ethics Committee of Democritus University of Thrace (for the whole BE-NEW program). After that, we contacted pathologists, diabetologists and endocrinologists to help us recruit type II diabetic patients to participate in the exercise program. We believed that the encouragement by the doctors would motivate many patients to participate in the project. Therefore, we made several visits to each one of them to inform them in detail about the scopes of the program and answer all their possible questions. The President of the Panhellenic Diabetes Association, and the Association of Insulin Dependent Persons "Sweet Hug" of Kavala were also informed.

At the same time, through social media, we advertised the program to make it more widely known to diabetic patients. Furthermore, we prepared a poster and a leaflet about the beneficial effects of exercise in the control of blood glucose levels and that this could be achieved by participating in new educational and physical activity programs (BE-NEW). This material was placed in public places and distributed to the local community.

Initially, we performed the physical conditioning and blood metabolites measurements in each scheduled training period. Thereafter, the patients started executing an aerobic exercise session of 60 minutes total duration that included walking at an intensity 30% of HRR for 25-30 minutes until the completion of the first four weeks. Each following month, exercise intensity increased by 5% and the duration of the session by 5 minutes. For the improvement of the overall health of the diabetic population and to reach the level of physical activity recommended by the World Health Organization, patients should exercise at least 3 times a week where weight training should be performed twice.

Below is presented the progression of the walking training program regarding its frequency, intensity and duration the first 16 weeks of the training period.



## Exercise protocols

Walking training program															
Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Frequency (sessions/week)	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2
Intensity (%HR)	30	30	30	30	35	35	35	35	40	40	40	40	45	45	45
Duration (min)	25	25	26	25	30	30	30	30	35	35	35	35	40	40	40

- **HRmax was estimated from the equation  $HR_{max} = 220 - \text{Age}$**
- **At some training sessions, bicycle was as an exercise mode instead of walking**

Initially, a consent form to participate in the program was distributed to the diabetic patients and signed by all of them. After that the following questionnaires were completed by the patients:

- Quality of life
- Frequency of participation in exercise programs
- Level of fear of falling during social and physical activities within and outside home, regardless if the person performs the activity
- Walking quality
- Weekly physical activity
- Satisfaction of participating in the current training program

### 4.2.2 Participant evaluation and feedback

Upon the start of the training program, anthropometric, body composition and biochemical measurements were conducted. These initial measurements showed that most of the participants had high values of anthropometric characteristics with an average body mass index of 35.2, waist circumference of 111.5 cm, abdominal circumference of 121.6 cm and hip circumference of 113.3

cm. Using the method of bioelectrical impedance (Tanita MC780), total body as well as segmental composition was recorded: body fat mass 37,5kg, trunk fat 38,7kg, body fat 36,0%. Regarding the blood measurements, the levels of glycosylated hemoglobin (HbA1c) were approximately 7% higher than the normal average of the values, which agrees with the results of the glucose tolerance curve (OGTT, Oral Glucose Tolerance Test) where after two hours glucose levels were above 260mg/dL. Exercise in adult patients with type 2 diabetes will continue until the end of June 2022 and with the completion of the first phase of the intervention program the next measurements will be performed. All measurement data are analyzed and explained to diabetic patients (providing feedback) and new goals are identified to improve their metabolic health.

At the start of each exercise session participants execute a warm-up involving low intensity walking and stretching of basic muscle groups. Then, the main part involving walking at the predetermined intensity is applied. At the end some mobility exercises are executed and stretching exercise for the whole body are performed as a cool down. An outline of the exercise sessions executed at the 1st, the 6th and the 14th week are presented below:

WALKING TRAINING PROGRAM			
1 <sup>st</sup> week			
<b>AIM</b>	Improvement of aerobic capacity		
<b>FREQUENCY</b>	2 times per week		
<b>EXERCISE MODE</b>	Treadmill or free walking		
TRAINING CONTENT			
		Intensity	Duration
<b>WARM – UP</b>			
	Walking on a treadmill or free walking	30% HRR	5 min
	Dynamic and static stretching of upper and lower limb muscles		10 min
<b>MAIN ACTIVITY</b>			
<b>Aerobic activity – Walking</b>			
		Intensity	Duration
	Walking on a treadmill or free walking	30% HRR	25 min
<b>COOL DOWN</b>			
	Static stretching of upper and lower limb muscles		10 min

### WALKING TRAINING PROGRAM

6<sup>th</sup> week

<b>AIM</b>	Improvement of aerobic capacity
<b>FREQUENCY</b>	2 times per week
<b>EXERCISE MODE</b>	Treadmill or free walking

#### TRAINING CONTENT

		Intensity	Duration
<b>WARM – UP</b>			
	Walking on a treadmill or free walking	30% HRR	5 min
	Dynamic and static stretching of upper and lower limb muscles		10 min
<b>MAIN ACTIVITY</b>			
	Walking on a treadmill or free walking	35% HRR	30 min
<b>COOL DOWN</b>			
	Static stretching of upper and lower limb muscles		10 min

### WALKING TRAINING PROGRAM

14<sup>th</sup> week

<b>AIM</b>	Improvement of aerobic capacity
<b>FREQUENCY</b>	2 times per week
<b>EXERCISE MODE</b>	Treadmill or free walking or Cycling

#### TRAINING CONTENT

		Intensity	Duration
<b>WARM – UP</b>			
	Walking on a treadmill or free walking	30% HRR	5 min
	Dynamic and static stretching of upper and lower limb muscles		10 min
<b>MAIN ACTIVITY</b>			
	Walking on a treadmill or free walking or Cycling	45% HRR	40 min
<b>COOL DOWN</b>			
	Static stretching of upper and lower limb muscles		10 min



### 4.3 Sport for All Suceava (Romania) – AJSPT

Association Sport for All Suceava (AJSPT Suceava) is a non-profit organization at regional level, a non-governmental organization, officially recognized by the Romanian Justice Ministry since 2002. Also in 2002, our organization was officially recognized by the Ministry of Youth and Sport as a sport organization. Our main objectives are promoting the benefits of sport and physical education, tolerance and fair-play, healthy lifestyle; organize sport activities for all ages and social condition; releasing mutual programs, aiming at developing activities for disadvantaged people; developing in partnership activities in schools and university.

#### 4.3.1 Identification of the target groups for sport activities

The identification of the target groups was done with the help of the network of teachers in the region. They communicate through groups on specialized social networks or with the help of education unions. The promotion of the project and the need to identify the target group was made for the active teachers, those who are retired, but also their families. We also benefited from the help of 3 family doctors and a pharmacy that disseminated our need to identify the target group. We considered these to be secure ways of communicating based on the trust of those who transmitted these messages.

The sports activities were divided into two segments: the mandatory physical tests and the practical part to be performed throughout the project. The volunteer subjects received all the information about these activities, about the way they are carried out, about the locations and the availability of the staff of our organization or of the partner organizations to help them in carrying out the sports programs.

In this sense, we have identified 2 cities with 3 locations where we can carry out the tests and practical activities: the city of Gura Humorului at the Petru Comarnescu secondary school and the city of Suceava at the Sport High School and the Municipal Sport Club.

The locations were made available free of charge by those who manage them based on the requests of our organization based on the sports law, the national movement for health program and the national diabetes program.

The proposed sports activities were presented to the volunteers by the members of the project team. Together with them they decided which are the best options for frequent physical activity based on the physical capacity of each, the availability of sports facilities in the communities where the volunteers come from, but also adapted to weather conditions or daily work-rest- personal time.



Thus, out of the 16 participants, 8 men and 8 women, only one woman decided to go to the gym. The remaining 15 people decided to use walking as a regular sport's physical activity. The reason was that they can have access to the proposed sports facilities at classes that can be adapted to the daily or family work schedule, having at their disposal the advice of the sports instructors there.

The materials distributed to the volunteers were information brochures on diabetes but also the benefits of practicing sports on them. Also, with the help of specialized instructors, video material was provided on the ways of practicing correct and efficient walking, tempo, running technique in the sports version, advice on the appropriate equipment for the gym or outdoor athletics track. They also received free blood glucose monitoring cards from a partner pharmacy, which they could use in their daily records.

#### 4.3.2 Participant evaluation and feedback

The evaluation of the participants was done in accordance with the standard tests established by the project application. These have been translated into Romanian for a better understanding and application. Before starting the evaluation of the participants, we did a training with the team members who were going to do the tests for a unitary application.

So far, the initial tests have been given, the physical training activities have taken place and we are in the process of completing the tests from stage 2, before the holidays. In 2 weeks, we will be able to provide a comparative evaluation of these tests.

The feedback of the participants is a positive one, being especially an oral one. Volunteers are satisfied with the training conditions, the professionalism of those who supervise them, the way they feel in terms of physical condition.

Project plan of activities:

- ✓ January-February 2022 - performing the initial tests
- ✓ March-June 2022 - Training activities
- ✓ June-July 2022 - intermediate testing
- ✓ September 2022 - intermediate test 2 after returning from vacation
- ✓ September-December 2022- training activities
- ✓ December 2022 - January 2023 - final testing





## 4.4 University of Bologna (Italy) – UNIBO

The University of Bologna was founded in 1088. It is one of the most renowned and prestigious universities across Europe. It is the most populated university community in Italy, with 86.000 enrolled students, 2800 teaching professors (full, associate and assistant) and 3000 technical-administrative staff. UNIBO is a comprehensive higher education institution with 32 departments and 219 Degree Programmes: 92 first cycle programmes (BA), 114 second cycle programmes (MA) and 13 single cycle programmes. UNIBO also offers 45 PhD programmes, 52 specialisation schools, 74 professional courses, 16 of which are international. UNIBO is a multi-campus university with 5 campuses in the Emilia-Romagna region: the main and oldest campus in Bologna, plus 4 additional campuses in Cesena, Forlì, Ravenna and Rimini. Each campus has its own distinct scientific and educational identity and maintains active and strong collaboration ties with local authorities, organisations and communities with a view to enhancing the cultural, economic and social development of these territories.

### 4.4.1 Identification of the target groups for sport activities

Our target population is made of diabetic and pre-diabetic people with potential comorbidities. We enroll three groups of people: type 1 diabetic people, type 2 diabetic people with/without comorbidities and prediabetic people.

Type 1 diabetic people can benefit of physical exercise as well as type 2 diabetic people (even if type 1 diabetes has an autoimmune origin and the glycemic levels are very well controlled). From a scientific point of view, studying the effect of physical exercise on type 1 diabetic population for a long period of time allow us to deepen the knowledge on the disease.

We decided to enroll prediabetic people to promote sport activities in a sedentary population with a potential risk of type 2 diabetes onset. Further, the long-term studies of pre-diabetic population will allow us to quantify the effect of physical exercise in borderline people.

Exclusion criteria were any kind of physical problems (transplants, bone surgery with metal implants) or serious cardiovascular problems which could result in risky activities.

The three types of volunteers have been assigned to the training groups according to their preferences. Following the project's aim, our subjects are free to choose the type of activity they prefer.



It is well known that men and women of all ages and abilities can improve their quality of life through regular, moderate physical activity.

Being physically active is one of the most important actions that people of all ages can take to improve their health. The regular practice of physical exercise fosters normal growth and development and can make people feel better, function better, sleep better, and reduce the risk of a large number of chronic diseases. Health benefits start immediately after exercising, and even short episodes of physical activity are beneficial. The evidence about the health benefits of regular physical activity is well established, and research continues to provide insight into what works to get people moving, both at the individual and community level. Achieving the benefits of physical activity depends on our personal efforts to increase activity in ourselves, family, friends, patients, and colleagues. Action is also required at the school, workplace, and community levels.

The BE-NEW project is aimed to improve the physiological conditioning of people with diabetes through participation in exercise and sports activities programs. The consortium promotes physical exercises, together with social inclusion and equal opportunities. An important aspect of the BE-NEW activities is to make diabetic people aware that the regular practice of physical exercise has beneficial effects on health.

All partners of the project have been involved in the development of the activity protocols.

***PHA in the gym:*** this program is performed two times per week. Each peripheral heart action training (PHA) session started with a 5-min warm-up and conclude with a cool-down. The conditioning phase of each session involves circuit weight training and consists of eight resistance exercise stations, as strictly ordered:

1. Pectoral machine
2. leg extension
3. lat machine
4. leg curl
5. shoulder press
6. calf machine
7. abdominal exercise
8. lower back muscles exercise





Subjects perform 10-15 repetitions of each exercise (starting from pectoral machine), and then move to the next station (leg extension) without rest but with active pauses (e.g., subjects perform an exercise of the lower limbs as soon as they have finished one on the upper limbs, and vice versa), until the completion of the circuit training (calf machine). Such circuit training will be performed two-four times, separated by 1-min of rest. Subjects will wear a heart rate monitor and maintain an intensity around 40–60 % of 1-RM, which corresponds approximately to 60–80 % of maximal heart rate calculated during the pre-test.

The resistance training program should have a progression with the following characteristics:

- 2 cycles for the first four weeks, 3 cycles for weeks five to eight, 4 cycles for week nine and thereafter
- 10-13 repetitions per exercise with loads 40-50% for the first two weeks
- 13-15 repetitions per exercise with loads 40-50% for week 3 and 4
- 10-13 repetitions per exercise with loads 50-55% for week 5 and 6
- 13-15 repetitions per exercise with loads 50-55% for week 7 and 8
- 10-13 repetitions per exercise with loads 55-60% for week 9 and 10
- 13-15 repetitions per exercise with loads 55-60% for week 11 and 12

After the first 5 to 6 six months of training, higher loads, 70-80% of 1RM with the execution of 6-7 repetitions per exercise could also be used at one training session **ONLY** if these loads are tolerable by the subjects, if not they will maintain 13-15 repetitions per exercise with loads 55-60% of 1-RM.

**Swimming protocol:** once in the swimming pool, participants complete a standardized warm-up consisting of 5 min of articular mobilization, 30 minutes of easy swimming (alternating the various swimming styles – front crawl, breaststroke, backstroke and butterfly), 5 min of leg-only swimming and 5 min of arm-only swimming, 5 min of aquatic skills, and 5 minutes of cool-down. In case the subjects will be previously untrained, the swimming training program should begin with 20 minutes of swimming and increase each week by 2 minutes until 30 minutes of swimming will be reached.

**Head-out water immersion:** the alternative mode of water-based program may be used successfully and induce positive metabolic adaptations in patients with DM2. Thus, the exercise program could consist of half sessions per week: two sessions with aerobic aqua-exercise (until 60% of HR reserve)

and two sessions focusing on water-based circuit weight training (40-60% of rate perceived exertion, values from 10 until 12-13 on the original scale of 6 to 20) for muscular endurance and neuromuscular performance (work to rest ratio, 1:1,5 for the 1st, 2nd and 1,5:1 for the 3rd, 4th month respectively). The aquatic exercise should be conducted in a heated pool (120 cm depth).

**Walking protocol:** the walking program consists of 3 exercise sessions/week at 30% heart rate reserve (HRR). Target heart rate will be determined using the HRR equation by Karvonen et al. (1957). Target HR =  $(220 - \text{age} - \text{resting HR}) \times 0.3 + \text{resting HR}$  (3).

The program begins with 25 minutes of walking and increase each week by 2 minutes until 40 minutes of walking will be reached. A heart rate monitor will be worn at each exercise session to ensure that the target heart rate will be achieved. Intensity levels at 30% of HR reserve are appropriate for untrained individuals. After 4 weeks, the intensity will increase progressively as individuals are getting fitter and intensity levels of 40-60% of HR reserve are suggested. The intensity level should increase every odd week of training by 5%, until 60% is achieved. Also, exercise duration could increase by 5 min (starting with 25 min) every even week until 40 min exercise are achieved.

After the first six months of training, intensity at 1-2 training sessions could be >60% of HR reserve but not more than 70% (vigorous intensity level).

The walking training program should have a progression with the following characteristics:

- 25 min for the first four weeks at 30% of HHR
- + 5min and + 5% from the 4 to 8 weeks
- + 5min and + 5% from the 8 to 12 weeks
- + 5min and + 5% from the 12 to 16 weeks
- + 5% from the 16 to 20 weeks
- + 5% from the 20 to 24 weeks
- + 5% from the 24 to the end of the training program (increase until 70% of HHR **ONLY** if these loads are tolerable by the subjects, otherwise maintain 60% of HHR)

#### 4.3.2 Participant evaluation and feedback

Our subjects fill in the IPAQ questionnaire before starting the exercise program. Then, before each measurement, they fill in the entire battery test listed below:

- QOLID (Quality Of Life - Diabetic Version)

- FES (Fear of Falling, Falls Efficacy Scale-International)
- WIQ (Walking Impairment Questionnaire)
- AESOP - Adherence to Exercise Scale for Older Patients
- ADLS - Brief disability questionnaire

Before starting recordings, the participants express their willingness to participate in the research project by signing the informed consent and data protection forms. The experimental protocol has been approved by the Bioethics Committee of the University of Bologna and the experiments are carried out in accordance with the ethical standards established in the 1964 Declaration of Helsinki. Subjects are given questionnaires to allow the research team to determine the hand-foot laterality. Subsequently, the volunteers undergo to a beat-beat monitoring of blood pressure using the Portapres®, a device for detecting beat-beat blood pressure and cardiovascular autonomic variables that allows the monitoring of these parameters over time.

The surface EMG allows the study of the functioning of the muscles through the non-invasive analysis of the electrical signals generated during muscle contractions. We record from the following muscles: right anterior tibial (RTA), left anterior tibial (LTA), right soleus (RSOL) and left soleus (LSOL).

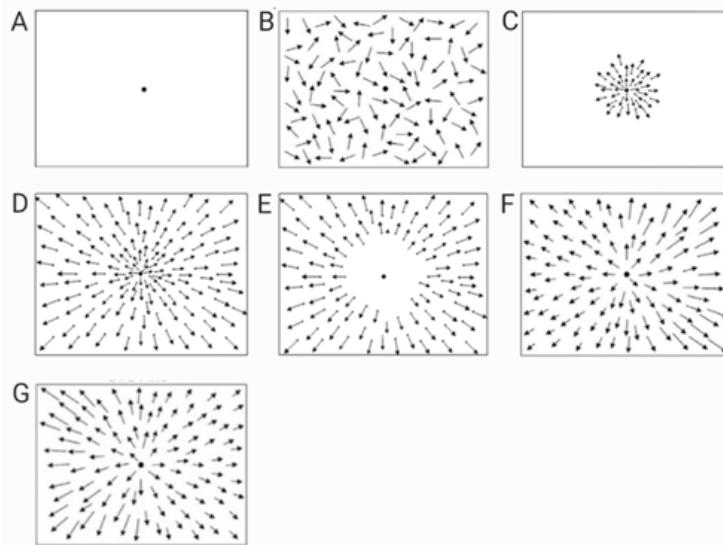
The acquisition of stabilometric data is carried out through the use of two Kistler force platforms (Kistler Instrument), which allow the measurement of antero-posterior and latero-lateral displacements of the center of pressure (COP) and the quantitative evaluation of the force exerted on the ground by the person. Subjects are asked to remove their shoes, to ensure better plantar proprioception and to place one foot on each platform immediately before the start of registrations.

During recordings, subjects wear an eye tracker (EyeLink® II; SR Research Ltd). All measurements are carried out in a dark room. The optical flow stimuli are projected onto a translucent screen by a video projector (Sony VPL EX3) located at a distance of 415cm from the screen itself. Optical flow stimuli were generated using the Matlab psychophysical toolbox (The Mathworks Inc.) (Fig.2). For each stimulus, two trials lasting 30 seconds each were acquired, in order to ensure a greater number of data in case of experimental errors.

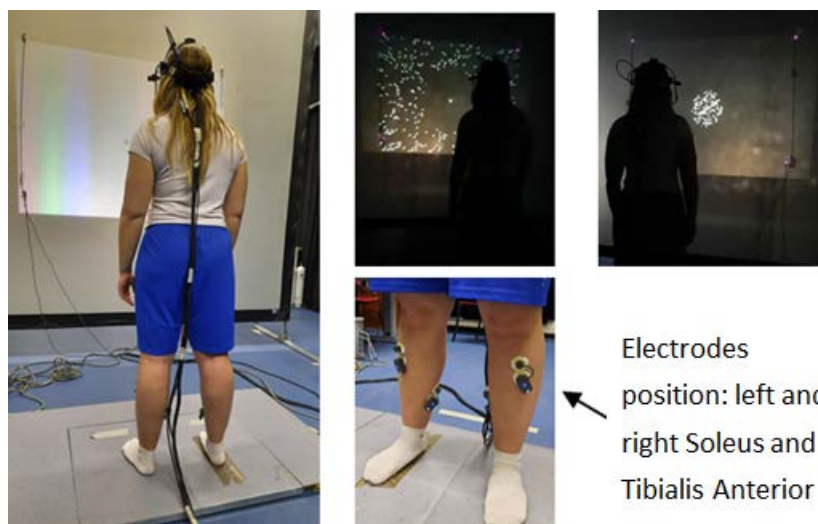
During the recordings, the instruments are synchronized with each other: the EyeLink system, through the SceneLink software, allows the presentation of stimuli and the recording of eye movements, acquired at a frequency of 500 Hz. When the stimulus is presented, the EyeLink system sends a TTL

signal to the BTS SMART System that manages the acquisition of EMG and stabilometric data (Fig.3).

Lastly, the volunteers undergo a series of physical tests aimed at examining the abilities of physical strength, resistance to effort, flexibility and stretching, cardio-respiratory resistance and dynamic balance: 1) curl with handlebars, 2) chair stand test, 3) back scratch test, 4) sit and reach test or chair sit and reach test (as an alternative), 5) the six minutes walking test and 6) the eight foot up and go test.



**Figure 2.** Types of stimulus projected on the screen in front of the observer: (A) Baseline, (B) Random, (C) Fovea, (D) OF-Center, (E) Periphery, (F) OF-Right, (G) OF-Left.



Electrodes position: left and right Soleus and Tibialis Anterior

**Figure 3.** Experimental setup. On the left: subject in front of the screen, standing on the two force platforms, with the helmet for oculomotor data recordings and electrodes for electromyographic recordings. On the top: two photos taken during recordings in the dark that show two types of stimulation. On the bottom: probes with the adhesive electrodes and the recording position.



“The Italian Society of Diabetology (SID) has in its organization chart a special study group on the subject and numerous studies have been conducted and all lead in the same direction: aerobic physical activity is good.”

## **4.5 Unione Italiana Sport per Tutti (Italy) – UISP**

The Unione Italiana Sport Per Tutti (UISP) is a national association founded in 1948. UISP is formally recognized by the Italian Olympic Committee as a Sports Promotion Association, by the Italian Ministry of the Interior as a social welfare agency and is registered in the official list of Italian social promotion organizations. UISP offers a wide range of diverse physical activities for each population group, with a focus on the sedentary population suffering from chronic degenerative diseases, promoting the collection of collective well-being through the individual well-being. UISP develop not only cultural innovation, but also methodological and organizational technique for a Sport for all potentially extended to all citizens the provision of physical practice as a practical research and experimentation of a better-quality life that affects primarily the health and fitness, privileges outdoor practice, engages with the development of experiences that exploit sweets energy using poor equipment and versatile space.

### **4.5.1 Identification of the target groups for sport activities**

The identification of the target groups was done with our network of teachers, instructors, gyms and swimming pools. They communicate through groups on specialized social networks or with the help of education unions. The promotion of the project and the need to identify the target group was made for the active teachers, instructors and all the persons that work in gyms and swimming pools.

the sporting activity was organized thanks to the collaboration between gyms, swimming pools and all the staff who work there. Our members received all the information about these activities, about the way they are carried out, about the locations and the availability of the staff of our organization or of the partner organizations to help them in carrying out the sports programs.

The proposed sports activities were presented to the volunteers by the members of the project team. Together with them they decided which are the best options for frequent physical activity based on the physical capacity of each, the availability of sports facilities in the communities where the volunteers come from, but also adapted to weather conditions or daily work-rest- personal time.





The materials distributed to the volunteers were information brochures on diabetes but also the benefits of practicing sports on them. Also, with the help of specialized instructors, video material was provided on the ways of practicing correct and efficient walking, tempo, running technique in the sports version, advice on the appropriate equipment for the gym or outdoor athletics track. They also received free blood glucose monitoring cards from a partner pharmacy, which they could use in their daily records.

#### **4.5.2 Participant evaluation and feedback**

The evaluation of the participants was done in accordance with the standard tests established by the project application. These have been translated in Italian for a better understanding and application. Before starting the evaluation of the participants, we did a training with the team members who were going to do the tests for a unitary application. So far, the initial tests have been given, the physical training activities have taken place and we are in the process of completing the tests from stage 2, before the holidays. In 2 weeks, we will be able to provide a comparative evaluation of these tests. The feedback of the participants is a positive one, being especially an oral one. Volunteers are satisfied with the training conditions, the professionalism of those who supervise them, the way they feel in terms of physical condition.

At the start of each exercise session participants execute a warm-up involving low intensity walking and stretching of basic muscle groups. Then, the main part involving walking at the predetermined intensity is applied. At the end some mobility exercises are executed and stretching exercise for the whole body are performed as a cool down.

#### **4.6 Sports Union of Slovenia (Slovenia) – SUS**

Sports Union of Slovenia as the largest sports for all organization connects different sports organizations, associations, clubs and individuals working in the field of sports recreations and sports education in Slovenia. It unites over 200 organisations and has over 60.000 members scattered all over Slovenia. Their common goal is to promote healthy lifestyle and active use of leisure time. The vision of the Sports Union Slovenia is to be the leading sports organisation in the field of sports recreation and its education in Slovenia, which will seek to approximate recreational sports and physical education for every individual. The purpose SUS is to unite clubs that act in the field of







sports, sport and recreation and recreational educational activities, encourage their advanced professional training, strive for the progress of professional work and introduce new methodologies.

#### 4.6.1 Identification of the target groups for sport activities

The target population for participants in the BE NEW sport activities in Slovenia are people with the diagnosis of diabetes. Sports Union of Slovenia (SUS) is umbrella sport for all organization in Slovenia, which has over 170 members (local sport organizations) all over the country. Their main programmes involve sport recreation. There are no sport organizations among SUS members, which works with diabetic people. For this reason, we have contacted Slovenian Diabetes Association to reach the target population. In cooperation with SDA we sent the invitation to diabetic people to join the BE NEW project, using letters and emails, and even some personal invitations. Surprisingly, at the beginning there was no response. We posted invitation on social media and asked volunteers in local diabetes associations for help. More personal approach was more successful.

After the recruitment of participants, we asked them to fill in the BE NEW questionnaires. Before the start of the sport activities, the 1st field test was organized in January. 16 diabetic people participated. After the test of physical fitness we started with the organized training – walking in the nature. Organized activities were delivered twice a week. Participants were encouraged to exercise by themselves to reach the intensity 3-times per week. In the beginning of May the 2nd field test was organized, where 20 diabetic people participated. Generally, 2nd field tests showed improvement in physical fitness of participants. Until the end of June we continued with the organized training. In July and August, we had a break. We plan to re-start the organized training in September, and to deliver additional field tests. In September new invitations will be sent out, trying to reach new participants.

Participation in sport activities is free of charge.

We have decided to implement the BE NEW walking protocol:

The walking program consists of 3 exercise sessions/week at 30% heart rate reserve (HRR). Target heart rate will be determined using the HRR equation by Karvonen et al. (1957).

Target HR = (220-age-resting HR) x 0.3 + resting HR (3).

The program begins with 25 minutes of walking and increase each week by 2 minutes until 40 minutes of walking will be reached. A heart rate monitor will be worn at each exercise session to ensure that the target heart rate will be achieved.



Intensity levels at 30% of HR reserve are appropriate for untrained individuals. After 4 weeks, the intensity will increase progressively as individuals are getting fitter and intensity levels of 40-60% of HR reserve are suggested. The intensity level should increase every odd week of training by 5%, until 60% is achieved. Also, exercise duration could increase by 5 min (starting with 25 min) every even week until 40 min exercise are achieved.

After the first six months of training, intensity at 1-2 training sessions could be >60% of HR reserve but not more than 70% (vigorous intensity level).

The walking training program should have a progression with the following characteristics: • 25 min for the first four weeks at 30% of HHR

- + 5min and + 5% from the 4 to 8 weeks
- + 5min and + 5% from the 8 to 12 weeks
- + 5min and + 5% from the 12 to 16 weeks
- + 5% from the 16 to 20 weeks
- + 5% from the 20 to 24 weeks
- + 5% from the 24 to the end of the training program (increase until 70% of HHR ONLY if these loads are tolerable by the subjects, otherwise maintain 60% of HHR).

We have distributed the guidelines for the BE NEW walking protocol and instructions on how to execute one session (warm up, main part, cool down). Participants received a table to insert data of all trainings they performed, including non-organized walking. We have distributed promo materials: towels to raise the motivation.

#### 4.5.2 Participant evaluation and feedback

The field tests are delivered to evaluate physical fitness of the participants and their progress.

We measure the effectiveness of the program by:

- asking how things are going and feeling before/after the training sessions,
- checking the presence in the training and the walking sessions they do by themselves,
- comparing the results of the measurements/questionnaires answers.

Feedback so far: in general, people don't like to fill in the questionnaires and to be tested. Some potential participants avoided the training because of the physical fitness tests.

Most participants enjoyed the organized activities, mostly because they liked the work of the trainer and his attitude. A few participants gave positive feedback on possibility of doing the walking



sessions by themselves due to work or private responsibilities that disabled them to participate in the organized session sometimes.

Project plan of activities:

- January-February 2022 - performing the initial tests
- March-June 2022 - Training activities
- May 2022 - intermediate testing
- July-August 2022 - break
- September 2022-February 2023- training activities
- January 2023 - final testing

## 5. Implementation of the teacher training

The PE teachers' training is described below:

- Nine lectures aiming at the professional development of teachers for co-education of students, with and without Diabetes type I, during the course of PE or PA, in order to obtain multidimensional benefits for their quality of life and health, based on the Project's goals, were created and delivered.
- The lectures were delivered via the synchronous method, with Teams and asynchronous via E-Class, following principles of adult education (e.g., self-directed learning, brainstorming, collaborative methods, problem solving, interactive techniques, discussion, theory & practice connection, and feedback).
- PETs attended the lectures as described above, participated in assignments (questions, problems/scenarios), uploaded their work, and received feedback individually and in plenary session (lecture 9). They also reported problems they were facing but also positive effects.
- The PETs training outline is presented in Table 1.

Initially, a consent form to participate in the program was distributed to the diabetic patients and signed by all of them. After that we submitted the following questionnaires twice: at the beginning and at the end of the training program.

- a) Quality of life
- b) Frequency of participation in exercise programs

- c) Level of fear of falling during social and physical activities within and outside home, regardless if the person performs the activity
- d) Walking quality
- e) Weekly physical activity
- f) Satisfaction of participating in the current training program.

Weeks	Lectures	Measurements
1st	Synchronous MS TEAMS	Initial measurement in the beginning of the week
2nd	Asynchronous E-CLASS	
3rd	Asynchronous E-CLASS	
4 <sup>th</sup> & 5 <sup>th</sup>	Synchronous MS TEAMS	
6th	Asynchronous E-CLASS	
7th	Asynchronous E-CLASS	
8 <sup>th</sup> & 9th	Synchronous MS TEAMS	
		Final measurement

Table1. PETs Training Outline.

In regards to PE teacher training,

- o consent forms were distributed to PE teachers, and through them to parents and students.
- o we prepared the call to the PE teachers

- ◊ Google forms with the evaluation tools were prepared. Each PET was asked to complete on-line three questionnaires, twice (initial and final measurement). Similarly, students and parents were asked to fill in questionnaires.
- before the initiation of the final measurement, instructions were posted in e-class in regards to the first measurement of health-related fitness with the "Fitnessgram Assessment Package (Cooper Institute, 2017) for children aged 5-17 years", and the repetition of the questionnaires completion
- we created eight (8) out of nine lectures in Greek and then sent them to the partners to translate them in English, and to provide their review, comments, additions, or new lecture(s), etc. We conducted a final review in the English version of the lectures, before being translated by the partners in the language of their country
- we prepared material for the assignments (i.e., questions, problems/scenarios) during the lectures.
- we prepared the certification for the PE teachers' participation in the BE-NEN program.

## 6. Conclusions

The number of people with diabetes has increased by more than 1 million comparing to the year 2000. This increase is mainly due to the aging of the population. However, other factors can be considered such as early diagnoses and increased survival of patients with diabetes. Mortality due to diabetes has decreased more than 20% in all age groups in the last decade. In addition, in the most recent birth cohorts, the proportion of people with diabetes increases more at earlier ages than in previous cohorts, also as an effect, among other factors, of the progressive anticipation of the age at which the disease is diagnosed.

It has been already ascertained that the increase of the incidence of Type II diabetes among the occidental populations is associated to the reduction of physical activity, with following increase of prevalence of obesity, the world level of sedentary lifestyle tends to increase. It is well known that, in managing the diabetes, besides a healthy nutrition, an appropriate physical exercise is essential. A regular aerobic exercise improves the glycaemic balance in diabetes and reduces the risk of complications. Thus, playing a sport and participating in physical activity in general becomes important for both holding under control the glycaemic values (and all the other values associated to the diabetic pathology such as those of the blood pressure), and a healthy ageing. Likewise, important is to demonstrate that the diabetes does not represent an obstacle to a competitive sport and actually



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the latter, whether played on the base of essential knowledge on the management of the therapy, leads to significant improvements in the clinical history.

It is strongly recommended to expand the BE-NEW project in order to educate people of all ages (with but also without diabetes) about the beneficial effects of physical activity, and the ways to improve their health or support others to improve their health, based on research and practice data.

**Project webpage:** <https://site.unibo.it/benew/en>

**This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.**

