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Resistance training education to support self-efficacy in blood glucose management among prolanis participants with type 2 diabetes mellitus

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A R T I C L E I N F O

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Self-efficacy,
Type 2 diabetes mellitus.

A B S T R A C T

Type 2 diabetes mellitus is a major non-communicable disease that requires long-term management through pharmacological treatment and lifestyle modification. Resistance training is recommended as an important component of diabetes management because it can improve skeletal muscle glucose uptake, insulin sensitivity, and functional capacity. However, structured resistance training education remains limited in many community-based chronic disease management programs. This study aimed to analyze a resistance training education and assistance program designed to support knowledge, practical skills, and self-efficacy in blood glucose management among Prolanis participants with type 2 diabetes mellitus. A descriptive program evaluation was conducted on May 17, 2025, at Yayasan Angsa Putih, Bandar Lampung, involving 60 active Prolanis participants with type 2 diabetes mellitus. The program consisted of interactive diabetes education, pre-exercise health screening, instructor-led movement demonstration, guided resistance training practice, and distribution of an illustrated exercise guidebook. The exercise protocol included simple bodyweight and low-load movements that could be performed independently at home, such as chair squat, wall push-up, seated leg extension, standing calf raise, hip abduction, shoulder press, and bicep curl. The findings showed that all participants completed the program and actively participated in the education and practice sessions. Participants showed improved understanding of the relationship between skeletal muscle activity, resistance training, and blood glucose management, and they were able to perform the exercise movements under supervision. The simple, equipment-free approach was well accepted and supported participant confidence to continue exercising independently. This program may serve as a feasible educational strategy to strengthen lifestyle-based diabetes management in Prolanis settings.

1. Introduction

Type 2 diabetes mellitus is one of the most common non-communicable diseases and remains a major public health challenge in Indonesia and worldwide. This condition is characterized by insulin resistance, impaired glucose regulation, and progressive metabolic dysfunction. If not properly managed, type 2 diabetes mellitus can lead to various complications, including cardiovascular disease, neuropathy, nephropathy, retinopathy, reduced functional capacity, and decreased quality of life. Therefore, diabetes management requires a comprehensive approach that combines pharmacological treatment, dietary regulation, health education, regular monitoring, and structured physical activity [1, 2].

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In Indonesia, the Chronic Disease Management Program, known as Program Pengelolaan Penyakit Kronis or Prolanis, plays an important role in supporting patients with type 2 diabetes mellitus and hypertension through routine monitoring and health education. Prolanis provides an opportunity to strengthen community-based diabetes management, particularly at the primary healthcare level. However, lifestyle intervention components, especially structured physical exercise education, are often less emphasized compared with medication adherence and routine clinical monitoring. As a result, many participants may understand the general importance of exercise but may not know what type of exercise is appropriate, how to perform it safely, or how it contributes to blood glucose regulation [3–5].

Physical activity is an essential non-pharmacological strategy in the management of type 2 diabetes mellitus. Among various forms of exercise, resistance training has specific benefits because it targets skeletal muscle, which is one of the primary tissues responsible for glucose uptake. Skeletal muscle contraction during resistance exercise can stimulate glucose transport into muscle cells through insulin-dependent and insulin-independent pathways. In addition, regular resistance training may increase muscle mass, improve insulin sensitivity, enhance metabolic efficiency, and support long-term glycemic control. These physiological benefits make resistance training an important component of diabetes self-management [6, 7].

Despite its benefits, resistance training is often perceived as difficult, unsafe, or requiring special equipment, particularly among older adults and patients with chronic diseases. This perception may reduce patient confidence and willingness to perform resistance exercise independently. Therefore, practical education is needed to introduce simple, safe, and accessible resistance training movements that can be performed at home. Bodyweight-based exercises and low-load movements using simple objects, such as a chair or water bottle, may be suitable for Prolanis participants because they are inexpensive, easy to learn, and adaptable to individual physical capacity [8–10].

Self-efficacy is also an important factor in diabetes self-management. Patients who feel confident in their ability to perform exercise are more likely to maintain physical activity as part of their daily routine. Educational programs that combine explanation, demonstration, guided practice, and visual guidance can help improve patient confidence more effectively than verbal instruction alone. Direct practice allows participants to experience the movements, correct their technique, understand safety principles, and develop confidence to continue the exercise independently [3, 11].

The resistance training assistance program described in this study was implemented among Prolanis participants with type 2 diabetes mellitus at Yayasan Angsa Putih, Bandar Lampung. The program included interactive education on diabetes and resistance training, pre-exercise health screening, demonstration by trained instructors, supervised practice, and distribution of an illustrated guidebook. The exercise movements were designed to be simple, safe, and feasible for home-based practice without special gym equipment.

Based on this background, this study aimed to analyze a resistance training education and assistance program designed to support knowledge, practical skills, and self-efficacy in blood glucose management among Prolanis participants with type 2 diabetes mellitus. The study focuses on program implementation, participant engagement, exercise safety, practical skill development, and the potential role of resistance training education as part of lifestyle-based diabetes management in community and primary healthcare settings.

2. Materials and Methods

2.1. Study design and location

This study used a descriptive program evaluation approach to analyze the implementation of a resistance training education and assistance program for Prolanis participants with type 2 diabetes mellitus. This approach was selected because the program focused on describing educational activities, exercise demonstration, guided practice, participant engagement, and the feasibility of simple resistance training as part of lifestyle-based blood glucose management.

The program was designed as a community-based health education activity that combined diabetes education, pre-exercise health screening, supervised resistance training practice, and independent home-exercise guidance. The study did not use a controlled experimental design; therefore, the evaluation focused on program implementation, participant participation, observed exercise skills, and self-reported confidence rather than long-term clinical outcomes [12, 13].

The activity was conducted on May 17, 2025, at Yayasan Angsa Putih, Bandar Lampung, which serves as one of the regular activity locations for Prolanis participants with type 2 diabetes mellitus. The program was integrated into the participants' routine Prolanis activities to make the intervention more accessible, practical, and relevant to daily diabetes management.

A total of 60 active Prolanis participants with type 2 diabetes mellitus were involved in this program. Participants were included if they were registered as active Prolanis members, had type 2 diabetes mellitus, were willing to participate in all stages of the activity, and were able to perform light to moderate physical activity based on pre-exercise screening.

Participants with unstable clinical conditions, severe musculoskeletal limitations, or medical contraindications to exercise were evaluated by the supervising healthcare team before joining the practice session. The original manuscript states that participants ranged from 37 to 69 years old, with a mean age of approximately 59 years, indicating that the program was mainly targeted at adult and older adult participants with type 2 diabetes mellitus.

2.2. Pre-exercise health screening

Before the resistance training session, all participants underwent brief medical screening to ensure exercise safety. The screening included blood pressure measurement, random blood glucose testing, musculoskeletal complaint assessment, and oxygen saturation measurement when needed.

Blood pressure was measured to identify participants with uncontrolled hypertension or potential cardiovascular risk before exercise. Random blood glucose was measured to assess whether participants were within a safe range for physical activity. Participants with very high or low blood glucose levels required further evaluation before joining the exercise session. Musculoskeletal screening was conducted through brief anamnesis to identify joint pain, limited mobility, or physical conditions requiring movement modification. Oxygen saturation was assessed particularly for participants with a history of cardiac or pulmonary problems.

The screening results were used to determine whether participants could safely join the activity and whether exercise modifications were required. The resistance training education and assistance program consisted of four main components:

1. Interactive diabetes education
   Participants received an explanation of type 2 diabetes mellitus, insulin resistance, blood glucose regulation, and the role of skeletal muscle in glucose uptake.
2. Resistance training education
   Participants were introduced to the benefits of resistance training, including its role in improving muscle activity, insulin sensitivity, physical function, and blood glucose management.
3. Movement demonstration
   Trained instructors demonstrated simple resistance training movements that could be performed safely without gym equipment.
4. Guided practice session
   Participants practiced each movement under supervision. The healthcare team and instructors observed participant technique, corrected movement errors, and provided modifications when necessary.

An illustrated exercise guidebook was also provided to support independent practice at home.

2.3. Resistance training protocol

The exercise session consisted of three phases: warm-up, main resistance training, and cool-down. The warm-up lasted approximately 5–10 minutes and included light dynamic movements to prepare the body for exercise. The main resistance training session lasted approximately 20–25 minutes, followed by a cool-down session for approximately 5 minutes. The resistance training movements were designed to be simple, low-cost, and feasible for home-based practice (Table 1).

Table 1
The resistance training movements

No	Exercise Movement	Description	Recommended Dose
1	Chair squat	Standing in front of a chair, lowering the body as if sitting, then returning to standing	2 sets × 10–12 repetitions
2	Standing calf raise	Standing while holding a chair, lifting the heels, then lowering them slowly	2 sets × 12–15 repetitions
3	Wall push-up	Pushing the body toward and away from a wall using both arms	2 sets × 10–12 repetitions
4	Seated leg extension	Sitting on a chair and extending one leg forward alternately	2 sets × 10–12 repetitions per leg
5	Standing hip abduction	Standing while holding a chair and lifting one leg sideways	2 sets × 10–12 repetitions per side
6	Shoulder press with water bottle	Lifting a water bottle from shoulder height to above the head	2 sets × 10–12 repetitions
7	Bicep curl with water bottle	Flexing and extending the elbow while holding a water bottle	2 sets × 10–12 repetitions

Each movement was performed at a controlled tempo. Participants were instructed to breathe properly during exercise, avoid holding their breath, and stop immediately if they experienced dizziness, chest pain, shortness of breath, excessive fatigue, or symptoms of hypoglycemia.

2.4. Safety procedures

Safety was emphasized throughout the activity. Participants were instructed to perform the movements according to their individual capacity and to avoid excessive intensity. Exercise modifications were provided for participants with joint discomfort, reduced balance, or limited mobility.

Participants were also educated about warning signs during exercise, including dizziness, cold sweating, trembling, chest discomfort, shortness of breath, blurred vision, or sudden weakness. They were advised to stop exercising and seek assistance if any of these symptoms occurred. Fluid intake before and after exercise was also encouraged. Participants were reminded not to exercise when blood glucose levels were too low or too high and to follow medical advice regarding medication and meal timing.

2.5. Program evaluation

Program evaluation was conducted descriptively based on participant attendance, active participation, observed ability to follow exercise movements, question-and-answer interactions, and participant responses after the guided practice session. The evaluation focused on three main aspects: knowledge, practical skills, and self-efficacy.

Knowledge was assessed through participant responses during discussion and question-and-answer sessions. Practical skills were assessed through observation of participants' ability to perform the resistance training movements under supervision. Self-efficacy was evaluated based on participant responses regarding their confidence and willingness to continue the exercise independently at home.

Because this program did not include long-term follow-up or objective pre- and post-intervention clinical measurements, outcomes related to blood glucose control should be interpreted cautiously. Random blood glucose testing in this activity was mainly used for safety screening before exercise, not as a primary clinical outcome.

2.6. Data analysis

Data were analyzed descriptively by organizing information from observations, participant responses, and program implementation into several themes: participant engagement, understanding of resistance training benefits, ability to perform exercise movements, perceived feasibility of home-based resistance training, and confidence to exercise independently.

The analysis aimed to describe whether the program was feasible, acceptable, and useful as an educational strategy for Prolanis participants with type 2 diabetes mellitus. The findings were interpreted in relation to the role of resistance training education in supporting lifestyle-based diabetes management.

All participants were informed about the purpose and procedures of the activity before participation. Participation was voluntary, and participants were allowed to stop the exercise if they felt uncomfortable or experienced symptoms during the session. Personal medical information was kept confidential, and no individual identifying data were presented in the manuscript. The activity was conducted under supervision to ensure participant safety during the exercise session.

3. Results and discussion

3.1. Implementation of the resistance training education program

The resistance training education and assistance program was implemented among 60 active Prolanis participants with type 2 diabetes mellitus at Yayasan Angsa Putih, Bandar Lampung. The program was conducted as a community-based educational activity that combined interactive diabetes education, pre-exercise health screening, instructor-led movement demonstration, guided resistance training practice, and home-based exercise guidance [6, 14, 15].

All participants attended the activity until completion and actively participated in each session. The program was divided into three main stages: education on type 2 diabetes mellitus and the role of resistance training, demonstration of safe resistance training movements, and supervised practice. During the educational session, participants were introduced to the relationship between skeletal muscle activity, insulin sensitivity, and blood glucose management. The demonstration and practice sessions allowed participants to directly observe and perform each movement under supervision [4, 16].

The high level of participation during the activity indicates that resistance training education can be accepted by Prolanis participants when delivered in a simple, practical, and supervised format. Most participants were able to follow the exercise instructions, ask questions, and practice the movements with guidance. This finding suggests that direct practice is important for improving participant confidence, especially among individuals who have limited experience with structured resistance training [17, 18].

3.2. Pre-exercise screening and safety considerations

Before the exercise session, participants underwent pre-exercise health screening to ensure safety during physical activity. The screening included blood pressure measurement, random blood glucose testing, musculoskeletal complaint assessment, and oxygen saturation assessment when necessary. This screening was important because participants with type 2 diabetes mellitus may have comorbidities such as hypertension, cardiovascular risk, neuropathy, or musculoskeletal limitations

The screening process also helped determine whether participants required exercise modification. Participants were instructed to stop exercising if they experienced dizziness, chest pain, shortness of breath, excessive fatigue, or symptoms suggestive of hypoglycemia. These safety procedures are essential in community-based exercise programs, particularly for older adults and patients with chronic diseases [3, 6, 16].

The use of simple bodyweight and low-load resistance exercises also improved program safety and feasibility. Movements using a chair, wall, or water bottle were easier to perform and did not require special gym equipment. This approach is suitable for Prolanis participants because it can be replicated independently at home with minimal resources.

3.3. Resistance training protocol

The resistance training session consisted of warm-up, main exercise, and cool-down phases. The main exercise program included seven simple resistance movements targeting major muscle groups of the upper and lower body. The corrected exercise protocol is presented in **Table 2**.

Table 2
Resistance training protocol for prolanis participants with type 2 diabetes mellitus

No	Exercise Movement	Description	Target Muscle Group	Recommended Dose
1	Chair squat	Standing in front of a chair, lowering the body as if sitting, then returning to standing	Quadriceps, hamstrings, gluteal muscles	2 sets × 10–12 repetitions
2	Standing calf raise	Standing while holding a chair, raising the heels, then lowering slowly	Gastrocnemius and soleus	2 sets × 12–15 repetitions
3	Wall push-up	Pushing the body toward and away from a wall using both arms	Chest, shoulders, triceps	2 sets × 10–12 repetitions
4	Seated leg extension	Sitting on a chair and extending one leg forward alternately	Quadriceps	2 sets × 10–12 repetitions per leg
5	Standing hip abduction	Standing while holding a chair and lifting one leg sideways	Hip abductors and gluteal muscles	2 sets × 10–12 repetitions per side
6	Shoulder press with water bottle	Lifting a water bottle from shoulder level to above the head	Deltoid and trapezius muscles	2 sets × 10–12 repetitions
7	Bicep curl with water bottle	Flexing and extending the elbow while holding a water bottle	Biceps brachii	2 sets × 10–12 repetitions

The exercise protocol was designed to be practical, safe, and appropriate for community-based diabetes management. Chair squat, seated leg extension, standing calf raise, and standing hip abduction target lower-limb muscles that are important for mobility and glucose uptake. Wall push-up, shoulder press, and bicep curl target upper-limb muscles and help improve functional strength. Using a chair and water bottle made the exercise more accessible for participants who did not have access to exercise equipment.

3.4. Program guidelines and exercise safety

Participants were also given guidance regarding exercise frequency, duration, intensity, warm-up, cool-down, hydration, and warning signs during physical activity. The recommended guidelines are summarized in Fig. 1.

These guidelines are important because resistance training for participants with type 2 diabetes mellitus should be performed safely and gradually. Participants need clear instructions on movement technique, breathing, rest intervals, and warning signs. The guidebook provided during the activity helped participants remember the steps of each movement and supported independent practice at home [24].

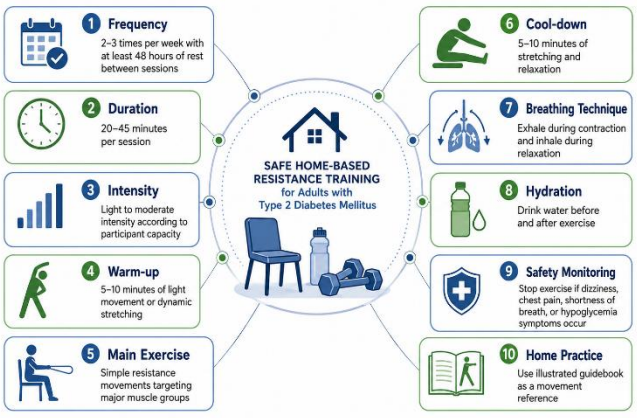

Fig. 1. Resistance training guidelines for participants with type 2 diabetes mellitus. The figure summarizes key safety and implementation principles for home-based resistance training, including exercise frequency, duration, intensity, warm-up, main exercise, cool-down, breathing technique, hydration, safety monitoring, and the use of an illustrated guidebook to support independent practice

3.5. Participant engagement and practical skill development

The guided practice session was one of the most important components of the program. Participants were able to directly practice each movement after observing the instructor's demonstration. This approach helped participants understand correct movement patterns, body position, tempo, and breathing technique.

The use of practical demonstration was more effective than verbal explanation alone because participants could immediately imitate the movements and receive correction when needed. Some participants required movement modification due to age-related limitations, joint discomfort, or reduced balance. For example, participants with knee discomfort were advised to reduce squat depth, while those with balance problems were instructed to hold a chair during standing movements.

The direct practice session also increased participant confidence. Many participants responded positively because the exercises were simple, did not require special equipment, and could be performed at home. This finding suggests that resistance training education should not only explain the benefits of exercise but also provide practical skill training [14, 22, 23].

3.6. Knowledge and self-efficacy in blood glucose management

The educational session improved participants' understanding of how resistance training may contribute to blood glucose management. Participants learned that skeletal muscle plays an important role in glucose uptake and that muscle contraction during exercise can help improve glucose utilization. They also learned that regular resistance training may support insulin sensitivity, functional capacity, and long-term diabetes self-management [20, 21, 25].

However, because this program did not use a validated pre-test and post-test questionnaire or a self-efficacy scale, the findings should be

interpreted as observed improvement in participant understanding and confidence rather than statistically measured improvement. The increase in knowledge and self-efficacy was mainly reflected through active participation, question-and-answer interactions, ability to follow movements, and participant responses after the practice session.

This point is important because claims of "significant improvement" or "clinical effectiveness" require measurable data. Therefore, the present program is more accurately described as feasible, acceptable, and useful as an educational strategy to support lifestyle-based diabetes management.

3.7. Resistance training and blood glucose management

Resistance training has strong physiological relevance for type 2 diabetes mellitus management. Skeletal muscle is one of the main tissues responsible for glucose uptake. During resistance exercise, muscle contraction stimulates glucose transport into muscle cells through mechanisms involving GLUT-4 translocation and insulin-independent pathways. Regular resistance training may also increase muscle mass, improve insulin sensitivity, and support better metabolic regulation [16, 26, 27].

In this program, participants were introduced to resistance training as a practical non-pharmacological strategy for supporting blood glucose management. The selected movements were simple and adaptable, making them suitable for community-based diabetes education. Although random blood glucose was measured during screening, the program did not evaluate changes in fasting blood glucose, postprandial glucose, or HbA1c before and after intervention. Therefore, the effect of this program on actual glycemic control cannot be concluded from the current data.

Future studies should include objective clinical measurements to determine whether regular participation in this exercise program can improve blood glucose control. Suggested outcomes include fasting blood glucose, 2-hour postprandial glucose, HbA1c, muscle strength, exercise adherence, and quality of life [14, 22, 23].

3.8. Feasibility of home-based resistance training

The program demonstrated that home-based resistance training is feasible for Prolanis participants when movements are simple, safe, and clearly demonstrated. The use of bodyweight exercises and water bottles as resistance tools reduced barriers related to cost, access to facilities, and lack of equipment. This is particularly relevant for community-based programs where participants may not have access to gyms or structured exercise facilities [28, 29].

The illustrated guidebook also supported feasibility by providing visual instructions that participants could use after the activity. For older adults or participants with limited exercise literacy, visual guidance can help improve recall and reduce uncertainty when practicing independently at home [19–21].

The feasibility of this program suggests that resistance training education can be integrated into routine Prolanis activities. It may complement existing components such as medication adherence, blood glucose monitoring, dietary education, and routine health checks.

3.9. Program strengths and limitations

One strength of this program was the combination of education, demonstration, supervised practice, and safety screening. This structure allowed participants to learn not only the theoretical benefits of resistance training but also practical movement skills. The program was also low-cost and easy to replicate because it used simple movements and minimal equipment [14, 22, 23].

However, several limitations should be acknowledged. First, the evaluation was mainly descriptive and observational. Second, knowledge, practical skills, and self-efficacy were not measured using validated instruments. Third, clinical outcomes such as fasting blood glucose, postprandial blood glucose, HbA1c, muscle strength, and long-term adherence were not evaluated. Fourth, the program was conducted as a single-session activity, so long-term behavior change could not be determined.

These limitations indicate that the program should be interpreted as an educational and feasibility activity rather than a clinical trial. Future research should use a stronger design with baseline and follow-up measurements to evaluate the clinical effectiveness of resistance training among Prolanis participants with type 2 diabetes mellitus.

3.10. Implications for prolanis programs

The findings suggest that resistance training education can be integrated into Prolanis activities as a practical lifestyle intervention. Prolanis programs commonly emphasize health monitoring, medication adherence, and general education, but structured physical exercise education may still be limited. Adding resistance training education may help participants better understand the role of muscle activity in glucose management and increase their confidence to exercise independently.

For implementation in primary healthcare or community settings, resistance training education should include safety screening, simple exercise demonstration, supervised practice, home-based guidance, and periodic follow-up. With these components, resistance training may become a sustainable part of diabetes self-management for Prolanis participants. Overall, this program shows that resistance training education and assistance are feasible and well accepted among Prolanis participants with type 2 diabetes mellitus. The program supported participant engagement, practical skill development, and confidence to perform simple resistance exercises independently. However, further studies with objective clinical outcomes are required to determine its effect on blood glucose control and long-term diabetes management.

4. Conclusion

This study shows that resistance training education and assistance can be implemented as a feasible and well-accepted lifestyle-based intervention for Prolanis participants with type 2 diabetes mellitus. The program, which combined interactive diabetes education, pre-exercise health screening, instructor-led movement demonstration, supervised practice, and an illustrated home-exercise guidebook, supported participants in understanding the role of skeletal muscle activity and resistance training in blood glucose management.

The findings indicate that participants were actively engaged throughout the program and were able to perform simple resistance training movements under supervision. The use of bodyweight and low-load exercises, such as chair squat, standing calf raise, wall push-up, seated leg extension, standing hip abduction, shoulder press, and bicep curl, made the program practical, safe, and suitable for home-based practice. This approach also helped improve participants' confidence to continue resistance training independently as part of daily diabetes self-management.

Overall, resistance training education has potential to be integrated into routine Prolanis activities as a complementary non-pharmacological strategy for type 2 diabetes mellitus management. However, the clinical effectiveness of the program in improving blood glucose control should be evaluated further using objective and longitudinal measurements, such as fasting blood glucose, postprandial glucose, HbA1c, muscle strength, exercise adherence, and quality of life. Future programs should also include structured follow-up to determine whether participants can maintain resistance training habits independently over time.

CRediT authorship contribution statement

Salsa Nata Patresia: Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Salwah Zamaya Dara Junita**: Writing – original draft, Methodology, Data curation. **Savira Marlisa**: Investigation, Data curation, Formal analysis, Writing – original draft. **Septi Putri Khelia Ananda**: Investigation, Formal analysis. **Tiara Novita Hadjidah**: Investigation, Formal analysis. **Tiara Putri Maharani**: Investigation, Data curation, Formal analysis. **Tiara Ridha Esfandiari**: Investigation, Data curation, Formal analysis. **Tino Avan Dita**: Investigation, Formal analysis. **Tissa Nadialsa**: Investigation, Formal analysis. **Triamita Septi Ariyanti**: Investigation, Data curation, Formal analysis, Writing – review & editing. **Ratna Purwaningrum**: Supervision, Validation, Data curation, Resources, Methodology, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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