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Telephone coaching supports exercise in people with prediabetes and diabetes: A mixed-methods study

Suporte para a prática de exercícios em pessoas com pré-diabetes e diabetes por meio de chamadas telefônicas: Um estudo de métodos mistos.

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ABSTRACT

Objective: To evaluate whether a telephone coaching intervention can help people with prediabetes and diabetes to exercise as recommended by diabetes guidelines after a lifestyle intervention. Methods: The telefone coaching intervention included problem-solving strategies to address barriers to successfully implementing an action plan to achieve exercise goals. Data were collected from January to December 2020 in Juiz de Fora, Minas Gerais, Brazil. Confidence, motivation, barriers to exercise, and weekly exercise duration were evaluated using both quantitative (questions with response options on a 0-10 Likert scale) and qualitative (open-ended questions) data, which were analyzed complementarily using mixed methods. Results: Thirty-one individuals (20 to 74 years old, 55% male, 71% type 2 diabetes) answered, on average, 4.0 ± 1.4 phone calls. The averages of confidence and motivation to exercise scores were between 8.0 to 8.7 and 7.0 to 8.9, respectively. The most frequently reported barriers to exercise were weather, pain or physical injuries, and lack of adequate space. The average self-reported time exercising was higher than 150 minutes/week in all phone calls. The main reasons for feeling confident and motivated to exercise were knowledge about exercise, joy in exercising, and benefits in physical health. Conclusion: The telephone coaching intervention can support people with prediabetes and diabetes in adhering to exercise recommendations outlined in diabetes guidelines, especially after participating in programs focused on promoting lifestyle changes.

Keywords: Diabetes mellitus; Telephone coaching; Physical exercise.

RESUMO

Objetivo: Avaliar se uma intervenção de aconselhamento por telefone pode ajudar pessoas com pré-diabetes e diabetes a se exercitarem conforme recomendado pelas diretrizes de diabetes após uma intervenção de estilo de vida. Métodos: A intervenção de aconselhamento telefônico incluiu resolução de problemas relacionados às barreiras para o sucesso na implementação de um plano de ação para atingir as metas de exercícios. Os dados foram coletados entre janeiro e dezembro de 2020 em Juiz de Fora, Minas Gerais. Foram avaliados a confiança, motivação, barreiras para realização de exercícios e tempo exercitado semanalmente a partir de dados quantitativos (questões com opções de resposta em escala Likert 0-10) e qualitativos (questões abertas) analisados de forma complementar utilizando métodos mistos. Resultados: Trinta e um indivíduos (20 a 74 anos, 55% homens, 71% diabetes tipo 2) responderam, em média, 4,0 ± 1,4 chamadas telefônicas. As médias de pontuação de confiança e motivação para exercícios foram entre 8,0 a 8,7 e 7,0 a 8,9, respectivamente. As barreiras mais frequentemente relatadas para exercícios foram clima, dor ou lesões físicas e falta de espaço adequado. O tempo médio de exercício auto-relatado foi superior a 150 minutos/semana em todas as chamadas. As principais razões para se sentirem confiantes e motivados para exercitar foram conhecimento sobre exercícios, prazer em se exercitar e benefícios na saúde física. Conclusão: A intervenção de aconselhamento por telefone pode apoiar pessoas com pré-diabetes e diabetes na adesão às recomendações de exercícios para esta população, especialmente após participar de programas de promoção de mudanças no estilo de vida.

Palavras-chave: *Diabetes mellitus; Coaching por telefone; Exercício físico.*

Introduction

Diabetes is a non-communicable disease characterized by persistent hyperglycemia, which can lead to microvascular and macrovascular complications (nephropathies, neuropathies, coronary artery disease, cerebrovascular disease, peripheral vascular diseases, and retinopathies) which directly impact the survival and quality of life of those living with this condition[1,2].

The incidence of diabetes has been increasing worldwide, it has been estimated that there are 537 million adults aged 20 to 79 worldwide living with diabetes, which represents 10.5% of all adults in this age group[3]. In addition, it is estimated that diabetes cases will double by the year 2040 if measures are not taken to change this scenario[3].

Lifestyle significantly influences diabetes development and glycemic control in those living with this condition[4]. Thus, strategies for diabetes prevention and treatment involve behavioral interventions targeting physical exercise, dietary counseling, and patient education[5].

It is recommended that individuals with diabetes follow a lifestyle program, and it should include a structured physical activity (PA) intervention which should encompass at least 150 minutes of moderate to vigorous-intensity aerobic exercise per week[4-6], associated with other fundamental components of diabetes treatment aiming to control blood glucose levels, such as self-management disease education and medical nutritional therapy. However, individuals with diabetes are less active than the general population[8,9] and face additional barriers to achieving those recommendations. Besides common barriers such as lack of time, unsafe urban environments, lack of access to suitable spaces, financial cost, lack of motivation, and psychological barriers[10], these individuals face as the main barrier to PA the fear of hypoglycemia while exercising[11-13].

An effective way to overcome these barriers is through exercise promotion programs for people with prediabetes and diabetes which have been shown to improve physical fitness, manage the disease, reduce hemoglobin (A1c) levels, decrease the use of oral medications and insulin, and promote weight loss[14]. However, short-term programs (1 to 5 months) have generally not been successful in achieving sustained long-term behavior changes[9].Thus, healthcare providers use various strategies to help people with prediabetes and diabetes self-manage their condition and achieve long-term PA goals[6,7]. Among them, telephone coaching has proven to be accessible and with good acceptability, promoting additional support to these individuals and may contribute to disease management[15].

Although telephone coaching is an effective approach to improve chronic diseases management[15-17], studies using this strategy aiming the healthy behavior maintenance subsequently of behavior change programs participation still need investigation[18-20]. In particular, people with glucose metabolism disorders could benefit from this type of approach to adopt and/or maintain an active lifestyle, as physical exercise is a fundamental component for the prevention and treatment of diabetes[5]. Therefore, this study aims to evaluate whether a telephone coaching intervention can support people with prediabetes and diabetes to exercise as recommended during participation in a lifestyle intervention after its completion.

Methods

Study design

This study used an embedded mixed-methods approach to assess the results of a six-month telephone coaching intervention on confidence, motivation, barriers to exercising, and exercise adherence after a lifestyle intervention in people with prediabetes and diabetes. Data were collected from January to December 2020 in Juiz de Fora, Minas Gerais, Brazil. The study was approved by the Research Ethics Committee of the Hospital of the Federal University of Juiz de Fora (CAAE: 77831517.0.2002.5133), and all participants gave written informed consent.

Participants

Individuals with prediabetes and diabetes immediately after the completion of a lifestyle intervention that was part of a randomized pilot study, on which they were counseled to exercise at least 150 minutes of moderate- or vigorous-intensity aerobic by week[21].

Telephone coaching intervention

One of the study researchers (APDB, a physiotherapist) contacted participants by five phone calls apart from one month each other over six consecutive months. Aiming to maximize the chance of reaching out to all study participants monthly five contact attempts were made at different times of the day on different days of the week, for a total of two weeks. The telephone coaching intervention included problem-solving related to barriers to success in implementing an action plan to achieve the exercise goals as recommended. Data on confidence,

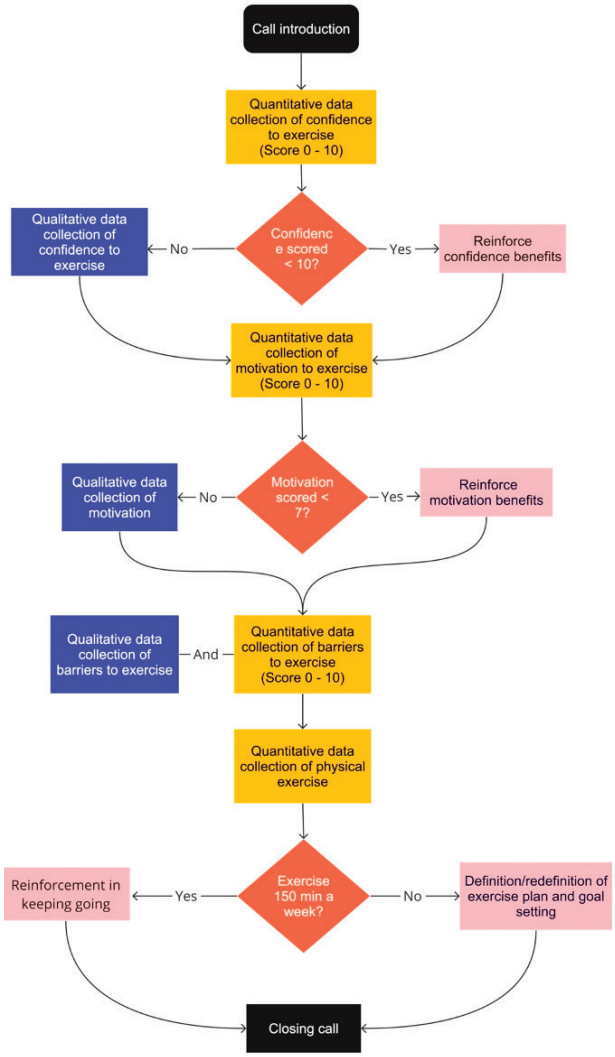

Figure 1 – Steps of the phone calls.

motivation, and barriers to exercise were collected. The success in achieving the recommended exercise behavior goals was assessed at each phone call, and problem-solving toward those goals was discussed. Only one researcher was responsible for delivering the entire intervention during the six months, which ensured the standardization of the participant-researcher interaction.

All phone calls were divided into six steps as described in Figure 1: (1) introduction, (2) investigation of confidence to exercise and counseling, if needed, (3) investigation of motivation to exercise and counseling, if needed (4) investigation of barriers to exercise, (5) investigation of time exercised per week and definition or redefinition of exercise plan and goal settings, if needed, and (6) closing call. In the first step, the researcher introduced herself, checked the participants' availability to be engaged in the intervention during the next 20 to 30 minutes, and explained the purpose of that call. In the second and third steps, the participants who were not completely confident (scored < 10 in a Likert scale ranging 0-10[22]) and/or needed motivation to exercise (scored < 7 in a Likert scale ranging 0-10[22]) receive brief counseling about the importance and benefits of being confident and motivated to achieve the exercise behavior goals as recommended. In the fourth step, the researcher investigated the participants' barriers to exercise, which were discussed in the next step when defining or redefining the exercise plan and goal setting if needed. In the fifth step, for participants who were not achieving the exercise behavior goals as recommended, their exercise plan and goal setting to be achieved during the next thirty days were defined based on the concept of goal setting and action-planning discussion[22] and they were redefined in the subsequent calls if needed. For those achieving the exercise behavior goals as recommended, the researcher reinforces the importance of keeping going. In the sixth step, the participants were counseled to redefine their exercise plan and goal setting by themselves in case the exercise behavior goals were not being achieved as recommended and were reminded that the next call would be in about a month, except for the final call of the study, during which a closure call was conducted.

Outcomes

The participants' sociodemographic and clinical characteristics, including the diabetes diagnoses, were collected from self-reported before the lifestyle intervention that preceded the present study[21].The authors developed the confidence and motivation questions based on the socio-ecological model[24] .The self-reported confidence and motivation to exercise, as well as the impact of each barrier on the exercise execution, were measured using a Likert scale ranging from 0 (not confident at all; not motivated at all; no impact at all) to 10 (completely confident; completely motivated; extremely impactful[22]) The self-reported time exercised weekly was collected during the phone calls. The researcher recorded the number of phone call attempts and call duration.

The qualitative data were collected monthly over the six-month telephone coaching intervention from answering phone calls that followed a structured script with open-ended questions.

Data analysis

The IBM Statistical Package for Social Sciences version 22.0 software was used to store and analyze quan-

titative data. The distribution of numerical data was analyzed using the Shapiro-Wilk test and visual histogram analysis. Continuous variables were expressed as mean and standard deviation or mean [95% confidence interval (CI)]. Categorical variables were presented as absolute and relative frequency (%). Given the nature of this study that followed up participants from a pilot trial with a small sample size[21], we do not report p values to compare quantitative outcomes, and descriptive statistics were utilized to analyze these data.

To analyze the qualitative variables the telephone interviews were recorded in digital audio and transcribed fully by a researcher not involved in the calls. Bardin's method[25] was used to analyze the transcripts, and the content analysis was conducted in three stages as follows: (1) pre-analysis, from skimming reading and organization of all transcribed material; (2) exploratory analysis, the data were organized into codes and further into broader categories encompassing the initial codes; and (3) thematic analysis, of which categories were compared to the rest of the data to establish preliminary themes and subthemes.

Saturation sampling was not possible due to recruitment limitations to a pilot study's participants. However, thematic saturation was achieved, with no new themes emerging. The findings' trustworthiness is supported by adhering to qualitative research reporting criteria[26] and using pseudonyms to ensure confidentiality.

Results

Participants characteristics

The study sample comprised 31 individuals aged 58.5 + 8.7 years, with prediabetes (9.7%), type 1 diabetes (19.4%), and type 2 diabetes (71%), mostly male (54.8%). The time elapsed since diagnosis was 10 (3 – 17) years.

Adherence to phone calls, exercise plan adjustments, and weekly exercise time

Participants answered an average of 4.0 ± 1.4 phone calls. A total of 18 participants answered all calls (5/5),

Table 1 – Results from the quantitative analysis of confidence, motivation, barriers to exercise, weekly time exercised, phone call duration, and attempts during the telephone coaching intervention.

		Phone call 1 (n = 28)	Phone call l 2 (n = 28)	Phone call 3 (n = 26)	Phone call 4 (n = 20)	Phone call 5 (n = 23)
Confidence to exercise[a] (score range 0 to 10)		8.6 [7.8 – 9.3]	8.5 [7.6 – 9.4]	8.1 [7.2 – 9.1]	8.7 [7.6 – 9.8]	8.0 [6.8 – 9.3]
Motivation to exercise[b] (score range 0 to 10)		7.0 [7.0 – 8.8]	8.2 [7.2 – 9.2]	8.4 [7.4 – 9.3]	8.9 [8.2 – 9.5]	8.3 [7.0 – 9.5]
Barries to exercise[c] [score range 0 to 10]	Pain or physical injuries	4.7 [3.1 – 5.9]	4.0 [2.6 – 5.4]	2.5 [1.6 – 3.3]	3.2 [1.7 – 4.7]	2.6 [1.1 – 4.0]
	Physical fatigue	2.8 [1.6 – 4.1]	3.3 [2.0 – 4.5]	2.7 [1.7 – 3.7]	2.9 [1.5 – 4.3]	2.4 [1.1 – 3.7]
	Weather factors (wind, rain, etc.)	4.9 [3.5 – 6.3]	5.2 [3.9 – 6.5]	4.9 [3.3 – 6.5]	4.6 [2.8 – 6.4]	4.6 [2.9 – 6.4]
	Time constraints	3.5 [2.2 – 4.8]	3.3 [2.0 – 4.6]	2.9 [1.6 – 4.1]	3.1 [1.4 – 4.8]	2.6 [1.1 – 4.1]
	Lack of company	3.2 [1.8 – 4.5]	3.1 [1.6 – 4.6]	2.5 [1.4 – 3.5]	2.8 [1.1 – 4.5]	2.8 [1.2 – 4.4]
	Lack of encouragement from family and/or friends	2.0 [0.7 – 3.2]	2.4 [1.2 – 3.5]	2.3 [1.1 – 3.5]	2.3 [0.6 – 3.9]	1.5 [0.2 – 2.8]
	Lack of financial resources	3.0 [1.5 – 4.4]	2.7 [1.4 – 4.1]	2.0 [0.9 – 3.1]	2.4 [0.7 – 4.1]	2.2 [0.7 – 3.7]
	Security	3.2 [1.8 – 4.6]	2.9 [1.5 – 4.4]	2.1 [1.1 – 3.1]	1.8 [0.6 – 3.0]	2.3 [0.9 – 3.6]
	Lack of adequate space	2.7 [1.4 – 4.1]	3.9 [2.4 – 5.4]	2.3 [1.1 – 3.4]	1.7 [0.4 – 2.9]	2.5 [1.1 – 4.0]
	Non-availability of equipment	3.1[1.8 – 4.5]	3.5 [2.2 – 4.9]	3.1 [1.7 – 4.5]	2.6 [1.1 – 4.0]	2.3 [0.7 – 3.8]
Self-reported time exercised (min/week)		201.6 [149.9 – 254.2]	192.0 [145.4 – 238.6]	184.6 [131.1 – 237.9]	151.0 [114.5 – 187.6]	177.1 [129.1 – 225.1]
Phone call duration (minutes)		14.6 [12.4 – 16.8]	15.5 [14.0 – 17.0]	13.5 [12.1 – 14.8]	12.1 [10.7 – 13.5]	11.6 [10.9 – 12.3]
Number of phone call attempts		3.1 [2.2 – 3.9]	2.9 [1.9 – 3.9]	3.2 [2.2 – 4.2]	4.3 [3.1 – 5.5]	3.4 [2.6 – 4.2]

Values are expressed as mean [95% CI of the mean]. a = higher scores indicate higher confidence to exercise; b = higher scores indicate higher motivation to exercise; c = higher scores indicate the higher impact of this barrier on exercise execution.

7 participants answered four calls (4/5), 3 answered three calls (3/5), 1 answered one call (1/5), and 2 participants did not answer any calls (0/5). Adherence to the first and second phone calls was the highest (90%). The fourth and the fifth phone call had the lowest adherence (74.1%) and the highest average number of call attempts (4.3 [CI 95%: 3.1 – 5.5]), respectively, and the second one was the phone call that lasted the longest (15.5 [CI 95%: 7.0–14.0] minutes).

Between the first and fifth phone calls, there was a reduction in the percentage of participants who needed support for the definition/redefinition of exercise plans and goals (32%, 29%, 31%, 26%, and 22%, respectively). In the third, fourth, and fifth phone calls, one different participant did not perform the redefinition of the exercise plan and goals because they were not exercising that month due to medical restrictions.

Although the average self-reported time exercising decreased over the months, the adherence to the recommendation of exercising 150 minutes per week remained high. In phone call 1, 67.9% of the participants self-reported time exercising above 150 minutes per week, and 78.3% in phone call 5.

Confidence, motivation, and barriers to exercise

The average confidence to exercise scores were between 8.0 to 8.7/10, and the motivation to exercise scores were, on average, 7.0 to 8.9/10 during the six-month telephone coaching intervention. The barriers to exercise more frequently reported by participants were weather, pain or physical injuries, and lack of adequate space. All reported barriers are described in Table 1.

Two themes emerged from the qualitative data analysis: (1) reasons for feeling confident to exercise and (2) reasons for feeling motivated to exercise. Table 2 describes the themes and the sub-themes that

Table 2 – Themes and sub-themes related to confidence and/or motivation to exercise.

Theme	Sub-theme	Example quotes
Theme 1: Reasons for feeling confident to exercise	Benefits of exercise in mental health	"The benefits [of exercise] in my health, particularly physical and mental health. Exercise always improves my mood and determination" (ERD: female, 59 years old, phone call 1) "Results of exercise practice include diabetes control, weight decrease, and besides those [results] it gives me the energy and relaxation…" (APB: male, 45 years old, phone call 5)
	Fear of possible complications due to exercise	"My family depends on me, if I'm sick, it's complicated, you know, I must provide everything here" (RFI: male, 31 years old, phone call 2) "The disease, right?! I lost a friend with diabetes; he was hospitalized, got covid, and died… He didn't take medicine right or follow the guidelines, then died " (RFI: male, 31 years old, phone call 4)
Theme 2: Reasons for feeling motivated to exercise	Accountability	"Because I know that if I leave it to myself, things end up falling apart, but if I have someone pushing me, I know that I will exercise" (ERS, male, 56 years old, phone call 2) "Because sometimes, I feel like exercising, but I have nothing and no one to encourage me" (TFB: male, 66 years old, phone call 2)
	Social network	"It's like this because at least one other person and I always go [walking]. So, it's exercise, but it's also leisure, and I have the support of people in my family. It gives me more motivation. Something that pulls me forward" (HLB: female, 59 years old, phone call 3) "The environment motivates me because it's a dirt road, a trail, contact with nature, and getting to know other landscapes" (PRS: male, 55 years old, phone call 3)
	Turning exercise into a habit	"Because when I take on a mission, I go with it until the end… if it were to stop halfway, I wouldn't even start" (TFB: male, 66 years old, phone call 3) "I'm already used to it, too, a habit. If I don't do it, something seems wrong and missing" (ADD, male, 63 years old, phone call 3)
	Sense of commitment.	"Physical activity is a commitment I have to myself, an hour I take for myself" (RFS, female, 58 years old, phone call 1) "It's my interest because I've always been determined in certain things. I have to, I can, and I will" (ERS, male, 56 years old, phone call 1)
	Knowledge about exercise	"I know what I can do; I know I have the skills to exercise" (TFB: male, 66 years old, phone call 1) "Because I know about the activities, I can change the exercises. If I didn't have the knowledge I have, I would be more insecure about doing something wrong" (HLB: female, 59 years old, phone call 2)
Theme 1 and 2* = Reasons for feeling confident and motivated to exercise	Joy in exercising	"Now I feel pleasure while exercising [this is] something I didn't feel before" (RGB: male, 67 years old, phone call 1) "Because I feel good [while exercising]. And walking makes me feel good. It distracts me" (GBS: female, 65 years old, phone call 1)
	Benefits in physical health	"The results I've been getting [with exercise]. After I started to motivate myself, the results have been good, in terms of breathing, [and] my diabetes went down" (PHB: male, 67 years old, phone call 1)

(*) Sub-themes that emerged in themes 1 and 2 simultaneously.

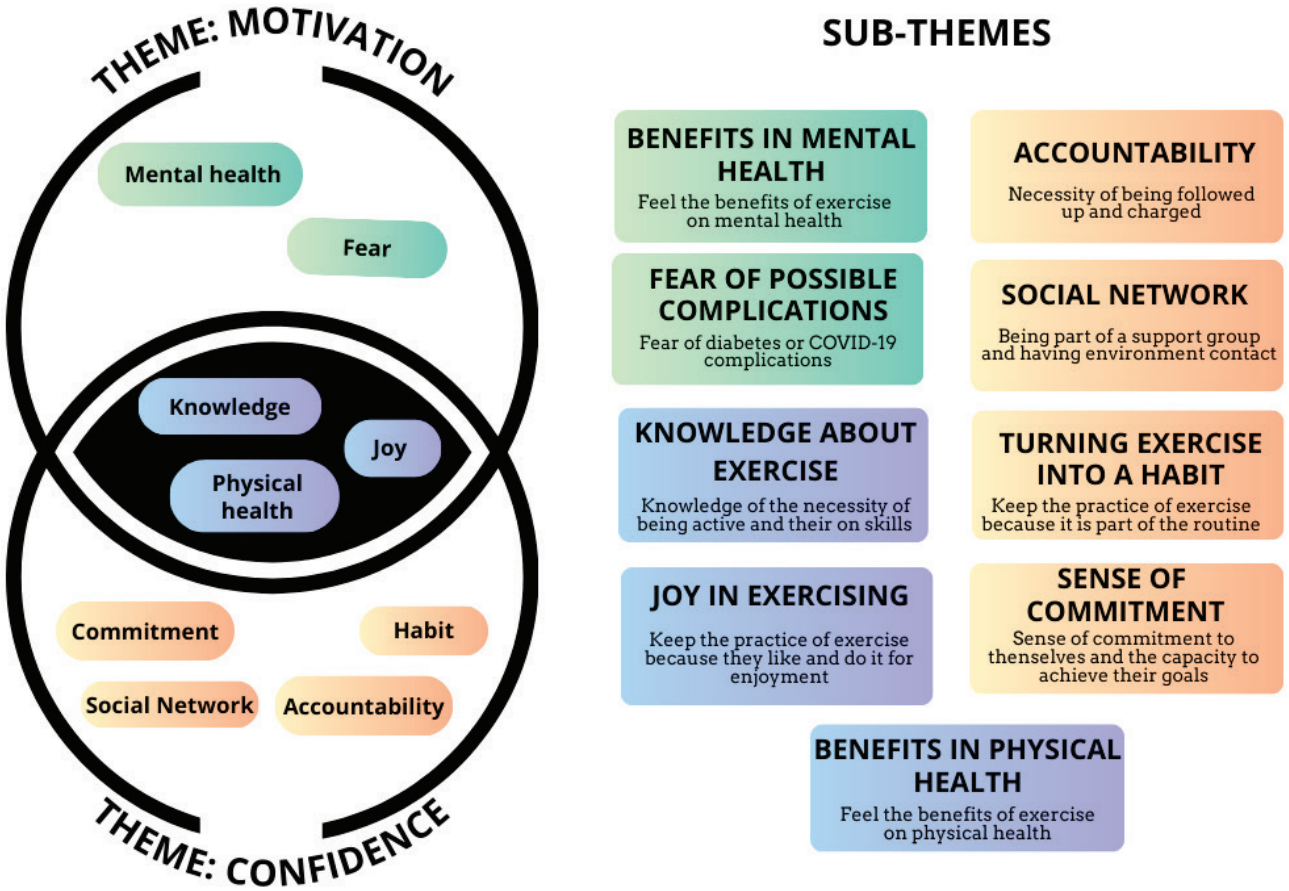

Figure 2 – Themes and sub-themes emerged from the research.

emerged in each of the two themes and those that emerged in both with example quotes.

Regarding theme 1, two subthemes were extracted: (1) benefits of exercise in mental health and (2) fear of possible complications due to exercise (Figure 2). According to the participants, physical exercise improves mood, reduces stress and anxiety, and positively affects emotional well-being. Participants mentioned that uncontrolled diabetes and other sudden health problems are reasons to exercise to care for their health. They expressed the desire not to be sedentary, recognizing that the lack of PA can negatively impact their quality of life. The fear of possible complications of diabetes, or the development of one of the severe symptoms of COVID-19 motivated some participants to maintain their exercise routine. Knowing someone who has suffered from the complications of diabetes encouraged some participants to exercise to avoid such complications.

Regarding the second theme, four subthemes were extracted: (1) accountability, (2) social network, (3) turning exercise into a habit, and (4) a sense of commitment. Some participants mentioned that having someone hold them accountable or track their exercise progress increases their confidence to stick to exercise recommendations. The presence of an external stimulus increases confidence. Participants point out that participating in physical exercise groups or having meetings with other people who share the same goal with exercise is a motivating factor. Support from family and encouragement from friends also help to increase motivation. Some participants mention that being in contact with nature during exercise, such as on trails or riding a bicycle on dirt roads, is an additional motivation to exercise. Some participants mentioned that exercising is part of their daily or weekly routine. They are sure in their ability to incorporate exercise into their lives due to their discipline and habit; once the practice is established, they miss it when they don't exercise. Several participants recognized themselves as determined in their abilities to exercise and achieve their goals, which is why they exercise regularly. Participants have a sense of commitment to themselves and believe that they can accomplish what they set out to do, in addition to seeing exercise as a way to overcome challenges and

improve their physical conditioning.

Three additional subthemes were extracted from both themes: (1) knowledge about exercise, (2) joy in exercising, and (3) benefits in physical health (Figure 2). Participants reported that knowing about PA and what they do increases confidence and motivated in exercising (e.g., adapting exercises avoids the insecurity of doing something wrong and getting injured). In addition, many participants mentioned feeling confident and motivated because they perceive that they have the necessary physical capacity to exercise (e.g., without breathing difficulties or limiting pain). Several participants expressed that they like to exercise and find pleasure in walking, doing PA, and working out. They feel good when exercising and see PA as a moment for themselves. Participants recognize the benefits of physical exercise on their physical health (e.g., decreased blood glucose, improved physical fitness, maintaining, losing weight, and reduced pain). They also mentioned that the demotivation they previously felt to start the exercise reduced when they began to experience its benefits, especially in controlling diabetes. The participants also had the opportunity to mention other barriers to exercise, which were: (1) physical health problems, (2) discouragement, and (3) factors related to the pandemic (social distancing, fear of being infected by the virus, and having no place to exercise), the latter was the most recurrently mentioned.

Discussion

This study explored whether a telephone coaching intervention could sustain exercise behavior in individuals with prediabetes and diabetes in a low-resource setting. The results showed that participants maintained over 150 minutes of weekly exercise for six months, with decreasing call time and fewer participants needing help with exercise plans, suggesting improved adherence. Quantitative data indicated that participants felt confident and motivated to exercise, while qualitative analysis linked confidence to mental health benefits and concerns about complications, and motivation to accountability, social support, habit formation, and sense of commitment.

The results showed that this intervention may have supported participants in exercising more than 150 minutes weekly for six months, and it can be related to the awareness about the importance and benefits of being confident and motivated to achieve the exercise goals reinforced along the phone calls.

The time spent on the phone call was decreased on average by four minutes (14.6 minutes to 11.6 minutes) over the six-month intervention. This may relate to the fact that both the participant and the researcher have gotten used to the questions and approaches made during the phone calls. Lorig et al. also observed a reduction in the time spent creating an action plan with patients during two sessions of a self-management workshop, and the authors attributed this finding to rapid learning for the patient and the research team[23].

In addition to the percentage reduction of participants who needed support for defining or redefining their exercise plan and goals, it was also found that the participants remembered the exercise plan and goals and their adaptations. In this way, the exercise plan execution was feasible, even four weeks later, which corroborates findings from studies that showed that when patients create an action plan, they can remember it after three weeks[23,27].

The benefits of exercise concerning physical health were the reason most frequently reported by the participants for being confident and motivated to exercise. Thus, the exercise benefits brought to the participants can generate confidence and motivation to sustain the habit. Our research group conducted a quantitative cross-sectional study[28] to identify facilitators, barriers, and reasons for graduates of a pilot study, also conducted by our research goup[21], to remain physically active at home during the COVID-19 pandemic three months post-intervention of the pilot study. That study involved 15 individuals and revealed that the main factors that motivated the practice of exercises were physical conditioning and pleasure in exercising[28], which were also subthemes in this study.

Although motivation and confidence are distinct constructs, the analysis of both themes in the present study – reasons for feeling confident and reasons for feeling motivated to exercise – revealed common responses. Participants frequently cited the benefits of physical exercise on physical health as a key factor for both their confidence and motivation to engage in PA. The literature consistently shows physical health benefits as a reason for increasing confidence and motivation to exercise[28-31]. In addition, Schmidt et al[29]. conclude that the support of health professionals providing counseling to change lifestyle, an approach also carried out in the present study, helps consolidate a new habit by increasing motivation.

One of the most frequent barriers reported was

pain or physical injuries, which corroborates findings in the literature that individuals with prediabetes and diabetes experience pain as a barrier to exercising[5]. Additionally, when observing the exercise barriers' impact over the six months, it was possible to identify a reduction in the impact of those that the participants could manage. For example, the participants could handle barriers such as time constraints, pain, or physical injuries. In contrast, other barriers, such as weather and lack of adequate space, did not depend solely on the participants to be resolved.

The present study complements the findings of the previous one[28] as it presents five longitudinal measurements collected over six months to assess confidence, motivation, and barriers to exercise by monthly phone calls that gave the participants freedom of response different from that presented in the previous study. The lack of adequate space was one of the barriers reported by the present study's participants. It was observed as the main barrier in the previous study[28] due to the social restrictions imposed by the COVID-19 pandemic, as many participants were exercising only at home. Both studies were conducted during the pandemic, and the results may be influenced by the particularities of this period.

Additionally, the researcher identified the participants' difficulties in maintaining physical exercise from the monthly phone calls and supported them in defining or redefining their exercise plans and goals to achieve the recommended exercise behavior. Active goal planning based on telephone coaching is one of the strategies to support behavior change that has been shown to improve results[16,17,31].

For lifestyle interventions to be effective, knowing the motivations, confidence, and barriers to maintaining exercise behavior that patients face is essential[11-13,32]. Especially when these interventions can count on an exercise plan and goal setting, adapting the exercise plan to something viable and personalized for that individual is crucial for its fulfillment[33].

The present study has some limitations, such as the nature of the study design without a control group, precludes causal conclusions (i.e., future studies should be conducted to assess the effectiveness of the telephone coaching), the small sample of a pilot study, and the use of self-reported, non-validated questionnaires which may introduce some bias. The applicability to other low-resource settings cannot be known, and the sample derived from a pilot study may introduce further bias. In this way, it is possible that these individuals, having already gone through various stages of a previous research, are more likely to be more motivated than those from the general population. Despite the aforementioned limitations, it is important to highlight the current relevance of studies that, like this one, proposes an intervention to support individuals in maintaining lifestyle changes after an exercise intervention. This study demonstrates a feasible and straightforward methodology that can be easily replicated. Efforts were made to ensure the interviewer's neutrality by following a structured script during phone calls, the study had only one researcher responsible for delivering the entire intervention, and a large number of phone call attempts were made to prevent loss on participants' follow-up during the intervention. Therefore, this study can serve as a reference for conducting similar studies and for implementation in healthcare services, as it demonstrates the potential of this intervention to promote adherence to exercise recommendations. Said that, future research should continue exporting this field by incorporating control groups and, more diverse and large samples to better assess the effectiveness and generalizability of telephone coaching in various settings.

Conclusion

Despite a slight decrease in self-reported exercise time, participants consistently met the 150-minute weekly recommendation with reduced phone support over six months. This indicates that the telephone coaching intervention can help individuals with prediabetes and diabetes adhere to exercise guidelines after a lifestyle intervention.

Conflict of interest

The authors declare no conflict of interest.

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Author's contributions

Batalha APDB: Conceptualization; Methodology; Formal analysis; Investigation; Visualization; Writing – original draft; Approval of the final version. Ghisi GLM**:** Conceptualization; Methodology; Visualization; Writing – review & editing; Approval of the final version. Seixas MB; Conceptualization; Methodology; Investigation; Writing – review & editing; Approval of the final version. Pereira AL: Visualization; Writing – original

draft; Approval of the final version. Oh P: Resources; Writing – review & editing; Approval of the final version. Pereira DAG: Conceptualization; Formal analysis; Writing – review & editing; Approval of the final version. Silva LP: Conceptualization; Methodology; Supervision; Writing – review & editing; Approval of the final version.

Declaration regarding the use of artificial intelligence tools in the article writing process

The authors did not use artificial intelligence tools for preparation of the manuscript.

Availability of research data and other materials

The contents underlying the research text are contained in the manuscript.

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Reviewers' assessment

The reviews of this article were originally conducted in Portuguese. This version has been translated using ChatGPT and subsequently reviewed by the Chief Editors.

Reviewer A

Jessica Fernanda Correa Cordeiro

Universidade do Porto, Faculdade de Desporto, Centro de Investigação em Atividade Física, Saúde e Lazer, Portugal.

Format

- Does the article comply with the manuscript preparation guidelines for submission to the Revista Brasileira de Atividade Física e Saúde?
  Partially
- Regarding formal aspects, is the manuscript well-structured, containing the sections: introduction, methods, results, and discussion (with the conclusion as part of the discussion)?
  Partially
- Is the language appropriate, with clear, precise, and objective text?
  Partially
- Was any indication of plagiarism observed in the manuscript?
  No
- **Suggestions/comments:**
- Study titled "Telephone Coaching Support for Exercise Maintenance in Individuals with Prediabetes and Diabetes". The aim of the study was to assess whether a telephone coaching intervention can help individuals with prediabetes and diabetes adhere to exercise guidelines following a lifestyle intervention. The article is well-written and organized, addressing a highly relevant topic, although it presents a descriptive analysis of the data. There is room to improve the analyses and better justify the study's relevance and hypothesis for people with diabetes.
- Title: I suggest including the study design in the title. I recommend standardizing the use of "individuals with prediabetes and diabetes" throughout the text.

Abstract

- Are the abstract and summary appropriate (including: objective, information about the study participants, variables studied, main results, and a conclusion) and reflective of the manuscript's content?
  Partially
- **Suggestions/comments:**
- The abstract is structured clearly and concisely, covering mixed methods and the main quantitative and qualitative findings. I suggest adding details about the analyses conducted in the methods and clarifying the age range of participants from the outset. Additionally, it would be helpful to briefly explain why the mixed methods approach was chosen in the context of this specific study.

Introduction

- Was the research problem clearly stated and defined?
  Partially
- Is the research problem appropriately contextualized in relation to existing knowledge, moving from general to specific?
  Partially
- Are the reasons justifying (including the authors' assumptions about the problem) the need for the study well established in the text?
  Partially
- Are the references used to support the presentation of the research problem current and relevant to the topic?
  Partially
- Was the objective clearly presented?
  Yes
- **Suggestions/comments:**
- The introduction is concise and to the point, providing relevant information and appropriately contextualizing the importance of physical exercise for individuals with diabetes. I recommend updating the references and bolstering the theoretical framework with recent systematic reviews and meta-analyses on the topic. Additionally, it would be beneficial to elaborate more on the specific barriers faced by individuals with diabetes and to include a clearly formulated study hypothesis.
- Objective: The study objective is clearly defined and aligned with the abstract.

Methods

- Are the methodological procedures generally ap-

propriate for the study of the research problem?
Partially
- Are the methodological procedures adopted for conducting the study sufficiently detailed?
Partially
- Was the procedure for selecting or recruiting participants appropriate for the research problem and described in a sufficient, clear, and objective manner?
Partially
- Were details provided about the instruments used for data collection, their psychometric qualities (e.g., reproducibility, internal consistency, and validity), and, where applicable, the operational definition of variables?
Partially
- Is the data analysis plan appropriate and adequately described?
Partially
- Were the inclusion and/or exclusion criteria for participants described and appropriate for the study?
Partially
- Did the authors provide clarification on the ethical procedures adopted for the study?
Yes
- **Suggestions/comments:**
- The methodology is detailed, with a clear description of the intervention and measures used. I suggest adding more information, such as justification for the chosen data collection timeframe. Furthermore, providing more detail on participant recruitment process would be helpful. It's important to clarify the validity and reliability of the Likert scales used. Additionally, a better justification for some study limitations, such as sample size, lack of a control group, activity duration, and sample variability, is recommended.

Results

- Is the use of tables and figures appropriate and does it facilitate the effective presentation of the study results?
Yes
- Is the number of illustrations in the article in accordance with the journal's submission guidelines?
Yes
- Does the manuscript present the number of participants at each stage of the study, as well as the number and reasons for losses and refusals?
No
- Are the participants' characteristics adequately presented and sufficient?
Partially
- Are the results presented appropriately, highlighting the main findings and avoiding unnecessary repetition?
Partially
- **Suggestions/comments:**
- Highlighting the novelty and relevance of the findings would be crucial to strengthen the study. The presentation of quantitative and qualitative results is clear and organized. Using tables to summarize key data facilitates understanding. Including a more detailed statistical analysis, even with a small sample, is recommended. It would be beneficial to compare results across different age groups or genders. Discussing potential biases considering study limitations, such as non-randomized sampling, absence of sample size calculation, and reliance on self-reported questionnaires, is important.

Discussion

- are the main findings of the study presented?
Partially
- Are the study's limitations and strengths presented and discussed?
Partially
- Are the results discussed in light of the study's limitations and the existing body of knowledge on the subject?
Partially
- Are the potential contributions of the study's main findings to scientific development, innovation, or practical intervention discussed by the authors?
Partially
- **Suggestions/comments:**
- The discussion is well-structured, but I suggest organizing paragraphs as follows: present key findings narratively, correlate them with existing literature, discuss additional outcomes, highlight strengths and weaknesses, interpret the results, and conclude with the study's main message. Additionally, enrich the discussion with national and international references, including meta-analyses. Emphasize the study's importance and novelty. Discuss study limitations in depth, including sample size, questionnaire validity, standardized coaching sessions for all, intervention duration, non-randomized selection,

self-reported questionnaires, single-site study, and simplified statistical analysis. Clarify the rationale for this coaching for individuals with diabetes and discuss if similar studies exist. Recommend directions for future research based on the findings.

Conclusion

- Was the study's conclusion presented appropriately and aligned with its objective?
  Yes
- Is the study's conclusion original?
  Partially
- **Suggestions/comments:**
  The conclusion addresses the study's objective.

References

- Are the references up-to-date and sufficient?
  Partially
- Are most of the references composed of original articles?
  Partially
- Do the references comply with the journal's guidelines [quantity and format]?
  Partially
- Are the in-text citations appropriate, meaning the statements in the text cite references that effectively substantiate them?
  Partially
- **Suggestions/comments:**
- Among the 28 references, 12 are over 5 years old. It is advisable to update them and format them according to the journal's guidelines.

Final decision

- Major revisions

Reviewer B

Igor Massari Correia
Universidade de São Paulo, São Paulo, Brasil

Format

- Does the article comply with the manuscript preparation guidelines for submission to the Revista Brasileira de Atividade Física e Saúde?
  Yes
- Is the manuscript formally well-structured, including the sections: introduction, methods, results, and discussion (with the conclusion integrated into the discussion)?
  Yes
- Is the language appropriate, and is the text clear, precise, and objective?
  Yes
- Was there any indication of plagiarism in the manuscript?
- No
- **Suggestions/Comments:**
- The article is well-structured and relevant to the health field. However, there are some aspects that need improvement. I've provided an annotated file with comments for further development of the manuscript.
- Table 1: Would it not be more appropriate to use the t-test to analyze whether there was a statistically significant difference?

Abstract

- Are the abstract and summary appropriate (including: objective, information about study participants, studied variables, main results, and a conclusion) and do they reflect the manuscript's content?
  Yes
- **Suggestions/Comments:**
  The keyword "physical exercise" might be more suitable and could reach a broader audience of researchers.

Introduction

- Was the research problem clearly stated and defined?
  Partially
- Is the research problem adequately contextualized concerning existing knowledge, moving from general to specific?
  Yes
- Are the reasons that justify (including the authors' assumptions about the problem) the need for the study well-established in the writing?
  Partially
- Are the references used to support the research problem presentation current and relevant to the topic?
  Yes
- Was the objective clearly presented?
  Partially
- **Suggestions/Comments:**
- 1st paragraph: Consider discussing the impact of diabetes on this population (e.g., increased mortal-

ity risk, comorbidities, reduced quality of life) and presenting global and national prevalence statistics to emphasize the study's significance.
- 3rd paragraph: It would be helpful to specify the duration of the programs. For instance, long-term physical exercise programs may have a greater impact on behavioral changes compared to 3-month programs, often implemented in research centers. Some studies have maintained lifestyle interventions through follow-up calls after short-term interventions, resulting in sustained adherence. The duration and methodology of the intervention might influence behavioral change.
- 5th paragraph, line 4: Why are previous studies considered limited and inconclusive? What distinguishes your study? What is its significance?
- 5th paragraph, end of line 4: The text is unclear about whether physical activity adherence will be assessed post-intervention through follow-up calls. Either clarify the objective or adjust the methodology accordingly.

Methods

- Are the methodological procedures, in general, appropriate for the research problem?
  Yes
- Are the methodological procedures detailed enough?
  Yes
- Was the procedure for participant selection or recruitment appropriate for the research problem and clearly described?
  Yes
- Were details provided about the instruments used for data collection, including their psychometric properties (e.g., reliability, internal consistency, validity) and, where relevant, the operational definition of variables?
  Yes
- Is the data analysis plan appropriate and adequately described?
  Yes
- Were inclusion and/or exclusion criteria described and suitable for the study?
  Partially
- Did the authors provide information on the ethical procedures followed in conducting the research?
  Yes
- **Suggestions/Comments:**
- 2nd paragraph, 3rd line: What were the inclusion and exclusion criteria? Adults only? Were participants excluded if they missed a certain number of calls?
- 3rd paragraph: Why was a specific counseling protocol for physical activity goals not followed?
- 4th paragraph: Consider discussing follow-up calls for participants after the intervention to assess the intervention's long-term effectiveness on behavior.
- 4th paragraph, last line: Which "step" is referred to? Step 7? Clarify whether there were follow-up calls post-intervention or not.

Results

- Is the use of tables and figures appropriate and does it enhance the presentation of the study results?
  Yes
- Is the number of illustrations in the article compliant with the journal's submission guidelines?
  Yes
- Are the number of participants at each stage of the study, along with the number and reasons for losses and refusals, presented in the manuscript?
  Yes
- Are the characteristics of the participants adequately presented?
  Partially
- Are the results presented appropriately, highlighting key findings while avoiding unnecessary repetition?
  Yes
- **Suggestions/Comments:**
- 1st paragraph: Consider presenting participant characteristics (e.g., type of diabetes, diagnosis duration, age, sex) in a table. If collected, include additional characteristics relevant to adherence to physical activity (e.g., ethnicity, education level, income). If not collected, acknowledge this as a study limitation.

Discussion

- Are the main findings of the study presented?
  Yes
- Are the study's limitations and strengths discussed?
  Partially
- Are the results discussed in the context of the study's limitations and existing knowledge on the subject?
  Yes

- Do the authors discuss the potential contributions of the study's main findings to scientific development, innovation, or practical interventions?
  No
- **Suggestions/Comments:**
- 4th paragraph, 6th line: Which intervention is being referred to? Clarify whether it pertains to this study or another method.
- 5th paragraph, 2nd line: Specify the intervention type to avoid ambiguity.
- 10th paragraph, final sentence: Highlight the study's importance and utility. What makes it unique and why should it be published?

Conclusion

- Was the study conclusion appropriately presented and consistent with the study's objective?
  Yes
- Is the study conclusion original?
  Yes
- **Suggestions/Comments:**
- No comments.

References

- Are the references current and sufficient?
  Yes
- Are most references original articles?
  Yes
- Do the references meet the journal's guidelines [quantity and format]?
  Partially
- Are in-text citations appropriate, meaning the claims in the text are supported by cited references?
  Yes
- **Suggestions/Comments:**
- Ensure the references comply with the journal's formatting standards.

Comments to the author

- The article is well-structured and relevant to the health field. However, there are some aspects that require improvement. An annotated file with comments has been provided to assist in the manuscript's revision.

Final decision

- Major Revision