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Effects of an Incentive Virtual Physical Activity Sessions for People with Type 2 Diabetes, during Social Containment due to COVID-19 Pandemic

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Abstract

The lockdown measures due to the COVID-19 pandemic had induced a negative impact on the physical, mental and social health of people with chronic diseases, and more specifically Type 2 Diabetes. The study's aim was to evaluate the impact of an incentive Physical Activity (PA) program during the COVID-19 lockdown period on the mental health of people with Type 2 Diabetes. Via an association of patients, people with Type 2 Diabetes were contacted by e-mail to receive virtual PA sessions (from 30 to 60 minutes), 3 times a week for 7 weeks. Their mental health status was assessed using the Hospital Anxiety and Depression Scale and their PA level was assessed using International Physical Activity Questionnaire's score. Nine people with Type 2 Diabetes (64.2 ± 11.5 years) completed the study. The participants' mental health status was maintained after the incentive intervention or even improved for some of them, with changes in the anxiety/depression profile for 3 patients. The PA score was also maintained at the end of the program ($p = 0.153$). In conclusion, this first exploratory work on the effects of an incentive virtual PA program on the mental health of diabetic people highlighted that this type of e-health approach could be relevant to use for, at least, maintaining the state of anxiety/depression of diabetic people during a lockdown period.

Keywords

Chronic Disease, Mental Health, Anxiety, Depression, Lockdown, Home-Based Intervention

1. Introduction

The appearance of COVID-19 at the global level and its rapid spread have forced

many countries, including France, to introduce national lockdowns and brutally impose social isolation, perceived by a large part of the population as a stressful and anxiety-provoking period; with the risk of having a negative impact on people's physical, mental and social health. This lockdown will also have a negative impact on people's daily habits by leading to behavioural changes such as reducing individuals' daily Physical Activity (PA) time. This risk of a decrease in the PA level is all the more important as the PA practice is often linked to and dependent on infrastructures, fitness rooms, clubs or even sports associations. Reducing individuals' PA level during lockdown can have deleterious effects on the human body (Peçanha, Goessler, Roschel, & Gualano, 2020) and this finding is all the more serious in people with a chronic disease and more specifically in people with Type 2 Diabetes (T2D).

The T2D is one of the most common chronic diseases, with an incidence of 4.5% in French population (Mandereau-Bruno & Fosse-Edorh, 2017) and is a multifactorial lifestyle disease, linked to dietary habits and sedentary behavior. Actually, a sedentary lifestyle is considered as one of the major risk factors for T2D and its complications (Bellou, Lazaros, Tzoulaki, & Evangelou, 2018; Hu, 2003). The World Health Organization considers that maintaining an appropriate level of PA is an effective strategy for T2D management, and is an important non-pharmacological therapeutic strategy in this field (Erdem & Korda, 2014; World Health Organization, 2008). Exercise and daily PA is indeed effective modality for improving glycemic control, weight loss, mental health and quality of life in T2D population. On the other hand, patients with T2D frequently suffer from unipolar depression and anxiety, at rates at least double than those observed in diabetes-free populations (Chireh, Li, & D'Arcy, 2019; Semenkovich, Brown, Svrakic, & Lustman, 2015). Anxiety and depression were associated with an increased risk of morbidity and mortality. Depression may have a deleterious impact on adherence to glucose-lowering treatments and has been shown to influence the management and prognosis of T2D through adverse effects on factors such as glycemic control (Cherrington, Wallston, & Rothman, 2010), self-care behaviours (Safren et al., 2014) and body mass index (Boulé, Haddad, Kenny, Wells, & Sigal, 2001). For people with T2D, several studies have demonstrated that the incorporation of exercise into treatment planning may have important benefits on mental health status and general well-being (Lincoln, Shepherd, Johnson, & Castaneda-Sceppa, 2011; Van Der Heijden, Van Dooren, Pop, & Pouwer, 2013). In particular, the authors have shown that, after a 16-week resistance PA program, the depressive symptoms (assessed using the Geriatric Depression Scale) of 29 patients with Type 2 Diabetes were significantly reduced compared to the control group (without treatment) (Van Der Heijden, Van Dooren, Pop, & Pouwer, 2013). In addition, it was shown in a Type 2 Diabetes population that an intensive PA program (three times a week for 1 h, targeting 60% - 80% of their Vo2max) for 6 weeks significantly improved ($p = 0.007$) anxiety symptoms versus a diabetes education program (Ligtenberg, Godaert, Hillenaar, & Hoekstra,

1998). Therefore, exercise proves not only physically but also psychologically beneficial and should be considered a part of routine treatment for depression and anxiety.

As mentioned above, the widespread of the virus as well as the lockdown measures applied in different countries have induced many consequences, including major consequences in the diabetic population with acute panic, anxiety, stress or even depression (Dubey et al., 2020). So, the insufficient PA level potentially observed during the quarantine period can increase the deleterious effects on the mental and emotional health of people with T2D. Although diabetic persons need to stay at home because they have a higher risk of coronavirus disease, they need to avoid a sedentary lifestyle. It, therefore, seems essential to find a remote intervention and incentive strategy that is adapted to the containment context and that allows us to try to maintain these people's PA level and therefore their mental health. One way to remotely encourage people to practice and maintain their PA level at home during this containment phase could be to offer a home-based PA program using new technologies as an incentive strategy; in other words using e-health solutions (Souza Filho, & Tritany, 2020). Especially since home-based programs for diabetic patients have been shown to be safe and have positive effects on health and more specifically on psychological variables (Marçal, Fernandes, Viana, & Ciolac, 2020).

In this way, the aim of our study was to evaluate the impact of a PA incentive program during this lockdown period, with virtual PA sessions, on the diabetics' level of mental health and more specifically the level of anxiety and depression. In an anxiety-provoking health context, we assume that if people with T2D manage to maintain their usual level of PA, their level of mental health will be preserved as well.

2. Methods

2.1. Participants

At the lockdown announcement in France, 25 members of an association for diabetic people were approached to participate in the study. The members of this association had no contraindications to PA. The participants of the study were people who were aware of physical activity benefits, autonomous and living independently in an individual home located in an urban environment with internet access. Each person was informed about the procedure and the purpose of the study. All volunteers read and signed a consent form and the study was conducted according to the Helsinki Declaration (World Medical Association Declaration of Helsinki, 2001). They were offered to receive videos by e-mail three times a week to encourage PA practice during the containment period.

The personal information of the participants has been filled in from the data collected by the association such as age, weight, height or the percentage of glycated hemoglobin (HbA1c).

2.2. Study Design

During 7 weeks, with a frequency of 3 videos per week, the participants received virtual PA sessions by e-mail, which they can perform at their own pace. Videos were provided in a free-access mode, i.e. in order to view the video, participants just had to click on the link, with no login information requested. The virtual PA sessions proposed to participants were based on an incentive mode and participants were free to do what they want. Therefore, the real time spent on each video was not recorded. These videos were made by PA professionals of the association and aimed to work, throughout the week, on a combined program focusing on endurance, muscular strength, balance and flexibility. The video content proposed one or more thematic exercises that could be repeated several times. The duration of the home sessions ranged from 30 to 60 minutes.

2.3. Evaluations

In total, the study lasted 9 weeks, corresponding to the French lockdown period and assessments were conducted in weeks 1 and 9. All evaluations were carried out remotely and administered using Google Forms and the links generated by this tool were emailed to the participants.

The "Hospital Anxiety and Depression Scale" (HADS) was used to assess the level of anxiety and depression of individuals (Haute Autorité de Santé, 2014). This scale consists of 14 items, with 4 possible responses every time, ranged from 0 to 3 points. Seven items (with a maximal total score of 21 points) allow the assessment of the level of depression and the other 7 items, also rated out of 21, assess the level of anxiety. The two scores obtained following the test can be interpreted as following, differentiating three profiles: 1) score ≤ 7 corresponding to "No symptomatology"; 2) score ≥ 8 and ≤10 corresponding to "Doubtful symptomatology"; 3) score ≥ 11 corresponding to "Definite symptomatology".

Participants' PA level was assessed using the "International Physical Activity Questionnaire" (IPAQ). The PA level (expressed in METs minute per week) was calculated from the PA times (3.3 × walking duration; 4 × moderate PA duration; 8 × vigorous PA duration) realized by participants over the last 7 days (Craig et al., 2003).

At the same time, participants were asked to report the number of actual sessions they had performed (to calculate the percentage of participation), whether some sessions had been conducted a second time, or to rate the quality of the videos content.

2.4. Statistical Analysis

Raw data was analyzed using the Prism 8 software (version 8.4.0 for mac; Graphpad software LLC). Unless otherwise stated, each parameter was expressed as mean ± standard deviation. Data normality was firstly checked using D'Agostino & Pearson and Kolmogorov-Smirnov tests. To compare scores of different evaluations before/after program, a Student-paired t-test was performed. A two-tailed *p*-value

less than 0.05 was considered significant.

3. Results

At the beginning of the study, 17 participants agreed to perform the proposed intervention during the lockdown period and finally 9 participants (Age: 64.2 ± 11.5 years; Body mass index: 32.2 ± 6.4; HbA1c: 6.8% ± 1.0%) carried out all pre and post-program evaluations. The study flow chart is presented in Figure 1.

3.1. Anxiety and Depression Levels

Concerning the mental health of the participants, data analysis highlighted that mental health was maintained after this virtual PA program. Indeed, the statistical analysis revealed no significant difference between before/after program respectively for the anxiety score (/21) (10.8 ± 4.2 vs. 9.0 ± 2.8; $p = 0.104$) and depression score (/21) (5.9 ± 2.9/4.2 ± 2.6; $p = 0.09$). Sub-category analysis revealed that 3 people had changed their anxiety/depression profile. Their HADS scores decreased and participants changed profiles on this scale from "definite symptomatology" to "doubtful symptomatology" or from "doubtful symptomatology" to "no symptomatology". Indivdual profile's change of participants is resumed in Figure 2. In this sense, we can say that their mental health improved between the beginning and the end of the program.

3.2. Physical Activity Level

Globally, the PA level of the participants has been maintained after the intervention program. The mean initial PA level evaluated by IPAQ (expressed in MET minute/week) was 2775.0 ± 1239.1 versus 4626.6 ± 4922.3 for the mean final PA level. The statistical analysis revealed no significant difference for PA level between the beginning and the end of the study ($p = 0.153$).

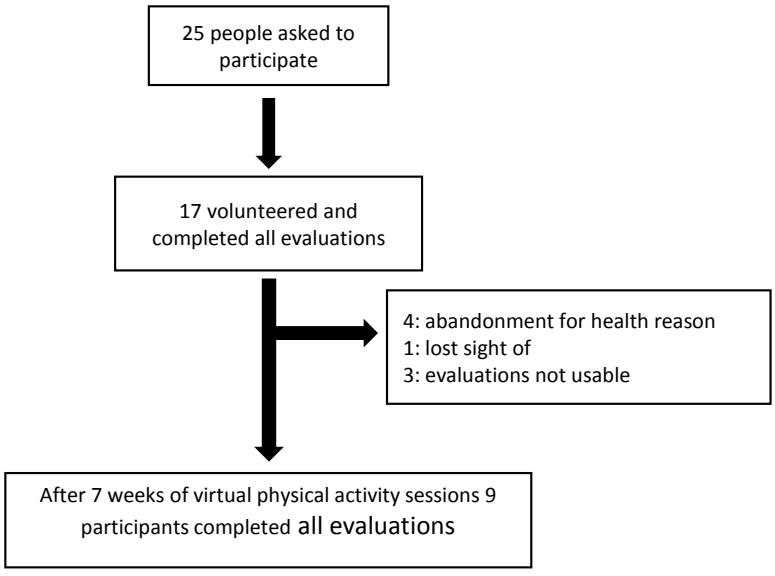

Figure 1. Study flow chart.

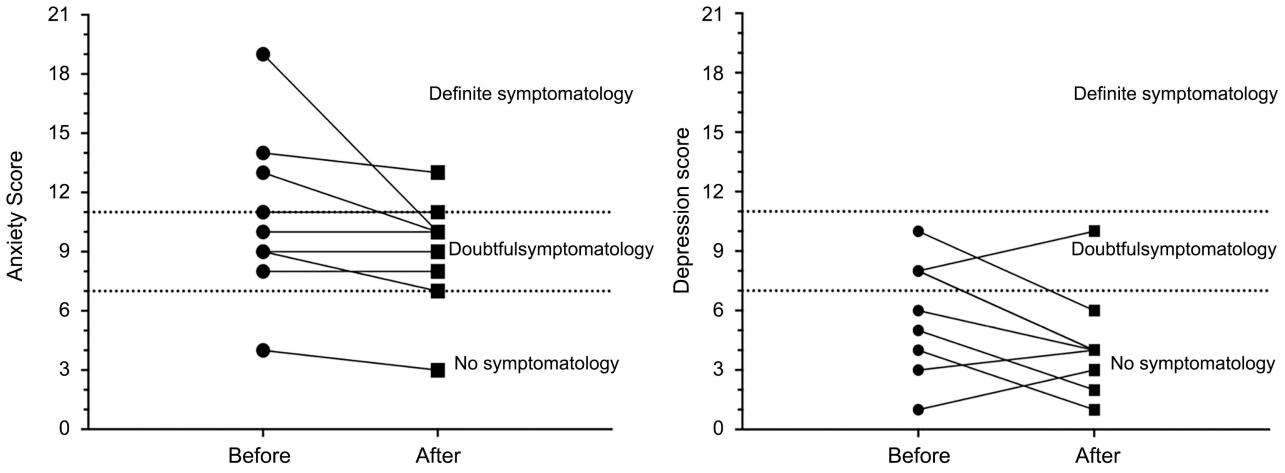

Figure 2. Individual evolution of anxiety and depression scores from Hospital Anxiety and Depression Scale. Note: On the graph on the depression score, one line represents 2 participants because of similar score before and after intervention.

The analysis of the responses on the number of sessions performed revealed that diabetic participated widely in the sessions. Overall, the percentage of participation to the program reported by participants is 75.6% ± 15.4% for the performed sessions, compared to the 21 proposed sessions. Furthermore, 72.3% of the participants report that they have repeated the sessions they received at least once more.

4. Discussion

The aim of our study was to evaluate the impact of an incentive PA program during the French national lockdown period, with virtual PA sessions, on the level of mental health of people with T2D, and more specifically the level of anxiety and depression. With this study we have shown that the incentive PA program has been successful in maintaining, and for some people even improving, the mental health of participants during containment and therefore strongly reducing the potential deleterious effects of social isolation.

COVID-19 pandemia has had and continues to have a negative psycho-social impact on people with T2D who, as a high-risk population, fear from being affected by the virus. This particularly reinforces their feelings of anxiety during the lockdown (Joensen et al., 2020; Lalau, 2020). In our study, we showed that the anxiety and depression status of the participants was maintained or even improved for some people between before and after lockdown. More precisely, 3 people positively improved their anxiety/depression profile after intervention. Exercise has been shown to improve the mental health of diabetics but few studies, with home-based incitative PA program, have evaluated the effect of PA on this parameter. Among them, the results are controversial. Duruturk and Özköslü studied the effect of a supervised home-based tele-rehabilitation program on the depression level (evaluated by the Beck Depression Scale) of people with T2D (Duruturk & Özköslü, 2019). The authors reported that 3 sessions of PA conducted by videoconference (including gymnastics, flexibility, strength and

breathing work) per week for 6 weeks significantly reduced the depression level of the people who followed the program compared to those in the control group (usual care combined with a PA education session) (Duruturk & Özköslü, 2019). Other authors have evaluated the effect of a personalized web-based PA program, based on a socio-ecological multi-level model of diabetes self-management and follow-up to support behaviour change, on the level of depression in people with T2D. After the 8-week program based on national PA recommendations (30 minutes at least 5 times a week), participants maintained their level of depression evaluated by Center for Epidemiologic Depression Scale (McKay, King, Eakin, Seeley, & Glasgow, 2001). We can thus say that our results are in line with these two studies. In one hand, the results of our study are consistent with a previous study, which reported the maintenance of the level of depression (McKay, King, Eakin, Seeley, & Glasgow, 2001). On the other hand, our results are also consistent with the findings and the conclusions of the study of Duruturk and Özköslü because after 6-week program, participants' depressed status improved (Duruturk & Özköslü, 2019). For our part, 3 people have improved their anxiety/depression profile. The last two studies presented here are based on two different approaches of PA programs. One is based on supervised care with controlled and regulated sessions in real time (Duruturk & Özköslü 2019), while the second is focused on an incentive approach to PA while offering personalized care (e.g. adapted sessions, regular meetings with participants to adjust the content) (McKay, King, Eakin, Seeley, & Glasgow, 2001). In our study, we are also working on an incentive rather than an intervention approach but without personalizing the content of the videos. So, we offer here an alternative service for people with T2D. The interest is to make the participant autonomous and not dependent to a program. The idea is that the PA sessions should be sent out regularly (at fixed times and days) but the person can realize the activity whenever he or she wishes to/can perform it. Practicing PA regularly could help maintaining or even improving the mental health of people with T2D as shown in this study.

By maintaining the PA level of the participants in this study, we can assume that the proposed incentive program allowed achieving this result. This assumption could be reinforced by the high percentage of participation and adhesion to PA sessions during the entire program. It has been found in the literature that people with diabetes reported lowering their PA level during lockdown (López-Sánchez et al., 2021; Lalau, 2020; Ruiz-Roso et al., 2020). Ruiz-Roso et al. showed that the PA level assessed from the IPAQ in 72 people with T2D, with no supplementary care than those they habitually received, decreased significantly between before and during lockdown (Ruiz-Roso et al., 2020). These authors reported a significant increase in the average time spent sitting per week as well as a significant decrease in the average times spent walking and spent in moderate activity per week. In our study, participants maintained their PA levels between before and after lockdown.

Thus, this incentive approach to PA as part of e-health could be a tool used to maintain the PA level of individuals and thus generate benefits that are linked to the practice of regular PA, but also maintain or even improve the mental health status of people with T2D. Here, this method has been used in the context of lockdown but could be proposed to all people who are temporarily or permanently isolated due to their personal, geographical or social situation. This e-health tool could have the advantages of tele-rehabilitation and care such as promoting people's sense of autonomy, facilitating and extending access to home care or increasing the sustainability of care (Duruturk, 2020). However, by remaining on an incentive approach, this tool would be less costly (humanely and financially) without using real-time interventions via videoconference.

Study Limitations

On the other hand, we showed in our study that our incentive program had helped to maintain or even improve people's state of anxiety and depression. However, in order to really assert the effectiveness of this treatment, our study would have needed a control group. This point was one of the limitations of our study. In addition, 17 people participated in the program but only 9 completed all the evaluations. Thus, the small size of our study also represents a limitation. In the future, it would therefore be relevant to carry out further work with a greater number of diabetics to confirm the initial results found and assess the long-term effects of an incentive PA program. Moreover, it could be relevant in a future study to propose an objective evaluation of the PA level of diabetics from accelerometers for example. In addition, it would be interesting to deepen the investigation by studying the potential impact of the frequency of video publication, the duration of the videos and the content. This could help for providing optimal benefits to be generated for the health of diabetics.

5. Conclusion

In conclusion, this first exploratory work on the effects of an incentive PA program on the mental health of people with D2T highlighted that this type of e-health approach could be relevant to use. This approach could offer an alternative home service for people who are temporarily or permanently isolated. For example, for people who are unable to go to an activity or for people who do not have a nearby PA offer (given their living environment) and thus counteract the negative impacts of isolation. It may be appropriate to develop effective PA promotion strategies targeting this vulnerable population to maintain their mental health and PA levels. In the context of our study, the targeted participants were people with Type 2 Diabetes, but this approach of virtual PA sessions could in a broad sense be extended to other chronic diseases or disabilities. It could also be relevant to integrate this virtual PA session approach into the management and educate patients in this sense. Thus, in case of temporary or permanent isolation, patients would already be aware of this method of care and its benefits. Further work

is needed to confirm these preliminary results and evaluate the effects of this PA incentive approach in the longer term.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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