Maintaining a physical active lifestyle after completing a three-month health intervention for type 2 diabetes patients

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Abstract

Objective: Type 2 diabetes have become a highly prevalent disease among the Danish population, hence management and treatment are crucial. Previous research has shown that physical activity is effective in treating type 2 diabetes, thus health interventions aim to help patients make and maintain a physical active lifestyle through education and physical activity. However, patients struggle to maintain a physically active lifestyle after the completion of the health intervention. The purpose of this study was therefore, to investigate why type 2 diabetes patients struggle to maintain a physical active lifestyle after the completion of a health intervention in the Region of Northern Jutland, Denmark.

Methods: Data were collected through questionnaires and semi-structured interviews with twelve patients (66.5±10 years) that had completed a three-month health intervention in the Region of Northern Jutland. Interview was conducted by telephone and questionnaires were distributed by email, immediately after the intervention, and three-months after the completion of the intervention.

Results: The three basic psychological needs; autonomy, relatedness and perceived competence, was connected to physical activity maintenance among the type 2 diabetes patients. Relatedness was found to have direct impact on maintenance three-months after the health intervention. Furthermore, the analysis revealed several other themes; being motivated, taking ownership, changes to the health intervention, physical activity habits and barriers.

Conclusion: The need for autonomy, relatedness and perceived competence are important factors for physical activity maintenance among T2DM patients after completing a health intervention. Especially relatedness was found to be important. Moreover, a more individualized approach, to target patients interest, might be needed to increase intrinsic motivation among the patients and thereby adherence to physical activity.

Keywords: Type 2 diabetes, physical activity, health intervention, maintenance, motivation, basic psychological needs.

Introduction

Type 2 diabetes mellitus (T2DM) has become a highly prevalent disease among the Danish population. More than 250.000 Danes equivalent to 4.4% of the Danish population are diagnosed with diabetes of which approximately 80% are people with T2DM (1). Moreover, it has been estimated that further 60.000 Danes unknowingly have T2DM and 300.000 people have prediabetes (1,2). Prediabetes is characterized by the presence of higher blood glucose levels than normal, although not high enough to be defined as T2DM. The prevalence of diabetes has been increasing for the last two decades and is presumed to continue rising (3). This is particularly problematic as this disease could lead to various health threatening complications like retinopathy, neuropathy, nephropathy and cardiovascular diseases (3). Furthermore, T2DM may cause poor life quality (4), risk of early mortality and in addition large socioeconomic costs (5). A large body of research have found that antidiabetic medication, healthy diet and physical activity are crucial in managing T2DM, by improving glycemic control and reducing the risks of developing complications (6,7). However, physical activity has further been found effective in treating T2DM, as it enhances the body's ability to regulate glucose in the bloodstream due to improved insulin sensitivity of muscle and adipose tissue. Studies have found that even physical activity at moderate intensity is beneficial in the treatment of T2DM, regardless of the type of activity performed (8–10).

The importance of maintenance to the regime of daily treatment (physical activity, diet, medication and no smoking) is key to managing T2DM and keeping optimal glycemic control (6,11). However, patients struggle to follow the lifestyle recommended for patients with T2DM (12). In particular patients express difficulty in maintaining regular physical activity, as it requires more time and effort than altering diet and medication intake (13). This is especially profound among older adults with T2DM who engage less in regular physical activity than the general population (14). Furthermore, only 23% of older adults with T2DM are physical active more than 60 min a week (14).

Previous literature has mainly focused on physical activity determinants in the adoption of physical activity and the majority of research have been conducted on healthy individuals. Researchers have more recently focused on maintenance predictors in diabetic patients. Qualitative studies regarding physical activity and T2DM patients have found some indications

towards three important mediators for physical activity maintenance; social support from significant others, the experience of self-efficacy and knowledge about the disease and treatment strategies (15,16). These factors are also supported by research in other health related areas. In particular social support and self-efficacy have been found important in addition to weight-loss maintenance (17,18). However, there is still a lack of understanding within this area to why people struggle to maintain lifestyle changes.

In Denmark, T2DM patients are offered the opportunity to participate in a three-month health intervention aiming to increase knowledge about T2DM, in addition to implementing a healthy lifestyle through physical activity, healthy diet and reducing unhealthy habits like smoking. In Denmark, municipalities are responsible for providing a health intervention to T2DM patients and research have shown that health interventions can be beneficial in improving glycemic control and reducing the risks of complications in T2DM patients (19,20). However, it has been recognized that patients struggle with continuing being physical active after the completion of a health intervention (20,21). In 2009 the Danish health authority published a report in which the effects of the Danish health interventions were assessed (12). It was concluded that the patients' physical activity level reverted back to previous sedentary levels shortly after the completion of the intervention. The same tendency is seen today among T2DM patients in four Danish municipalities in the region of northern Jutland. The effect of these health interventions is therefore questionable, as the interventions are unsuccessful in producing the desired lifestyle changes. The aim of this study is therefore to investigate why T2DM patients struggle to maintain a physical active lifestyle after the completion of a health intervention in the region of northern Jutland, Denmark.

Methods

Participants

A total of 13 T2DM patients from four different municipalities in the region of Northern Jutland in Denmark, volunteered to participate in the study. The sample included two participants from Rebild, five from Morsoe, three from Thisted, three from Dronninglund and included both male (n = 7) and female (n = 6) participants. The participants were aged between 33 and 75 years (66.5±10 years) and have had diabetes for 1-10< years (4.4±4.3). The occupation status of the participants was; retired (n = 11), unemployed (n = 1) and currently em-

ployed (n = 1). Patients were included if they were diagnosed with T2DM and had completed a three-month health intervention within one of the four municipalities. Patients were excluded if they were physically unable to take part in physical activity. All participants were recruited after attending a three-month health intervention for T2DM patients in the region of Northern Jutland, Denmark.

Health intervention

The health interventions in the four different municipalities are led by healthcare professionals such as physiotherapists, nurses, ergo therapists and dieticians. The interventions last approximately 12 weeks with courses consisting of lectures, containing information about T2DM, healthy diet, physical activity, in addition to exercise training sequences that was performed twice a week in a fitness facility. However, there are slight differences in how the information is communicated and how the exercise training sequences are carried out, between the courses in the four municipalities.

Theoretical foundation

To understand patient's self-care behaviors, it is necessary to consider different psychological and social factors since maintaining physical activity is a complex behavior (22). Social cognitive theories, which encompass both the social and psychological aspects of behavior, are among the most used frameworks in health behavior research (23,24). This study used self-determination theory (SDT) as the theoretical foundation, as it is one of the most recognized theories (25,26) and has been used in health related treatment settings like tobacco cessation (27), weight-loss (28), adherent use of medication (29), dietary regulation (30) and more importantly exercise adoption and exercise maintenance (24,31,32). The theory describes three basic psychological needs (BPN); autonomy, perceived competence and relatedness, that determines an individual's regulation of a behavior through a continuum of self-determination from amotivation and extrinsic motivation to intrinsic motivation. Autonomy is the need to feel volitional and choiceful in relation to one's actions, while competence is the need to feel capable and confident in achieving a desired outcome and relatedness is the need to feel understood and accepted by meaningful others (33). These components are also closely linked to some of the findings from prior studies regarding physical activity maintenance in T2DM

patients, like for instance social support (relatedness) and self-efficacy (competence) (16). The primary focus from previous research has been on fulfillment of the three basic psychological needs as the satisfaction of these needs are associated with more self-determined exercise behavior. Research has shown that this is particularly important for health behavior, as individuals that are more autonomously-regulated toward a given behavior are more likely to show greater persistence and stability in that behavior (26,33).

Data collection

Data were collected through quantitative questionnaires and qualitative semi-structured interviews. A quantitative questionnaire regarding personal information, T2DM and physical activity (frequency, intensity, duration and type of physical activity) were distributed online via surveyxact (Ramboll, Denmark) to the participants. The questionnaires were constructed based on a previous study as the population and protocol are similar to the current study. The previous study investigated physical activity among T2DM patients in Denmark and targeted patients who had completed a 12-week intervention in a Danish municipality and included a follow-up four months after the intervention involving questionnaires and interviews (34). The second questionnaire in this study was also based on the validated international physical activity questionnaire (IPAQ) (35), to explore the participants physical activity level. This information was used to distinguish between participants who managed to maintain a physically active lifestyle (maintainers) and participants who did not (non-maintainers), with the purpose of exploring differences between the two groups.

Semi-structured interviews were employed to target the constructs of BPN, but also contained questions focusing on participants perceptions on physical activity during the health intervention and three-months after the intervention. The questionnaires and interviews were performed at two time points, immediately after the completion of the health intervention and three-month post intervention. Between the two time points, the participants were responsible for continuing being physical active independently and unsupervised (see figure 1).

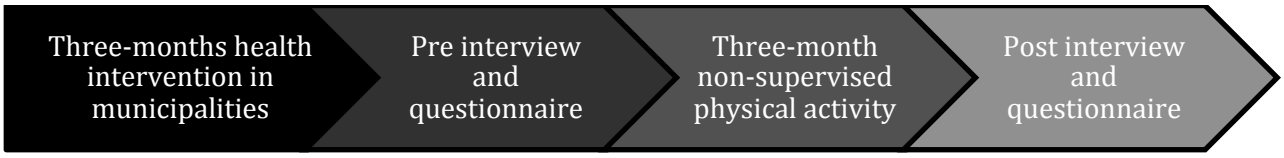

Figure 1 - Shows the timeline of this study. (1) Participants attended a three-months health intervention. (2) Pre interviews and questionnaires were performed. (3) Participants were not supervised during a three-months period. (4) Post interviews and questionnaires were performed.

A total of 13 participants completed the first questionnaire, while twelve answered the second. Furthermore, twelve patients completed both interviews. Researchers informed the participants about the study and all participants were ensured confidentiality, anonymity and informed that they could withdraw at any time during the interview or under the research period.

Data analysis

All quantitative data from the questionnaires were collected from surveyxact and illustrated using a graph and a table. All interviews were audio recorded and transcribed verbatim. The data were analyzed using systematic text condensation (36). In accordance with this method, the researchers began by reading the transcripts in order to get a general idea of the interviews. First, the interviews were analyzed deductively using the three basic psychological needs as main themes. Meaningful parts of the transcripts were highlighted in order to systematize (coding) it under the three main themes. Secondly, an inductive approach was used in order to find other meaningful connections and themes. If new themes evolved during the process, they were discussed for relevance among the researchers and if relevant, added to the analysis. If different connections appeared under the same theme, subgroups were formed. Coding was continued until saturation of new themes and connections. Themes were considered fully saturated when duplication of citations occurred. The analysis of the transcripts was divided into two areas; quotes regarding the health intervention and quotes regarding the three-months period after the health intervention. This was done to compare the two time points in order to follow the transition from participating in a health intervention to be physical active on your own. The Danish citations were translated into English and edited to a more readable form by removing redundant words, unnecessary pauses and changing the

local accent into written language. Quotes used in the article represent the general population's opinion.

Results

The results from the questionnaires and interviews will be presented in the following section. First, participants' physical activity level based on the results from the questionnaires will be presented, second, results from the interviews that were related to the three BPN will be presented along with the themes that emerged from the inductive analysis. The themes are complemented by quotes from the interviews with the participants. In total 13 participants answered the first questionnaire and twelve participants answered the second questionnaire. Twelve participants volunteered to participate in the interviews. Participants are given pseudonyms to ensure anonymity.

Physical activity level

The following section will first provide a graph showing the distribution of patients' weekly activity levels of at least 30 min, immediately after the health intervention and three-months post the intervention (figure 2). Furthermore, a table providing more detailed information about the intensity, duration, frequency and type of physical activity performed three-months after the health intervention will be presented. The table shows how many participants that managed to maintain a physical activity level, that met the Danish health board recommendations for physical activity (table 1).

Results from the questionnaire showed, that the participants were less physically active three-months after the health intervention compared to immediately after the intervention. Participants reported less daily activity three-month after compared to immediately after the intervention and two participants reported only being physical active once a week or never three-months after the intervention (figure 2).

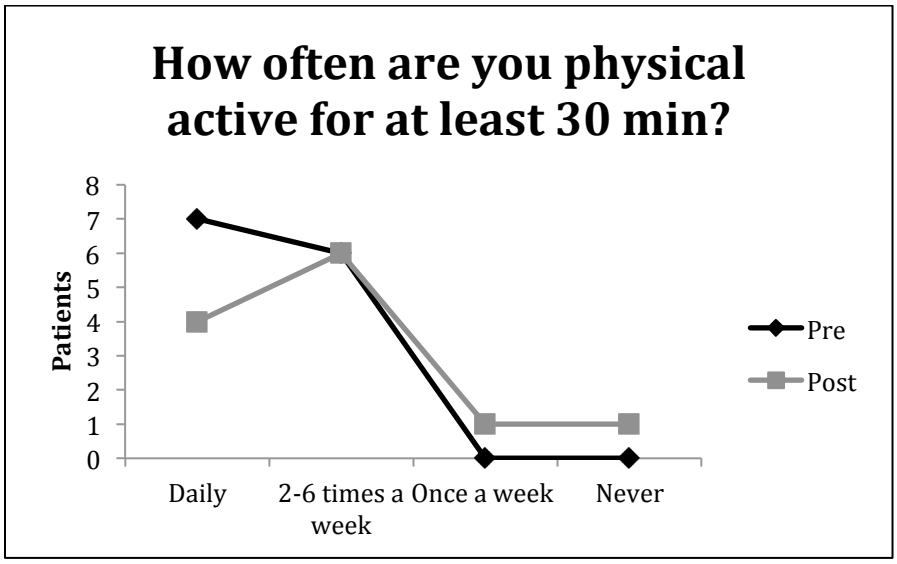

Figure 2 - Shows the distribution of participants weekly activity levels of at least 30 minutes at a time, immediately after the health intervention (pre) (n=13) and three months after the intervention (post) (n=12).

To investigate if participants maintained or did not maintain a physically active lifestyle three-months after the intervention, participants were divided into maintainers or non-maintainers. Participants were considered maintainers when the duration of the activities were at least 3.5 hours per week with moderate to high intensity, which is the amount of physical activity recommended for T2DM patients by the Danish health board. The results from the questionnaire revealed, that five of the participants did not meet the recommended physical activity levels (non-maintainers), while seven participants did meet the recommended activity levels (maintainers). Activities performed by the participants were mainly walks and bike rides, secondary activities involved; swimming, fitness, gymnastics and house/garden work. (table 1)

Total physical activity on an average week three months post intervention						
Patient	Moderate intensity		High itensity		Activity	Total
	Frequency	Duration	Frequency	Duration		
Poul	5	5 h. 0 min.	2	1 h. 0 min.	Walks	6 h. 0 min.
Susanne	0	0 h. 0 min.	0	0 h. 30 min.	No activites	0 h. 30 min.
Klaus	2	2 h. 20 min.	1	0 h. 30 min.	Walks and garden work	2 h. 50 min.
Per	5	7 h. 30 min.	3	1 h. 30 min.	Bike rides	9 h. 0 min.
Julie	4	2 h. 15 min.	2	1 h. 20 min.	Walks and bike rides	3 h. 45 min.
Benny	2	1 h. 30 min.	0	0 h. 0 min.	Walks	1 h. 30 min.
Anne	5	5 h. 30 min.	5	5 h. 30 min.	Walks, bike rides and fitness	11 h. 0 min.
Line	2	0 h. 30 min.	3	0 h. 30 min.	Fitness, wlaks and swimming	1 h. 0 min.
Louise	2	1 h. 30 min.	1	0 h. 30 min.	Walks, bike rides and housework	2 h. 0 min.
Lasse	1	1 h. 0 min.	0	0 h. 0 min.	Walks and bike rides	1 h. 0 min.
Maren	4	7 h. 30 min.	1	1 h. 0 min.	Gymnastics, fitness and walks	8 h. 30 min.
Mads	7	10 h. 0 min.	5	2 h. 0 min	Gymnastics, garden work and fishing/hunting	12 h. 0 min.

Table 1 - Shows the intensity, frequency, duration and type of activity each patient was performing three months after the health interventions.

Themes related to BPN

Through the deductive analysis, the researchers identified all three psychological needs; autonomy, relatedness and perceived competence, was connected to physical activity maintenance among the T2DM patients.

Relatedness

This theme was consistent throughout the analysis of the interviews. The majority of T2DM patients referred to relatedness as an important factor for being physically active; during the health intervention and the three-month period after the completion of the intervention. During the intervention, the majority of the participants discussed the importance of social support from the other participants and the sense of cohesion among them:

> *"... I think it's nice to be in a group of people who are in the same situation (having T2DM) as I am, people I can relate to, it's nice to have this feeling of cohesion.... we had a great unity where we could help and encourage each other. That meant alot."* (Susanne).

Most participants also mentioned that family and friends were supportive by acknowledging the participants choice in participating in the health intervention and making health-related progress:

"...My family and friends thinks it is a good idea that I participate in this intervention and they are very happy to hear how well it is going and that I lost weight" (Klaus)

Three-months after the health intervention the majority of the participants that maintained a physical active lifestyle felt a sense of relatedness, and it was an important factor for them being physically active. Most participants referred to relatedness as having someone to be active with and someone who held them accountable for being physical active:

"Well it does make it easier to get it done, when you have arrangements (with others)... and have someone to be active with. When you are doing it alone, it is easy to find excuses not to be physical active." (Anne).

In addition, most maintainers mentioned being physical active with their spouse and that their spouse was a motivating factor for being physical active:

"I walk 7-8 km every day with my wife... my wife is great at motivating me" (Sven).

On the other hand, all non-maintainers mentioned the lack of relatedness as a reason for not being physically active. This was expressed by most of the non-maintainers as they found it more difficult initiating in physical activity when they were on their own:

"Well I think that it is because I haven't pulled myself together to either get myself signed up to something or talked to someone about starting at something (exercise)... I haven't heard from any of the others (participants in the health intervention)" (Lasse).

Autonomy

The majority of the participants mentioned having a feeling of autonomy during and three months after the health intervention. Even though the content of the health intervention was rather predetermined, most of the participants felt a sense of autonomy during the intervention, through having confidence in the health professionals providing the best setting for treating T2DM. For instance, the majority of the participants highlighted the health professional's positive attitude, confidence and willingness to help as reasons for participating in the exercise training sequences:

"It (the health intervention) was something that was planned by the physiotherapists, but I had full confidence in what they had planned because they expressed full confidence in

what they were teaching us and also had a positive attitude. If you were in doubt, you could just ask for help. It's not like I think that there should be any kind of co-determination in such an intervention... All of us were taken into account and we had some really great sessions. It was not like I felt pressured into going at all, I really liked going". (Susanne).

After the health intervention all maintainers felt a sense of autonomy through performing their preferred form of activity. Participants mainly mentioned outdoor activities (like walking and biking), as they liked being outdoor and it provided a general feeling of wellbeing:

"Well, it is mostly walks I do, that is what I prefer, I think that is better than biking... just being outdoors, that is what I like." (Anne).

However, a lack of autonomy was not mentioned as a reason for not being physically active among any of the non-maintainers:

"I can do exactly what I want to do (in relation to physical activity)". (Klaus).

This indicates that the non-maintainers did not feel pressured into performing a certain kind of activity.

Competence

All participants mentioned having a feeling of competence throughout the health intervention. The participants felt that they were able to take part in all of the activities and that the level of the activity was suitable:

"I was able to participate (in the training). There (during the health intervention) it was fine to participate at the level you found comfortable - I felt like I was able to take part in the activities." (Louise).

Three-months after the health intervention, most maintainers continued to engage in previous (before the health intervention) performed activities they already knew of and matched the participant's abilities and competence level:

"I have always, for many years, been riding my bike and we (his wife and sons) have been biking in Mallorca. When you are used to ride your bike, you are used to racing… I have

started to ride my mountain bike at home (after the intervention) - yesterday i went biking for 15 kilometers." (Per).

A few non-maintainers mentioned that not being able to perform on the same level as others made them feel incompetent:

> *"I don't walk with anybody, my pace is not that fast… I feel inferior if they (people she walks with) have to stop and wait all the time. That makes me feel uncomfortable."* (Louise)

However, the majority of non-maintainers did not express a lack of competence as a reason for not being physically active.

Themes related to the inductive analysis

Through the inductive analysis several themes occurred from the interviews; *being motivated*, *taking ownership, changes to the health intervention, physical activity habits and barriers*.

Being motivated

During the health intervention all participants mentioned being motivated. All participants referred to extrinsic motivators for being physical active. For instance, the majority of the participants mentioned that physical activity was important for managing T2DM:

> *"... it is because I have diabetes and therefore have to try to lose weight. That is what motivates me" (Anne).*

Moreover, most participants mentioned measuring their blood glucose levels after performing physical activity as motivating or by losing weight as this showed them, that performing physical activity had an effect on their disease:

> *"We have been doing blood glucose measurements… that's very motivating, when you have problems with your blood glucose rising."* (Klaus).

A few participants mentioned physical activity as a motivating factor for managing everyday life:

"I simply have to. The right side of my husband's body is paralyzed due to a stroke, so I have to keep myself active and be the one who helps… It's just myself, I just have to motivate myself to do it (be physical active)." (Maren).

Three months after the intervention the participants that were still physical active (maintainers) mainly mentioned external motivators for being physically activity:

"...I see a lot of people that need dialysis and stuff like that, I definitely do not want that." (Poul).

A few maintainers also mentioned weight loss as a motivating factor for being physically active.

Only a few maintainers mentioned being intrinsically motivated, through feeling a sense of enjoyment with the activity they were performing:

"... it is the nature. I really want to be outside… you can easily get addicted, especially when I am biking, even though it is the same route I take every day" (Julie).

Most non-maintainers did not share any thoughts on motivation to physical activity however a few of the non-maintainers mentioned losing weight as a motivating factor if they were to initiate physical activity:

"...something that has a goal and where I can see, that I am losing weight." (Susanne).

Physical activity habits

During the intervention, participants attended two weekly training sessions, consisting of strength training and aerobic exercises performed within a fitness facility. However, it became apparent that most participants among maintainers performed the same activity after the health intervention as they already performed before the intervention. Walks and bike rides were the most frequent forms of activity mentioned among the participants:

"There is not much that have changed. I have been walking for many years". (Poul).

Only a few participants mentioned that they had initiated activities that were performed during the intervention.

"... I have tried to perform the exact same exercises that I learned at the health intervention." (Anne).

Taking ownership

Most maintainers mentioned feeling a sense of ownership, meaning that they felt responsible for managing their own disease. For instance, one participant expressed;

> *"My aunt lost both of her legs (because of T2DM), which is something I think about, so I have to do something about it (be physical active)."* (Maren).

The maintainers frequently mentioned this, as they expressed the severity of the disease as a reason for taking responsibility and doing something about the disease.

On the contrary most of the non-maintainers did not take ownership;

> *"Well, I have always postponed it (being physical active). Well first it's Christmas and suddenly it's after Christmas and then it's cold - there is a thousand excuses."* (Lasse).

External excuses, like the weather or family issues, were often the main reasons when non-maintainers explained why they were not physically active, which indicates not taking ownership.

Changes to the health intervention

Most of the maintainers and non-maintainers highlighted similar changes, which they felt could improve the health interventions, in addition to stay physically active after the intervention. Most frequently mentioned changes were; duration of the intervention, follow up consultations and being physical active with peers after the intervention. In addition to duration one of the participants mentioned;

> *"It would have been nice if it (the health intervention) lasted longer, so that it became a routine"* (Line).

Most maintainers and non-maintainers highlighted a longer lasting intervention, so they had more time to establish a routine of being physically active. As part of being physical active with a peer, participants suggested to improve the transition out of the intervention;

> *"... If there was some kind of team that you could join after the intervention, then you would have someone to be physical active with or if there was someone from the previous health intervention, then we could join them"*. (Lasse).

Participants requested, that the health professionals established contact with previous or present patients, so the participants would have someone to be physically active with after the intervention.
Lastly participants requested follow up consultations to make sure they still were physical active;

> *"It would be nice if they did (health professionals), like you (the interviewer) are doing now, asked about how you are doing and made sure that you are still physical active"* (Anne).

A few participants did not mention any changes regarding the health intervention but stated, that they were satisfied with the content of the intervention.

Barriers

Three-months after the intervention non-maintainers mentioned, injuries or health issues as barriers for not being physical active;

> *"Well, I am being held back by my hip injury, as it causes pain".* (Klaus).

Some participants also mentioned health issues among significant others as a reason for not being physically active;

> *"I have been absent at the gymnastic classes due to my grandson's disease… However, I should however be able to be physical active, but I am not" (Louise).*

Even though this participant is capable of being physical active she decides not to because her grandson is ill.

Some maintainers also mentioned injuries or health issues as a barrier, but in contrary to the non-maintainers they still found ways to be physical active;

> *"The reason why I stopped doing it (being physically active) is because I have got artialfibiliations that made me feel like I could not do it. However, it has been necessary for me to reevaluate my situation and do it (be physical active) on a level where I can do it even when my heart is out of rhythm."* (Per).

Discussion

This study investigated the challenge reported by municipalities, that patients with T2DM struggle to maintain a physical active lifestyle after completing a health intervention organized by local municipalities. The results from this study found, that the participants were less physically active three-months after the intervention compared to immediately after. This is in line with the statements from the municipalities and previous studies that have shown, that T2DM patients struggle to maintain a physically active lifestyle after the completion of a health intervention (12). This study also found that the three basic psychological needs (autonomy, relatedness and competence) were important factors for maintaining a physically active lifestyle three-months after completing the health intervention. Furthermore, being motivated to participate in physical activity and taking ownership of one's disease, were also important factors for being physically active three-months after the intervention.

Basic psychological needs

In the present study the three BPN were fulfilled three-months after the intervention among all participants that were classified as maintainers while not all elements of BPN were satisfied among the participants classified as non-maintainers. This is in accordance with past research that have found all three needs to be core elements in maintaining lifestyle changes and more importantly maintenance of physical activity behavior (24,31,32).

A novel finding of this study is the role of relatedness as a reason for not being physically active three-months after the intervention. During and three-months after the intervention the majority of the participants emphasized the value of being physically active with peers. Three-months after the intervention, all non-maintainers found it difficult initiating in physical activity when they did not have someone to engage in activities with, while most maintainers found it easier to participate in physical activity, when they had someone to be active with and someone who held them accountable for being physical active. Most maintainers were primarily physically active with their spouse, which previously has been associated with higher physical activity levels among this age group (37). Furthermore, the theme "changes to the health intervention" showed that both maintainers and non-maintainers suggested to establish contacts with previous or present patients, so they had a peer to be physically active

with. This suggests that being physically active with peers is important for T2DM patients in maintaining a physical active lifestyle. This is also in line with previous literature where participants highlighted the important role of having friends, family members and/or peers engaging in physical activity with them (38–40). Moreover, acknowledging participants health choices and receiving encouragement for participating in the health intervention from family and friends, was also mentioned as having a positive effect on participants motivation for engaging in the intervention. This is also supported in previous literature where family members, through encouragement and positive reinforcement, acknowledged the participants choice of taking care of their health and thus important during the adoption phase of physical activity (16).

In the present study no difference in autonomy between maintainers and non-maintainers were found, three months after the intervention. Maintainers expressed autonomy through choosing to perform the preferred activity, while non-maintainers felt free to choose whatever activity they considered participating in. It seems that the need for autonomy was fulfilled among all participants, which is also supported by the fact, that non-maintainers did not mention autonomy-related barriers for being physically active. Autonomy was not directly identified as a reason for maintainers being physically active, however a few maintainers mentioned the activity they chose to perform as enjoyable and provided them with a sense of well-being which, according to SDT is referred to as being autonomously motivated (33). Hence autonomy may have had an indirectly effect on these participants being physically active. This indirect link between physical activity and autonomy was also found in a study where autonomy was not associated with physical activity but was associated with autonomous motivation that led to physical activity participation (41). Furthermore, the vast majority of literature also supports the importance of autonomy fulfillment on physical activity maintenance (16,42).

The need for competence was fulfilled both during and three-months after the intervention among the majority of the participants. This is in accordance with past research that emphasize the importance of feeling competent in addition to physical activity maintenance (43,44). Three-months after the intervention, maintainers spoke of feeling competent in the activity that they were performing which is not surprising given the fact that the activity was well known (walking and biking). According to SDT competence refers to feeling a sense of confi-

dence and capability in a specific behavior (33). Hence it can be argued that the maintainers chose to engage in well-known activities, as they felt more confident in this activity than the activities performed during the intervention. However, all participants did express fulfillment of the need for competence during the intervention, but this may be attributable to the positive role of the healthcare professional's supervision during each exercise training sequence. The participants specifically mentioned the healthcare professionals as being very helpful, which made them feel confident. Studies show that T2DM patients feels competent when the healthcare professionals are being supportive by providing knowledge, instructing and helping the participants through the different exercises (45,46).

Most non-maintainers expressed feeling competent if they were to perform their preferred activity, indicating that a lack of competence was not a barrier for them to engage in this specific activity. However, a few of the non-maintainers mentioned feeling a lack of competence, as they could not participate in certain activities at the same level as others which led to non-participation. Not feeling sufficiently skilled in certain activities has previously been found among T2DM patients to be unmotivating, which led to patients being less likely to participate in physical activity (43).

These results have important practical implications, as the results of this study show that fulfillment of the BPN are associated with physical activity maintenance. More importantly having family, friends and/or peers to be physically active with were essential to improve physical activity maintenance among the participants in this study. This may have even greater implications for this age group, as older adults tend to have a decreased social network (47). Therefore health-related interventions concerning T2DM should consider the significant influence of BPN and especially relatedness.

Inductive analysis

Specific to the inductive themes, participants mentioned being extrinsically and/or intrinsically motivated both during and three months after the intervention, which on a theoretical level is in line with the motivational continuum described in SDT (33). The majority of maintainers reported being extrinsically motivated as they mentioned weight loss and fear of developing complications as a reason for being physically active. Non-maintainers also mentioned the same factors to be motivating if they were to start being physically active. Howev-

er, the literature shows that people are more likely to show greater persistence and stability when being intrinsically motivated than extrinsically (44).

In this study a few maintainers reported being intrinsically motivated by experiencing enjoyment in the activity they were performing. This is in particular interesting as the activity they were performing, was an activity which they were doing even before the intervention. In addition, the theme "physical activity habits" also shows that the majority of maintainers, including the aforementioned maintainers, returned to primarily walking and biking, which they also did before the intervention. Only a few participants adopted activities, which were introduced to them during the intervention. Taking into consideration that the purpose of the health intervention is to make lifestyle changes, it is interesting that only a few of the participants continued performing activities introduced to them during the health intervention. This gives reason to believe, that practitioners could base the intervention on the patients' preferences, instead of providing a standardized program that takes place in a fitness facility. This indicates that practitioners could focus on physical activity modalities that appeals to the patient's interests and foster intrinsic motivation and thereby implementing a more individualized approach. An individualized approach, along with other initiatives, was implemented in a study where practitioners focused on including T2DM patients in designing an individualized program (13). Practitioners proposed several activities to identify those that were more appealing to the patients. Most of the patients succeeded in maintaining a physical active lifestyle two years after the intervention, and this individualized approach was highlighted by the authors as particularly important for the patients' maintenance. This study emphasizes the importance of focusing on patients' individual needs to effectively manage diabetes. This individualized approach might however lead to the participants choosing activities that are less effective in treating diabetes than other activities, although it can be argued that this alternative is better than not being physically active (48).

Through the inductive theme "taking ownership", most maintainers mentioned feeling responsible for managing their own disease, this was however not the case among non-maintainers. In addition, non-maintainers more often mentioned, injuries or health issues as barriers for not being physically active compared to maintainers, even though both groups were troubled with injuries and health issues. People who take ownership, also referred to as empowerment, often finds solutions for overcoming barriers, compared to people who does

not take ownership and this relationship is also supported by the literature (49). One way to achieve empowerment among T2DM patients could be to implement a more individualized approach, as mentioned before. Studies show that patients feel in control of and responsible for their daily self-management of diabetes, thus improving empowerment, when using a more individualized approach through helping patients make decisions about their own healthcare (50,51).

Limitations

The population in this study was 66 years old on average, which makes the findings of this study applicable for this age group, as the circumstances for younger populations may be different. Therefore, it is not certain that these recommendations are valid among other age groups with T2DM. Furthermore, the study only investigated participants in four municipalities in the region of northern Jutland and it is unclear, if investigating other municipalities in different regions would have resulted in different findings. Moreover, this study only investigated physical activity maintenance over a period of three-month. Lifestyle changes are difficult to maintain over extended periods of time (20,21) and therefore future studies should increase the time of the follow-up, to investigate if they report the same perceptions and perspectives.

Another limiting factor is, that all interviews were performed by telephone, as it might result in a loss of contextual and nonverbal data (52). Participants physical activity levels were self-reported, a more reliable and valid approach to measure physical activity, would have been to equip the patients with activity-trackers.

Conclusion

This study has shown that autonomy, competence and relatedness was key components in physical activity maintenance for older T2DM patients, while especially relatedness was found as particularly important. Furthermore, the results also indicate that a more individualized approach is needed to target T2DM patients' interests. With such an approach, patients may become more intrinsically motivated and this may in return strengthen empowerment. From a practical standpoint practitioners should consider implementing these findings, as it might improve the effects of future health interventions, so that T2DM patients maintain a

physically active lifestyle. Further research should investigate the effect of implementing these findings in future health interventions.

Practical implication

The findings of this study are specifically relevant for health professionals who construct health interventions for T2DM patients. The results indicate that BPN theory is a useful framework for physical activity maintenance among T2DM patients. Especially the need for relatedness should be taken into consideration, as maintainers and non-maintainers frequently highlighted this as important. In particular, the participants mentioned a better transition out of the intervention, so they could remain in contact with each other or establish new relations that may help them towards a physically active lifestyle. T2DM patients might benefit from taking part in Danish sports unions as these unions constitute a community, which may satisfy these patients need for relatedness. Therefore, the practitioners of the health interventions should collaborate with the management of the sports unions, to improve the transition out of the health intervention.

Furthermore, practitioners should consider implementing a more individualized approach to the health intervention, as the results indicate, that the participants prefer to engage in other activities than those introduced to them during the intervention. More emphasis should be put on exploring and targeting patients interests in different physical activity modalities to improve physical activity maintenance and motivation. One way to implement such an approach would be through personal counseling to explore the patient's interests and possibilities to continue being physically active (13). Further this might improve patients' empowerment, as they get more involved in treating their own disease (50,51).

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Worksheet

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The purpose of this worksheet is to provide the reader with insight into the choices of methods and theories that forms the basis of this study. This is essential for the reader as it provides transparency into why the different methods and theories have been used and for what purpose. The first section describes the scientific methodology in which this study's ontological- and epistemological beliefs, methodology and method is presented. Second, the mechanisms behind T2DM are described followed by a short description of the health interventions in the region of Nordjylland. Lastly the theoretical foundation of this study is presented.

Scientific methodology

Scientific methodology is a philosophical discipline, which addresses science and knowledge acquisition on a meta level. Within the field of scientific methodology, there exists a number of paradigms that is the practices, that define a scientific discipline. These practices include the researcher's perspective on ontology, epistemology, methodology and method and constitutes the framework from which the research is viewed. This study uses the constructivist paradigm that describes reality as an ambiguous plurality, which is continuously constructed through reflective, social and linguistic constructions. In the following section the four concepts; ontology, epistemology, methodology and method, will be described and further specified in relation to this study (1).

Ontology and epistemology

The following section describes ontology and epistemology. Ontology refers to what constitutes reality and how we can understand existence, while epistemology refers to what constitute knowledge and how we can obtain it (2).

Ontology is the philosophical study of the nature of reality and distinguishes between two branches; materialism and idealism. In materialism, also referred to as realism, the world exists despite of human interference and insists therefore to explain the world from the world itself. On the other hand, idealism also referred to as relativism, represents the belief that reality is constructed in the mind and consciousness of the observer. Idealism is further divided into two subgroups; subjective and objective idealism. Subjective idealism encompasses the notion that reality exclusively exists through an individual's perceiving mind, thus material things are merely just perceptions. The objective idealism is based on the premise that there exists an objective consciousness, which is independent of people's consciousness (3).

This study uses a subjective idealistic ontology, which is in line with the constructivist paradigm. The researchers acknowledge that there are different ways to construct meaning and that reality is constructed in the mind of the participants.

Epistemology is however, the philosophical study of knowledge and how to acquire knowledge. Knowledge can be approached through objectivism, subjectivism and constructivism (2). In objectivism the subject is separated from the world and knowledge comes from the object itself. The subject is only involved in the process of knowledge in the extent of its senses.
In subjectivism knowledge comes from the subject itself. This means, that reality is a product of the subject's consciousness and that all that is seen as knowledge is what is acknowledged by the human mind. In constructivism knowledge comes from both the subject and the object, meaning that knowledge is a dynamic and interactive relation (2).
In this study subjective epistemology is used, as this study investigates the patient's subjective experience of the health intervention and their reasons to stay physically active three months after the intervention.

Methodology

Methodology is described as how we discover knowledge in a systematic way and is unlike epistemology more specific and practice based. The appropriate methodology is driven by the ontological and epistemological beliefs. Hermeneutics is the theory and methodology of interpretation. The main question raised in hermeneutics is; what is understanding and how is understanding achieved (4). Gadamer states that language is the universal medium in which understanding occurs and that understanding occurs in the interpretation. Pre-understanding is a term which Gadamer uses to describe an individual's prior understanding to a given field. According to Gadamer pre-understanding is an essential part of hermeneutics, as pre-understanding is a structure for being in the world that can never be put aside (4,5). Pre-understanding depends on a person's culture and background ex. - why people have different pre-understandings from which they construct meaning. Because pre-understanding is individual, it is important to articulate one's pre-understanding. Gadamer also mentions horizons as an important part of hermeneutics (4). A horizon consists of an individual's opinions and understandings and is the place from which everything is interpreted. A horizon is either wide

or narrow, meaning that an individual with a narrow horizon is more likely to see what is right in front of him/her, whereas a wide horizon means being able to see beyond what is close at hand (5). According to Gadamer it is possible to achieve a new horizon or expand one's horizon, in the encounter with different horizons. This happens when individuals, with different pre-understandings, meet and define a new meaning or understanding about a case (5).

Lastly Gadamer describes the hermeneutic circle. The hermeneutic circle describes a circular relationship between an individual's understanding of the whole and the individual parts of that understanding, meaning that the individual parts is only understood in relation to the whole and the whole is only understood in relation to the individual parts. When individual parts of the understanding change the whole understanding, a fusion between understandings occur. A fusion does not mean that two individuals have the same understanding, but that two individuals try to understand each other's understandings (4,5).

When used in scientific studies the researcher integrates his/hers pre-understanding in the research process eg. by using theory. The theory can either be used as a starting point for the research or integrated at any time in the process. In the current study the hermeneutic methodology was used, to generate the questions of the questionnaire and interviews, as they were based on the researchers understanding of the important factors for physical activity maintenance in T2DM patients. Furthermore, this methodological approach is used in the analysis of the data, as it involves the process of the hermeneutic circle. The researchers are trying to understand the individual parts, to get an understanding of the whole. This is done by trying to understand the different experiences and understandings the participants have about being physically active (parts) to understand why the participants are not being physically active after completing the health intervention (whole).

Method

Method refers to the specific approaches that are used in the data collection and analysis of the data. To determine the legitimacy of the methods used in a study, it has to be in accordance with the ontological, epistemological and methodological directions and the paradigm itself. In the constructivist paradigm, where social connections and reflection, are basic condi-

tions for the construction of meaning and knowledge, the method must reflect these conditions and therefore be of qualitative nature.

In the present study qualitative interviews were used as the main method to collect data from the participants of this study (6). This method was used to explore and understand why these individuals struggle with maintaining a physically active lifestyle. According to Brinkman and Tanggard (2015) the qualitative method is especially advantageous in investigating subjective perceptions like personal experiences, emotions, cultures and/or social relations. However the researchers have to ensure that the information is understood and interpreted correctly, without overinterpreting the results (7).
The questions from the interviews were based on the constructs of BPN, as this theory has been widely used and found effective in addition to physical activity maintenance and more importantly among T2DM patients. Moreover, the questions from the interviews were based on findings from previous literature, which occurred through the initial process of gaining knowledge on the area. The interviews were semi-structured to enable participants to elaborate on the different topics without them including irrelevant information, which would have been the case if the interviews were unstructured (6).
Quantitative questionnaires were however also used as a method, which is not in accordance with the constructivist paradigm, but is based on the paradigmatic representation of realism. This paradigm is more objective, as it states that reality exists in one form and distance itself from socio-cultural dispositions and individual cognitive processes. This was chosen, to separate maintainers from non-maintainers in order to identify the characteristics between both groups.

Through the data analysis an inductive and deductive approach was used. The deductive approach involved an analysis of the data, on the basis of BPN while the inductive approach involved the process of exploring the data for other connections. The two approaches were used in this study as the researchers wanted to explore the influence of BPN, on why the participants struggle at maintaining a physically active lifestyle. However, the researchers acknowledge that BPN may just be a part of the explanation, due to the psychosocial complexity of this topic, and therefore an inductive approach is further used. The connections that appeared through the inductive approach was however already existing topics from prior re-

search and theories, thus it can be argued that this process became deductive. This also shows the important role of the researchers through the analysis, as this process is highly influenced by the researchers pre-understanding on the topic.

Systematic text condensation was used as a method in this study, to systematize and synthesize the data through interpretation (8). The interpretative approach is closely related to the hermeneutic methodology, thus the hermeneutic circle was used as a method to gain meaning and knowledge. More specifically the researchers tried to understand the patient's perception (individual parts) of the issue from which a more general understanding (the whole) was acquired.

Theory

First, the mechanisms behind T2DM and the effects of physical activity on T2DM will be outlined. Second the health interventions that are provided by the municipalities in Denmark will be presented followed by a section regarding SDT.

Type 2 diabetes

In the following section an introduction to T2DM will be provided, as it is important to know the underlying mechanisms behind the diseases, to understand why people get T2DM and how it can be treated. Furthermore, physical activity as a treatment to T2DM will be described, with the purpose of providing a deeper understanding of the mechanisms behind this. Furthermore, recommendations on how to be physically active when you have T2DM is provided.

Type 2 diabetes is characterized as a metabolic disease and is caused by insulin resistance in adipose- and muscle tissue and decreased insulin secretion from the pancreas. The role of insulin is to remove glucose from the bloodstream to either store it as fat through lipogenesis or for the use of stimulating either glycolysis or gluconeogenesis in muscle tissue. As the insulin receptors of the cells become resistant towards insulin, the blood glucose level will rise above normal (HbA1c > 5,7%). This state of high blood glucose stimulates the beta cells, that are located within the pancreas, to produce insulin even though the insulin receptors don’t work as effectively and for this reason, do not uptake the amounts of glucose needed to create

normal blood glucose levels. The pancreas therefore continues to secrete insulin until the beta cells gets overused and damaged, which prohibit sufficient amounts of insulin secretion (9).

A healthy insulin receptor works in the way that whenever insulin binds to the insulin receptor the receptor will auto phosphorylate. This phosphorylation causes the activation of insulin receptor substrate (IRS). As the IRS gets active the enzyme; phosphoinositide 3-kinase (PI3K), will bind to it. PI3K then phosphorylates Phosphatidylinositol 4,5-bisphosphate (PIP2) into Phosphatidylinositol 3,4,5-trisphosphate (PIP3). This causes the amount of PIP3 to increase which recruits Phosphoinositide-dependent kinase-1 (PDK1) and protein kinase B (AKT/PKB) to the membrane of the cell. Within the cells there are vesicles containing glucose transporter 4 (GLUT4) which are responsible for getting glucose into the cell, however this is not possible before the protein AKT substrate (AS160) gets phosphorylated. This happens when AKT gets activated by PDK1 through phosphorylation. The vesicles then travel towards the membrane to secrete GLUT4 which allows glucose from the bloodstream to travel through the membrane of the cell (GLUT4 translocation) (figure 1).

In a pathological condition, as in T2DM, the influx of glucose into muscle fibers are impaired (insulin resistance) due to uncertain reasons (10). Several studies hypothesize that insulin resistance occurs due to circulating free fatty acids that are obtained by muscle fibers (11–13). It has been reported that high amounts of fatty acids within the muscle fibers prevents the cascade of cellular processes that leads to glucose uptake. This is consistent with research that have found a reduction in the content of GLUT4 in muscle fibers in T2DM patients. The increased amounts of fatty acids inside the muscle fibers are caused by low oxidation of free fatty acids due to impairment of mitochondrial function. Reduced mitochondrial function is often seen in inactive and obese individuals (9).

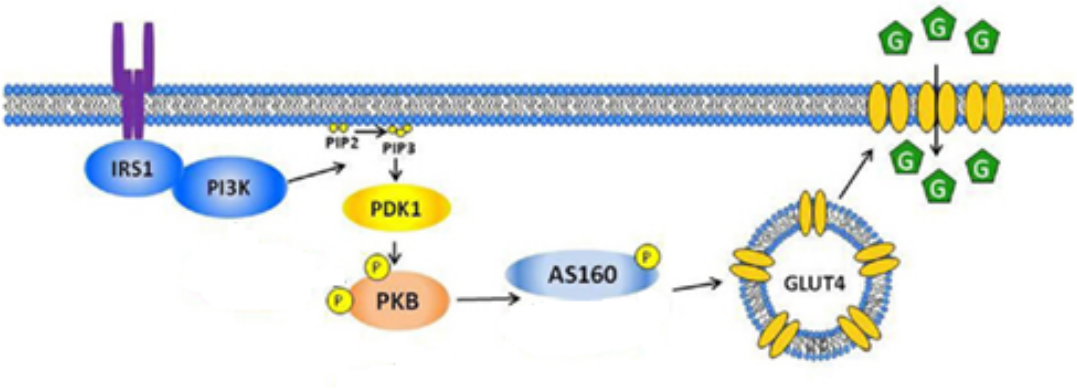

Figure 1 - Insulin binds to the insulin receptor after which insulin receptor substrate 1 (IRS1) autophosphorylate. Phosphoinositide 3-kinase (PI3K) binds to IRS1. As PI3K gets active phosphatidylinositol 4,5-biphosphate (PIP2) and increases the amount of phosphatidylinositol 3,4,5-triphosphate (PIP3). This recruits Phosphoinositide-dependent kinase 1 (PDK1) and protein kinase B (AKT/PKB) to the membrane. This causes AKT substrate (AS160) to phosphorylate which enables glucose transporter 4 (GLUT4) to travel to the membrane. This allow glucose to travel inside the cell. (13)

Type 2 diabetes complications

Hyperglycemia can result in damages to the micro and macrovascular vessels and can in term lead to more serious complications like retinopathy, neuropathy, nephropathy and cardiovascular diseases. The cause of these complications is due to damages to the micro and macrovascular vessels. The increase in glucose levels causes a variety of reactions within the smooth muscle cells of the vessels. The accumulated glucose in the bloodstream causes the endothelium of the blood vessels to uptake glucose. Glucose stimulates the production of reactive oxygen species (ROS) which leads to the activation of protein kinase C (PKC). This protein enhances growth factors and the production of the proinflammatory substance, nuclear factor kappaB (NF-kB) which promotes inflammatory responses. NF-kB increases the vascular permeability and creates receptors that are sensitive towards inflammatory monocytes. These monocytes travel through the membrane along with low density lipids (LDL). The monocytes are converted to macrophages that absorbs the LDL. These cells are called foam cells. The foam cells release the LDL within the layer of Tunica intima which causes a blockage. A proliferation of smooth muscle cells, due to the growth factors appearing because of the activation of PKC, also contributes to the blockage (Atherosclerosis) (figure 2). (14,15)

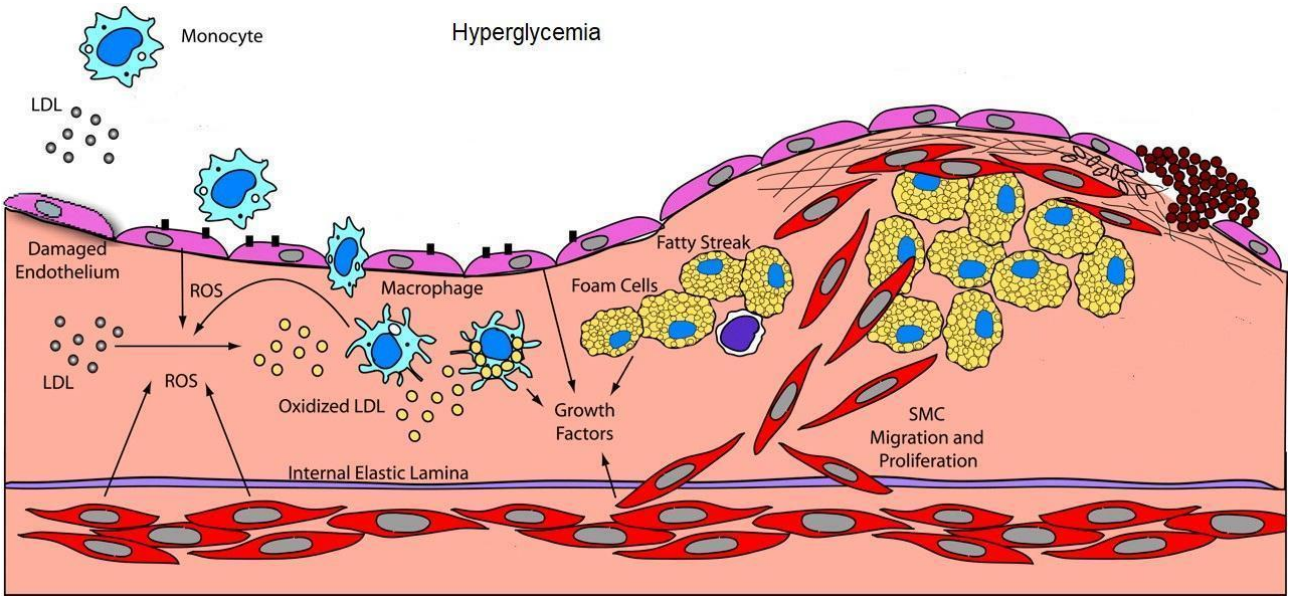

Figure 2 - Development of atheroslerosis. Monocytes and Low density lipids (LDL) enters the tunica intima and monocytes turn into marophages that absorbs the LDL. These macrophages are refered to as foam cells which relase the LDL within tunica intima and causes a blockage along with proliferation. (16)

Type 2 diabetes and physical activity

Researchers have acknowledged the effects of exercise in affecting glucose uptake through adaptations in skeletal muscle (17–20). Skeletal muscle is an important factor, as it is responsible for the majority of glucose uptake during the postprandial state (after the consumption of a meal). The mechanisms behind the effects of physical activity are not yet fully understood and does also differ according to the effects of a single bout of physical activity and regular physical activity. Studies have found that the effects of acute physical activity are caused by insulin independent mechanisms as physical activity has no effect on phosphorylation of IRS (19–21). However, studies have found a correlation between increased levels of the AMP-activated protein kinase (AMPK) and increased glucose uptake (19,20). AMPK has been found to phosphorylate AS160 which activates GLUT4 translocation. It is however not certain whether this correlation is the cause for increased glucose uptake. Medication like metformin has the same effect as acute physical activity, as it increases AMPK within muscle fibers (20).
Maintained physical activity on the other hand has important therapeutic implications for T2DM patients and has shown beneficial in improving insulin sensitivity through molecular adaptations within muscle tissue. Studies suggests that improved mitochondrial function and increased GLUT4 expression caused by physical activity are possible effects of increased insulin sensitivity (22–24). As mentioned before obese and inactive individuals often have im-

paired mitochondrial function that in turn can lead to T2DM. It is hypothesized that the increased mitochondrial function accompanied by physical activity is a reliable explanation for an increased insulin sensitivity as studies have found a relationship between improved mitochondrial function and increased amounts of GLUT4 within muscle fibers (22–24). However, some studies have not found this relationship (25). Despite uncertainties in addition to the underlying mechanisms, physical activity has proven effective in treating T2DM and it is therefore crucial that T2DM patients implement physical activity into their daily lives (26).

Recommendations

The vast majority of literature recommends patients with T2DM to perform both aerobic physical activity and strength training. Studies have found that regular aerobic physical activity improves glycemic control in T2DM patients (27–30). Strength training has also proven effective in improving glycemic control and the increase in muscle fiber size is thought to contribute to this effect (31–34). Recommendations for T2DM patients does however vary slightly according to duration, frequency, and intensity, as the effect of physical activity depends on the interplay between these three factors.

The literature shows that T2DM patients should perform a combination of aerobic and strength training (35–37). Regarding aerobic training research have shown that 150 minutes of moderate to high intensity aerobic training at least three times a week is effective in improving glycemic control in T2DM patients (26,38–40). Training must be performed with no more than two consecutive days between bouts due to the physical activity-induced improvements in insulin action (41,42). In addition to strength training patients are recommended to perform weight-bearing exercises two times a week, that include a minimum of 5-10 exercises with 10-15 repetitions involving the major muscle groups (43,44). These guidelines are in general consistent with the recommendations stated by the Danish health board. However, the Danish health board suggests that T2DM patients should be physically active seven days a week for at least 30 minutes instead of three days a week, to reduce the risk of hyperglycemia on days where you are not physically active (45).

Health intervention

In the following section the organisation and content of four Danish health interventions is described, so the reader can get an insight into how the health intervention is organised and what the courses contains.

This study was carried out in cooperation with two health consultants who are in charge of rehabilitation for chronic condition groups in the region of northern Jutland. Furthermore, four municipalities in the region of northern Jutland participated in the study by offering insight into the regime of the rehabilitation as well as helping to recruit T2DM patients to participate in the questionnaires and interviews. The following section will describe how the health interventions given by the municipalities are structured.

Every municipality in Denmark are instructed by the Danish health board to offer a health intervention to chronic patients, including patients with T2DM (46). The health interventions are controlled by physiotherapists, nurses, ergo therapists and dieticians and lasts approximately 12 weeks. The interventions contain educational lectures including knowledge about the disease and treatment strategies, advice about dealing with the disease and nutritional counselling. Furthermore, the patients are offered two days of physical training a week during the 12-week intervention, where the main focus is cardio and strength training. Among the municipalities there are slight differences in the way the interventions are carried out, as there are no strict requirements for how to execute the training and educational lectures. It is therefore the municipalities responsibility to design the intervention in the way that suits the patient's best, in that specific municipality (46).

Self-determination theory

In the following section SDT will be described. SDT is described because it is used in the study to analyse the results from the interview.

SDT is an empirically derived theory about human motivation in a social context which distinguishes between being autonomous and controlled and is developed by two American Psychologist? Edward L. Deci and Richard M. Ryan. Social psychology is an important aspect in

terms of how people act in social environments regarding attitudes, values and motives (47). Specifically SDT, rely on the assumption that humans are evolved to be inherently active, intrinsically motivated and oriented toward developing naturally through integrative processes and need to work effectively to assure healthy development and well-being (48). The theory describes motivation as a continuum from amotivation to intrinsic motivation. Intrinsic motivation is the desire to engage in an activity due to the pleasure it brings and have been associated with behavior maintenance (48).

The theory is particularly focused on the processes in which a person acquires the motivation for adopting health-related behaviors and maintaining them over time. Hence, the theory has previously been used, and found effective, in a variety of different health-related treatment settings like for instance; tobacco cessation, weight-loss, adherent use of medication, dietary regulation (48). According to SDT, Patients are more likely to maintain health behaviors when the behaviour is internalized, which is referred to as being autonomous, meaning that the behaviour corresponds to core values of the patient. When people are autonomously motivated in the context of physical activity, they engage in an activity due to reasons that are within oneself. They initiate physical activity because it brings enjoyment and satisfies valued goals to improve health and overall quality of life. SDT argues that there are three important psychological needs that are necessary to promote autonomous motivation of a health-related behavior; The need for autonomy, competence and relatedness. The three needs form the foundation of SDT and is referred to as the basic psychological needs (BPN). The need for autonomy reflects the need to feel volitional and choiceful in relation to one's actions. Competence is the need to feel capable and confident in achieving a desired outcome and is related to Bandura's term; self-efficacy. Finally, relatedness is the need to feel understood and accepted by meaningful others (49).

The three basic psychological needs have been extensively used in research regarding adoption and continuation of physical activity (50–52). Several studies have found a relationship between the fulfilment of these needs and people's participation and adherence in sports (50–52). A recent study by Springer et al. 2013 have investigated, through qualitative interviews, participation and maintenance to physical activity at a local fitness facility among a group of >25-year-old individuals (53). They found a clear relationship between the statements in the interviews and the BPN. The individuals emphasized the value of having family friends to

support them through encouragement and by initiating physical activity with them. Also, competence was mentioned, as a motivation to being physically active. The participants viewed challenge and competition towards physical goals like weight loss and strategies to manage health as a motivating factor. Lastly, the participants mentioned the importance of autonomy. Autonomy was not mentioned in the way, that the participants could freely choose what and when they wanted to be physically active as the structure of the health program already was determined on beforehand. However, autonomy was expressed through an internalized goal towards building and maintaining fitness status. This resulted in confidence to the program and the feeling of being self-directed (53). The researchers also identified that the participants created a physically active identity through satisfying these needs. This is in line with the process of internalization of physically active values (48).

SDT has also been used in accordance with T2DM, however most research is concerning medication adherence or adherence to all self-management behaviors (diet, physical activity and medication) (54–56). Though, some studies have found determinants for being physically active maintenance in T2DM patients; social support from significant others, the experience of self-efficacy and knowledge about the disease and treatment strategies. There is a clear similarity between these physical activity determinants and the three basic psychological needs (57). The term self-efficacy has previously been compared to the need for competence and there is a clear linkage between social support and the need for relatedness. Increased knowledge is not directly linked to the need for autonomy, however the patient is provided with information about the different possibilities in regard to treatment strategies which gives the patient the opportunity to choose which treatment strategy suits him/her.

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