

Role of Pedometer Based Walking in the Management of Type 2 Diabetes: A Review

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Abstract: *Diabetes has emerged as a major healthcare problem in India as well as in world. Rapid urbanization marked with increasing levels of obesity and sedentary lifestyles are major causes of DM. The awareness regarding physical inactivity and sedentarism in the aetiology of diabetes is lacking. Also, the focus on physical activity for control of diabetes and its complications is lacking in India. The aim of the present review was to determine the effectiveness of pedometer based walking programs among type 2 diabetes. We found that feedback devices like pedometer work as effective tool to increase activity awareness amongst users.*

Keywords: Type 2 Diabetes Mellitus, Physical activity, Pedometer, walking

1. Introduction

Diabetes is emerging as a major threat to developing as well as developed countries. According to International diabetes federation (IDF) 381.8 million people had diabetes in 2013 and this number is projected to increase up to 591.9 million by 2035 [1]. Roughly, 80% of people with diabetes are in developing countries of which India and China share the largest contribution [2],[3]. India leads the world with largest number of diabetes individuals earning the dubious distinction of being termed the “diabetes capital of the world” [4].

The magnitude of type 2 diabetes mellitus (T2DM) is increasing rapidly because of population ageing, unplanned urbanization and globalization of trade and marketing [5]. Urbanization, changing dietary patterns, changing nature of workplaces, emerging economic prosperity and fast urbanization in developing nations are all leading to a shift towards sedentary lifestyle patterns and eventually providing an invitation to T2DM [6],[1]. Several lifestyle factors including obesity, physical inactivity and a low fiber diet with high glycaemic index has been associated with an increased risk of diabetes [7]. Increasing per capita incomes of middle class Indians, improved and comfortable lifestyle, improving literacy rates and shift from a rural economy to an urban economy might be some of the key catalysts for unprecedented growth of diabetes in India.

Lifestyle modifications, specifically changes in diet, physical activity and exercise are considered the cornerstone of T2DM management [8]. The Finnish Diabetes Prevention Study (DPS) and the Diabetes Prevention Program (DPP) have also demonstrated that, modest weight loss achieved by lifestyle changes (diet and exercise) can significantly reduce the risk of developing T2DM in obese patients with impaired glucose tolerance (IGT) [9].

Walking appears to be the preferred activity among sedentary individuals taking up physical activity [10]. Walking is an appropriate and safe form of physical activity

which improves glucose utilization in inactive people diagnosed with T2DM [11]. Using a pedometer as a set step goal is of great interest, as this method of exercise prescription does not involve an intensity recommendation and relies solely on increasing overall daily walking [12]. The purpose of the present review was to determine the effectiveness of pedometer based walking programs among type 2 diabetes.

2. Role of physical activity in T2DM

A recent systematic review evaluated the effectiveness of physical activity in treatment and prevention of T2DM [13] and in this review authors documented large-scale, prospective studies that indicate relationship between higher levels of physical activity with lower incidence of T2DM. Both aerobic and resistance exercises have been shown to be associated with a decreased risk of T2DM [14]. Combined training thrice weekly in individuals with T2DM may be of greater benefits to blood glucose control. Misra et al (2012) [15] recommended 60 min of physical activity daily that includes 10–15 min of resistance exercise and work-related activity for Asian Indians.

Aerobic training has been promoted as the most effective mode of exercise for treating T2DM with improvements in lipid profiles and insulin sensitivity [8]. Older adults with T2DM are advised to undertake exercises that maintain or improve balance as a means of increasing joint range of motion and reducing risk of injury [16].

American College of Sports Medicine (ACSM) recommended that, persons with T2DM should undertake at least 150 min/week of moderate to vigorous aerobic exercise, spread out at least during 3 days a week with no more than 2 consecutive days between bouts of aerobic activity [16]. Sigal et.al (2004) [17] recommended at least 150 min/week of moderate intensity aerobic physical activity (40-60% of VO₂ max or 50-70% maximum heart rate) and/or at least 90 min/week of vigorous aerobic

exercise (>60% of VO₂max or >70% of maximum heart rate). Zanuso et al, 2009 [18] critically reviewed the literature to identify evidences on interrelationships between exercise and metabolic outcomes and concluded that effects of aerobic exercises are well established and interventions with more vigorous aerobic exercise programs resulted in greater reductions in HbA_{1c} and greater increase in insulin sensitivity.

The Diabetes Prevention Program [19] study shows that people with elevated blood glucose levels, who are at risk for developing T2DM, can reduce their risk by 58% through sustained modest intensity exercise such as walking 30 minutes daily. Walker et al (1999)[20] examined the impact of a 12 week walking program on body composition and risk factors for cardiovascular disease in women with T2DM and in normoglycaemic women with first degree diabetic relatives. After 12 weeks, they reported that regular walking program, which is self paced but of relatively long duration, will improve the fitness and lipid profile in postmenopausal women who have or are at risk of T2DM.

Evidences from the recent studies strengthen the importance of physical activity programs for the treatment and management of T2DM. Data from recent studies support the importance of aerobic exercise programs in the treatment and prevention of T2DM. From the above literature, it is clear that low to moderate intensity exercise, such as walking has been shown to have significant benefits in T2DM individuals. Several prospective studies have shown that physical activity does play an important role in the prevention and management of T2DM. For most patients, the exercise program should include both aerobic and resistance exercises. In the absence of contraindications, patients with diabetes should be encouraged to perform resistance exercise three times a week, including all major muscle groups. The role of exercise in preventing the progression from insulin resistance to impaired glucose tolerance has been brought out by several studies in the recent years. It is evident that regular physical exercise can prevent and manage the glucose control in T2DM. Thus resistance and aerobic exercises have a useful role in the control of diabetes and prevention of its long term complications.

3. Role of Pedometers in Measuring Physical Activity

Many studies have been conducted that have used pedometers as a measurement tool of physical activity through walking. Pedometers, which measure walking activity in the form of daily step counts, also serve as a motivator and have become popular components of physical activity interventions [21]. Kim et al, 2010 [22] did a pilot study to determine the accuracy, reliability and validity of pedometer use by older adults living independently and suggested that pedometers can provide a reliable and valid measure of physical activity. Feedback from pedometer step counts has been observed to trigger behavioural changes, as they raise awareness of current walking behaviour and can be used to motivate and self monitor [23] and pedometers are used to motivate, encourage and provide immediate feedback of activity for people with T2DM. Pedometers overcome the challenges faced by daily practice educators to

motivate and encourage clients to become more physically active [24].

Diedrich et al, 2010 [25] did a pragmatic randomised control trial study on 53 T2DM patients to investigate the effect of self management program with or without pedometer. They found that levels of HbA_{1c} and weight were significantly reduced in both the groups among 33 participants but diastolic blood pressure was decreased only in pedometer group. Diedrich and colleagues concluded that pedometers are a helpful motivational tool for T2DM to make their lifestyle more active.

In 2001, Tudor- Locke and colleagues [26] did a cross-sectional study and presented first normative data on pedometer-determined ambulatory activity in individuals with T2DM. They found distinct and consistent inverse relationship between steps/day and body mass index. Later in 2004, Tudor- Locke and colleagues [27] proposed the preliminary indices to classify pedometer-determined physical activity in healthy adults: (i) <5000 steps/day may be used as a 'sedentary lifestyle index' ; (ii) 5000-7499 steps/day includes daily activities excluding volitional sports/exercise and considered as 'low active' (iii) 7500-9999 likely includes some volitional activities and considered as 'somewhat active' and (iv) ≥ 10000 steps/day indicates the point that should be used to classify individuals as 'active'. Individuals who take > 12 500 steps/day are likely to be classified as 'highly active'. Richardson et al, 2008 [28] carried out a meta-analysis of pedometer based walking interventions and weight loss. In this meta-analysis, they searched 6 electronic databases and contacted pedometer experts to identify pedometer based walking studies without a dietary intervention that reported weight change as an outcome. They cited that on an average, participants lost 0.05 kg per week during the interventions and documented results from 9 cohort studies showed consistent outcome with previous findings that increasing moderate-intensity physical activity tends to result in a modest amount of weight loss but longer programs lead to more weight loss than shorter programs.

Johnson et.al, (2005) [29] conducted cohort study to investigate the use of pedometers and stopwatches to increase the intensity of physical activity. 11 individuals with T2DM were recruited and 8 participants completed 12 week pedometer based intervention and showed significant improvements in cardio respiratory fitness and they found that pedometers and stopwatches, when introduced within educational framework designed can serve to facilitate increased walking intensity for people with T2DM.

Arazia et al, 2006 [30] studied whether a recommendation to walk 10,000 steps per day would result in significant improvement in glycaemic control, insulin sensitivity and cardiovascular risk in patients with T2DM. Results at 6 weeks showed a significant improvement in physical activity among the pedometer group vs. control group and they concluded that pedometer may prove to be an effective tool for promoting health lifestyle changes. A randomised controlled study on 29 T2DM men, Bjorgaas et al, 2005 investigated the relationship between pedometer registered activity, aerobic capacity and self reported activity with fitness before and after a 12 week exercise [31]. Subjects were divided into exercise and control groups. Results

showed positive correlation between pedometers registered activity and aerobic capacity. Researchers have reported that pedometer based walking programs have increased walking by an average of 3,000 steps per day [32] as well as showing improvements in parameters of glycaemic control [30]. Previous researches have demonstrated efficacy in increasing physical activity of participants using First Step Program (FSP), a pedometer based self paced walking program designed to help people with T2DM, which increase their steps per day [25]. Tudor Locke et.al (2001) [26] showed that approximately >9000 steps/day was associated with body composition benefits and suggested that approximately <5000 steps/day was indicative of an index of sedentarism related to unhealthy body composition, though they recommended caution when applying their cut off points. It is estimated that 3000-4000 steps are equivalent to 30 minutes of moderate intensity walking [27].

Studies have shown the effectiveness of both physical activity protocols, like 30-40 minutes of moderate intensity walking [27] as well as the effectiveness of achieving 10,000 steps/day in T2DM [24]. Depending on personal preferences, circumstances and inclination, some people may find it easier to become more physically active in their activities of daily living, which translates to a greater step count and other might prefer dedicating 30-40 minutes of time for brisk walking. Both approaches may eventually translate into better health outcomes and quality of life of the individuals with T2DM. Addition of a pedometer to provide the feedback might modify and improve the adherence to both approaches.

4. Conclusion

Any increase in physical activity is to be encouraged and positively reinforced in T2DM. Sustained increase in physical activity through walking with pedometer has also been shown to improve glucose control, metabolic control and cardiovascular fitness independently. Physical activity must also be targeted according to the need of individuals with appropriate guidance and support.

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