

Treatment Interventions of Type 2 Diabetes: A Systematic Review

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Abstract

Objective: This study looks to review different methods of lifestyle changing interventions, examine and compare them to determine usefulness, efficiency, and outcome in regard to future ventures to help control the rise of this type 2 diabetes. **Methods:** Three systematic reviews were found and compared based on efficacy and key differences in their approach to the ever-growing problem of type 2 diabetes. Outcomes and intervention styles of the studies were noted and critiqued based on their statistical significance. **Conclusion:** The first study revealed that multiple behavior change techniques (BCTs) correlate with a reduction in weight and HbA1c, especially when they work synergistically alongside one another. The second study spoke of how community intervention had an inclusive quality about it, which allowed for population variability to not affect implementation. It also showed that small incremental changes were best when trying to establish a change long-term across a large population. Finally, the third study revealed that, as the participant got closer to maintaining a good physical activity regiment, their self-efficacy also increased. The attributes of these studies give evidence that interventions that use multiple approaches are most effective when looking to improve physical activity and diet in Type 2 diabetics.

Keywords

Type 2 Diabetes, Behavior Change Technique, HbA1c

1. Introduction

In July 2017, the CDC estimates that over 100 million Americans suffer from either diabetes or prediabetes [1]. Diabetes is a physiological disorder that arises when cells inadequately take in glucose that is free flowing in our blood stream.

The effects of having too much glucose in the blood disrupt the viscosity of the fluid and lead to symptoms that include, but are not limited to poor wound healing, poor circulation, weight gain, blurred vision, dementia, frequent urination, and fatigue. Type 2 diabetes is the type that an individual develops over time rather than Type 1, which is diagnosed as prepubescent. Type 2 diabetes and prediabetes are contracted when the body becomes resistant to the insulin produced in the pancreas. This is usually the case when an individual has had a high carbohydrate diet for a number of years and the excess insulin production slowly makes the cells less sensitive to the physiological response. Sugars need insulin to enter the cell and when the cell has a low sensitivity to insulin, less sugar goes in and more stays outside in the bloodstream. Diabetes is a serious disease that can often be managed through physical activity, diet, and the appropriate use of insulin and other medications to control blood sugar levels. People with diabetes are at an increased risk of serious health complications including premature death, vision loss, heart disease, stroke, kidney failure, and amputation of toes, feet, or legs [1]. With the steady growth rate and the large effect this disease has on the population, the need for prevention and management is ever-growing.

There are many factors that increase your risk for prediabetes. Genetics can play a role, especially if there is a family history of diabetes; however, lifestyle factors play a larger role in the development of the disease. Excess body fat and a sedentary lifestyle are other potential risk factors [2]. Diet consists of the types of food an individual consumes throughout his or her day. Although the American diet consists of a heavy proportion of carbohydrates, the minimization of carbohydrates and sugar filled food and beverages have been linked to success when fighting this chronic disease. Examples of diet plans can be found in various places on the internet and all lean towards carbohydrate reduction as well as “good” fats and protein increases, portion control, reduction of sugary beverages, and minimal alcohol consumption. This allows the body to produce less insulin and reduces the amount of sugar circulating through the bloodstream.

Implementation of physical activity can also be helpful when fighting diabetes because the additional muscle usage consumes more glucose from the bloodstream for fuel and allows insulin to work more efficiently with cells in the rest of the body. An overall healthy lifestyle where balance, physical activity, and appropriate diet are present is agreed upon by most to be very effective when dealing not only with diabetes but many other chronic diseases. The American Diabetes Association (Association) released new research on March 22, 2018, estimating the total costs of diagnosed diabetes have risen to \$327 billion in 2017 from \$245 billion in 2012 when the cost was last examined [3]. With the growing cost of diabetes in the U.S, it is imperative that lifestyle changing programs be implemented in at-risk areas to not only aid in the health of the individuals, but also aid in the economic burden of the disease in our country. In this review, different methods of lifestyle changing intervention will be examined and compared to determine usefulness, efficiency, and outcome in regards to future ven-

tures to help control the rise of this disease.

2. Behaviour Change Techniques Targeting both Diet and Physical Activity in Type 2 Diabetes: A Systematic Review and Meta-Analysis

This article looks at the behavior changing techniques of multiple HbA1c and body weight lowering diabetes interventions. The studies that it takes into account are focused on behavior changes, as well as an individual's diet and physical activity to aid in the care of Type 2 diabetes. In this article, a systematic review of articles published between the dates of 1975 and 2015 describing randomized control trials (RCT's) in regard to the diet and physical activity focus was performed. When looking at the RCT's, body weight and HbA1c, the blood test that has a direct relation to how much glucose is in the blood (normal is 4% - 5%), are the measures being studied at different time increments to evaluate the outcome when seeking behavior change. Type 2 diabetes is a multifactorial lifestyle disease, linked to dietary habits and sedentary behaviour [4]. When a disease is obtained by multiple daily life decisions, it is sometimes difficult to implement and maintain real change in an individual's life. The ADA included "support patient behavioral change" as one of their three key objectives for improving diabetes care and stated that 'lifestyle changes of increasing physical activity, eating a healthy diet, cessation of smoking, weight loss and coping strategies' was one of their key diabetes treatment foci [4].

As the article investigates the RCT studies, "Michie's v1 BCT taxonomy was used to identify and code the BCTs (Behavior Changing Techniques) reported in each study. This rigorously developed and validated taxonomy consists of clear definitions of 93 different BCTs, and is divided into 16 different categories [4]. HbA1c reductions of >0.3% were deemed significant, which was the precedent set by the other authors. Each outcome was measured at 3, 6, 12, and 24 months respectively. 13 studies met the inclusion/exclusion criteria and the average age of the participants in all the studies was 56.8 years. Only one of the included studies was community based while the rest were in a clinical setting.

In the articles, only months 3 and 6 had significant HbA1c mean reductions, but body weight reduction was significant at all points with the biggest reduction being at 12 months. Results revealed four BCTs and nine intervention features associated with clinically significant reductions in HbA1c (>0.3%) [4]. While the studies did have only physical activity or only diet related interventions, the interventions that combined both factors had the largest impact on HbA1c (-0.53%). Reviews have shown that physical activity was associated with a reduction in HbA1c, but only when combined with diet [4]. The studies revealed that the use of multiple BCT's correlated with a greater reduction in HbA1c and weight. The BCT's associated with significant reduction in HbA1c, and weight were: "instruction on how to perform a behavior", "behavioural practice/rehearsal", "action planning", and "demonstration of the behaviour". Although these three BCT's could work individually, the studies reveal that they worked synergistical-

ly in regard to these interventions.

A limitation stated by the article is that the meta-analysis cannot suggest causality, but rather infer association between certain BCT's and weight/HbA1c reduction. It is important to note the findings of this article pertaining to the coupling of outcomes (Weight and HbA1c) and multiple BCT's showed a greater effect in helping individuals with Type 2 diabetes. This information can be further researched as future researchers can implement programs that build upon the information gathered in this meta-analysis. The researchers sum up their study best by saying: "These findings are exploratory but lay a foundation for future hypotheses with clinical and research implications" [4].

3. Community-Based Physical Activity Interventions for Treatment of Type 2 Diabetes: A Systematic Review with Meta-Analysis

The next article considered analyzes the effect of community based physical activity interventions on an adult population that has Type 2 diabetes. This study is also a meta-analysis to help show how multiple community style interventions may or may not have reached the desired outcomes in the aid of Type 2 diabetes treatment and maintenance. The meta-analysis includes articles published from 2002-2012, identifying 22 community-based studies and 11 that had HbA1c as the outcome predictor.

While many of the current physical activity and diet intervention models are based on an individualized focus, encouraging individuals with T2D to adopt behavior modification during short visits to their GP (Health Care Professional) is challenging [5]. Another important factor to consider when thinking about individualized outreach programs is the fact that they can sometimes be "out of reach" for the low income and minimally educated populations. With this being said, community-based interventions can alter and adjust their interventions according to the need of the community they are adhering to, which makes the program more cost effective and reach a larger population. There was a focus on interventions that assessed changes in HbA1c as an outcome measure and includes interventions that employ community-based approaches (e.g., community centers, local facilities, and community-based educators) rather than those delivered in workplace or traditional clinical settings [5].

Multi-strategy approaches were used in 14 of the 22 studies to recruit individuals in a community. These strategies included: intervention recruitment, delivery, use of facilities, group sessions and expert advice. For the studies to have been taken into account for the analysis, they must have had at least 50% of the overall interactions include physical activity pertaining intervention. Of these studies, 9 of 22 used generalized exercise programming and 16 of 22 were RCT's. For the purposes of measuring outcomes, a reduction in HbA1c had to be -0.32% or greater to be considered significant. When looking at the outcome of HbA1c alone, 11 of the studies that reported HbA1c as an outcome measure were pooled in the meta-analysis. Meta-analysis revealed community-based

physical activity interventions contribute to a lowering of HbA1c by -0.32% which approached statistical significance effect ($p = 0.06$) [5]. The study also found that increases in overall physical activity was observed; specifically increased time spent in leisure time physical activity, number of participants meeting the physical activity guidelines, increased amount of days engaging in physical activity, and increased step counts [5].

Although the effects on HbA1c may be seen as small in comparison to some individualized interventions, experts advocate that practical, low/minimal intensity interventions that might not have large clinical effects, but can be delivered to large numbers of participants, are more likely to have a broader health impact [5]. Different baselines, inclusion criteria and recruiting methods and other factors used by each study may have also contributed to the smaller effect on the reduction of HbA1c as a whole as well. It is also important to note that few studies have explored the mechanisms of behavior change in community-based settings involving programs for individuals with Type 2 diabetes. Six of the studies were rooted in social cognitive theory, while a widespread array of other theory was used in the remaining studies, holding to the belief that behavior change intervention is more effective when rooted in a theoretical framework. In summary, this article makes the claim that community-based intervention can aid in the increase of physical activity due to its inclusive nature to consider many different socio demographic climates, while still being affordable and wide reaching. More research and theory development needs to occur in areas of community-based Type 2 diabetes intervention in the future.

4. Type 2 Diabetes Mellitus, Physical Activity, Exercise Self-Efficacy, and Body Satisfaction. An Application of the Transtheoretical Model in Older Adults

The final article examines how Type 2 diabetes mellitus patients in different stages of transtheoretical model stages of change, compare in self-reported physical activity levels, body satisfaction, and exercise self-efficacy. The article cites research showing the many ways that physical activity can benefit people suffering from Type 2 diabetes. It notes that pairing supervised aerobic and resistance training sessions with exercise counseling is shown to be “superior to counselling alone in promoting PA, improving physical fitness, hemoglobin (Hb) A1c, and CVD risk profile, and reducing medication number and/or dosage in sedentary patients with Type 2 diabetes” [6]. The article then goes further to mention that studies using a transtheoretical-based intervention were successful in increasing the physical activity levels of people with Type 2 diabetes. These study populations all consisted of younger and middle-aged diabetes patients and did little to examine the relationship between the self-reported data and the individual’s determined stage of change. Thus, this study set out to investigate the relationship between self-reported physical activity levels, exercise self-efficacy, and body satisfaction in older adults with Type 2 diabetes in different stages of change.

The population of the study consisted of 308 people (172 men and 136 women) with Type 2 diabetes and an average age of 65. Individual interviews were conducted with each participant to evaluate their exercise self-efficacy (using the Exercise Self-Efficacy Scale), body satisfaction (using the Silhouette-Matching Task), and physical activity level (duration of weekly physical activity in minutes). The subjects' stage of change for physical activity was determined by reading the subject a definition of physical activity and asking them to choose which statement most closely represented their current physical activity status with each statement representing a different stage of change within the transtheoretical model.

The results of the study show that exercise self-efficacy increased linearly from the precontemplation to the maintenance stage meaning that subjects who were determined to be in the precontemplation stage for physical activity reported a lower exercise self-efficacy than those in the maintenance stage. Additionally, body satisfaction presented an inverted U shape when graphed indicating that those in the contemplation stage showed the most deviance when identifying their body silhouette and therefore were the least satisfied with their body. Differences in gender did not result in a significant difference in self-efficacy or body satisfaction. The results of the study coincided with the results from previous studies, which show that personal and environmental barriers are associated with a failure to maintain physical activity. This study is only the first to look at the relationship between an individual's current stage of change and their exercise self-efficacy. Thus, further studies need to be done to further examine this relationship and provide more credibility to the results of this study.

5. Conclusions

Each of these studies took a different approach to try to implement better and more effective physical activity and diet interventions in populations that deal with Type 2 diabetes. The first study revealed that multiple behavior change techniques (BCTs) correlate with a reduction in weight and HbA1c, especially when they work synergistically alongside one another (*i.e.*, dietary volume reduction, healthier food choices, exercise regimens, and other health advantageous choices). The second study spoke of how community intervention had an inclusive quality about it, which allowed for population variability to not affect implementation. It also showed that small incremental changes were best when trying to establish a change long-term across a large population. Finally, the third study revealed that, as the participant got closer to maintaining a good physical activity regimen, their self-efficacy also increased. Awareness of the patient's stage of readiness regarding physical activity improved HbA1c outcomes by more focused counseling and attention to individuals as they developed through the transtheoretical model.

The attributes of these studies give evidence that interventions that use multiple approaches are most effective when looking to improve physical activity and diet in Type 2 diabetics. The smallest changes, although sometimes don't

show the largest reductions initially, can produce a long-lasting healthier lifestyle. This could be due to how much easier it is to “behavior practice” and “action plan” (most significant BCTs) for these small changes, or how it doesn’t take a large amount of self-efficacy to make a small change. Whatever the cause may be, when it comes to physical activity and diet for diabetics, the more methods the better.

For future studies and meta-analyses, two thoughts brought about by these articles are of primary interest. First, it would be interesting to see how BCTs and self-efficacy correlate and how they could play off one another in terms of an intervention. Evaluating how someone feels (Self Efficacy) and what behaviors they can change most efficiently (BCTs) could be effective in raising self-efficacy and more productively changing healthy lifestyle behaviors. The second suggestion that came to mind when reading these articles involved the need for a more community grounded theory when it comes to community-based Type 2 diabetes interventions. Since there is a lack of research and developed theory in this realm, I would suggest analyzing the existing theories and see how they worked in community interventions, then use their successful characteristics synergistically to further develop and test theories for this setting. Type 2 diabetes is a growing problem in the United States and many other parts of the world. With our high carb diet and sedentary lifestyle, something within our culture will need to change drastically over the next coming years. It will take multiple approaches that can fit large communities and have prime efficiency if we want to see our health care system rebound from these expenditures.

Conflicts of Interest

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

References

- [1] Centers for Disease Control and Prevention (2017) CDC Newsroom <https://www.cdc.gov/media/releases/2017/p0718-diabetes-report.html>
- [2] Cherney, K. and Rachel, N. (2018) The Right Diet for Prediabetes.
- [3] American Diabetes Association (2018) The Cost of Diabetes.
- [4] Cradock, K.A., ÓLaighin, G., Finucane, F.M., Gainforth, H.L., Quinlan, L.R. and Ginis, K.A. (2017) Behaviour Change Techniques Targeting Both Diet and Physical Activity in Type 2 Diabetes: A Systematic Review and Meta-Analysis. *International Journal of Behavioral Nutrition and Physical Activity*, **14**, Article No. 18. <https://doi.org/10.1186/s12966-016-0436-0>
- [5] Plotnikoff, R.C., Sarah A. Costigan, Nandini D. Karunamuni, and David R. Lubans. (2013) Community-Based Physical Activity Interventions for Treatment of Type 2 Diabetes: A Systematic Review with Meta-Analysis. *Frontiers in Endocrinology*, **4**, Article No. 3. <https://doi.org/10.3389/fendo.2013.00003>
- [6] Marco, G., *et al.* (2014) Type 2 Diabetes Mellitus, Physical Activity, Exercise Self-Efficacy, and Body Satisfaction. An Application of the Transtheoretical Model in Older Adults. *Health Psychology and Behavioral Medicine*, **2**, 748-758. <https://doi.org/10.1080/21642850.2014.924858>