

**A REVIEW OF CORPORATE-BASED WELLNESS PROGRAMS FOR
GENERAL HEALTH PROMOTION AND PREVENTION OF TYPE II
DIABETES MELLITUS**

by

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A Thesis Submitted to the Faculty of
The Charles E. Schmidt College of Medicine
In Partial Fulfillment of the Requirements for the Degree of
Master of Science

Florida Atlantic University

Boca Raton, FL

August, 2014

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This thesis was prepared under the direction of the candidate's thesis advisor, Dr. Robert H. Blanks, Department of Biomedical Sciences, and has been approved by the members of her supervisory committee. It was submitted to the faculty of the Charles E. Schmidt College of Medicine and was accepted in partial fulfillment of the requirements for the degree of Master of Science.

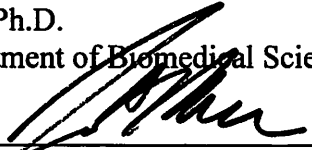
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ACKNOWLEDGEMENTS

I would first like to acknowledge my advisor, Dr. Robert H. Blanks for his constant optimism, patience and understanding during the writing of this manuscript. I would also like to thank my committee members, Dr. Wojcikiewicz and Dr. Broadfield for taking the time out of their busy schedule to guide me and advise me throughout my thesis work. Special thanks to Sandra Albrecht, who has been by my side since day one and is always there encouraging me to keep pushing on. Last, but certainly not least, I would like to thank my family and friends for their support in the pursuit of my graduate studies.

ABSTRACT

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Title: A Review of Corporate-Based Wellness Programs for General Health Promotion and Prevention of Type II Diabetes Mellitus

Institution: Florida Atlantic University

Thesis Advisor: Dr. Robert H. Blanks

Degree: Master of Science

Year: 2014

This research focuses on obesity and other major risk factors for chronic diseases such as Type II Diabetes Mellitus, Heart Disease, and Stroke. Worksite wellness programs have been successful in this realm of health promotion and disease prevention for heart disease and stroke, but their effectiveness in treating diabetes has been uncertain partially due to poor patient compliance, lack of stress reduction strategies, poor diet and lack of persuasive health education on the risk of being obese. Published peer-reviewed articles were reviewed, coded and analyzed to determine best practices, using a modified systematic review approach. The findings from these studies yield results that were used to develop a new employer-sponsored wellness program that is in accordance with the recently passed Affordable Care Act.

DEDICATION

This manuscript is dedicated to my family and friends, particularly to my ever loving parents, Gwendolyn and Rupert, who have been praying for me and strengthening me day by day and to my Fiancé, Brian, who is always there cheering me on. Also to my brother Clifton, who seems to always brighten my day regardless of how I am feeling. I also dedicate this work to my friends especially Carolyn and Dwayne who consistently gives me comments about the figures and tables and to those that encouraged me and prayed for me throughout the drafting of this manuscript.

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CHAPTER 1
BACKGROUND AND SIGNIFICANCE

Introduction

According to the American Diabetes Association (ADA), there were an estimated 17.7 million people living in the United States in 2007 with diagnosed diabetes and this number has increased dramatically. Diabetes Mellitus can be categorized in three types according to the ADA, Type 1, Type 2 and gestational diabetes. Type 1 which accounts for 10% of the known cases of diabetes in the United States; is also more prevalent in children and is thus called juvenile diabetes. This type of diabetes causes the patient to be insulin dependent, because they are not capable of producing their own insulin due to mutations or defects in the β -cells found in the pancreas that produce the hormone insulin. Another type is gestational diabetes, which accounts for 5% of diabetic cases and is found in pregnant women, who may or may not have a precursor to Type II Diabetes Mellitus. Gestational diabetes usually disappears when the baby is born and the mother has had the opportunity to diet and exercise. The third type is Type II Diabetes Mellitus (T2DM) that accounts for 85% of the known diabetics in the United States (US). This type occurs when the body glucose level is higher than normal and hyperglycemia follows. Throughout this process the body becomes insulin resistant.

Insulin Regulation and Type II Diabetes Mellitus

The hormone insulin is the key player in metabolism where the body uses digested food for energy. The digestive tract catabolize carbohydrates into glucose which later enters the blood stream. Insulin is then released from the beta cells to chaperone the glucose in respective cells throughout the body.

Insulin stops the use of fat as an energy source by inhibiting the release of glucagon.

Insulin assists muscle, fat and liver cells in storing glucose in the form of glycogen from the bloodstream, thus lowering blood glucose levels. Insulin also lowers blood glucose levels by reducing glucose production in the liver. In a healthy individual, these functions allow glucose and insulin levels to remain in the normal range, (National Diabetes Information Clearinghouse, July 4, 2014)

However; in an individual that is insulin resistant. Muscle, fat and liver cells do not respond properly to insulin. Thus glucose cannot readily be absorbed from the blood stream. As a result, the body needs higher levels of insulin to help glucose enter the cells.

The beta cells in the pancreas try to keep up with the increased demand of insulin by producing more. However, because of the constant demand eventually enough insulin is not produced and excessive glucose builds up in the blood stream leading to Type II Diabetes Mellitus.

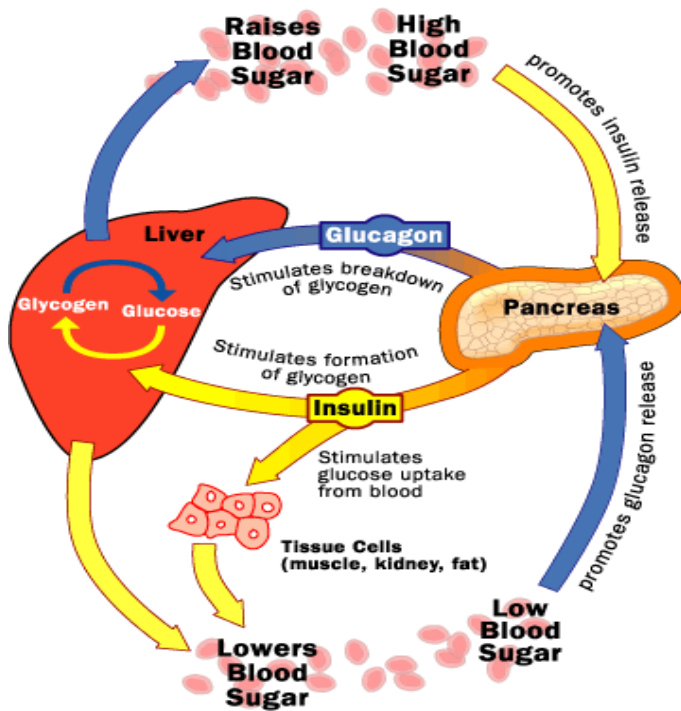


Figure 1: Normal pathway of Insulin and Glucagon regulation (Redrawn from <http://thetreatmentfordiabetes.com/wp-content/uploads/2012/01/Diabetes-is-an-Impairment-of-Blood-Glucose-Regulation-2447.jpg>)

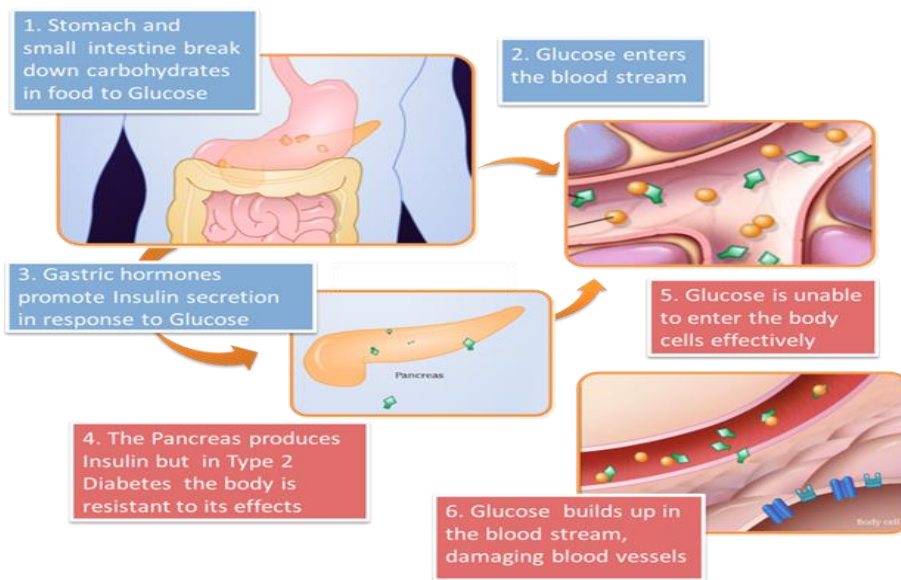


Figure 2: Insulin resistance and Type II Diabetes Mellitus (Redrawn from <http://www.metacure.com/wp-content/uploads/2011/02/Type-2-Diabetes-Metabolic-Process1.png>)

Cost of Treating Type II Diabetes Mellitus

The cost of treating T2DM in the United States is currently more than \$400 billion dollar per year, up from \$174 billion in 2007 (*Economic Costs of Diabetes in the U.S. in 2012*). In 2012 these costs were distributed among hospital inpatient care (43% of total cost), followed by prescriptions to treat the complications of diabetes (18%), diabetic supplies (12%), doctor office visits (9%), and nursing home costs (8%). People with diabetes spend, on average, \$13,700 per year of which \$7,900 is for diabetic care alone. These figures are on average 2.3 higher for diabetics than for healthy age-matched controls (ADA, Diabetes Care Publish Ahead of Print, March, 2013).

Most people with T2DM are required to monitor their blood sugar daily, and receive annual foot care, eye exams, and influenza and pneumococcal vaccinations- many require costly hospitalizations or entrance into nursing facilities (CDC Prevention, National diabetes fact sheet, 2007). Untreated diabetes continues to be the leading cause of kidney failure, non-traumatic amputations to lower limbs, and blindness in adults between the ages of 20-74 (CDC Prevention. National diabetes fact sheet, 2007). The incidence of diabetes is increasing in the US population, and it is estimated that 1 of 3 children born in 2000 will develop diabetes during their lifetime (Nrayan et al., 2003). Early screening of at-risk populations is most effective, and chronic disease prevention (e.g., diet, exercise, smoking cessation) are known to be effective in managing the symptoms of T2DM and preventing or delaying the disease all together (CDC, 2009).

The high incidence and cost of treating chronic diseases such as T2DM has forced the public and private sectors to initiate preventive programs to improve health of employees and citizens. Given these concerns, the Federal Healthy People 2010 recommended that at least 75% of all worksites, regardless of size, must develop comprehensive wellness programming (HHS, 2000). These recommendations were further integrated into the “Patient Protection and Affordable Care Act” (PPACA) enacted by Congress in 2010 (US Government Printing Office, March 23, 2010). A recent employer survey by the National Business Group on Health (NBGH) confirms that 86% of intermediate to large corporations offer health-improvement programs or “wellness” programs; participation by smaller firms is slow but on the increase (NBGH, 2014).

Wellness programs purport to improve health, but how is health defined?

The World Health Organization (WHO) defines health as “...a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity” (1948). In the face of criticism about the definition being too broad, the WHO (1986) later clarified to reach a state of health “...an individual or a group must be able to realize aspirations and satisfy needs, and to change or cope with the environment”.

Clearly, the definition of health involves both biomedical and social constructs.

Correspondingly, a “wellness” program promoting optimal health should include both biomedical and social domains. Goldstein (2000) examined the growth of the current fitness culture within the broad context of: “1) health as wellness, 2) personal responsibility for health, 3) the interpenetration of mind, body and spirit, 4) health as harmony with nature, 5) ambivalence toward science and technology, and 6)

transcendence, restraint, and vigilance.” The growth of the Wellness culture has been reviewed, particularly within the fields of Complementary and Alternative Health (cf. Blanks et al., 1997; Schuster et al., 2004a, b).

Who pays for health insurance and corporate wellness programs?

It is estimated that only about 40% of Americans have employer-paid health insurance (ADA, 2013). For the remainder of individuals, the medical cost are borne by Federal programs such as Medicare or Medicaid (62.4%), or they are self-paid by private individuals (3.2%). An earlier survey by Hollander and Lengermann (1988) found that as many as two-thirds of the fortune 500 companies offer corporate wellness programs and of those that do not currently about half plan to do so in the future. These numbers are likely to change with improvement in the economy and shifts in the health care funding base.

By promoting exercise, proper diet, smoking cessation and stress reduction, the employers’ surveyed hope to improve the overall health of their employees and reduce their risk for developing health promotion and disease prevention programs (Heinen & Darling, 2013).

Risk factors for T2DM

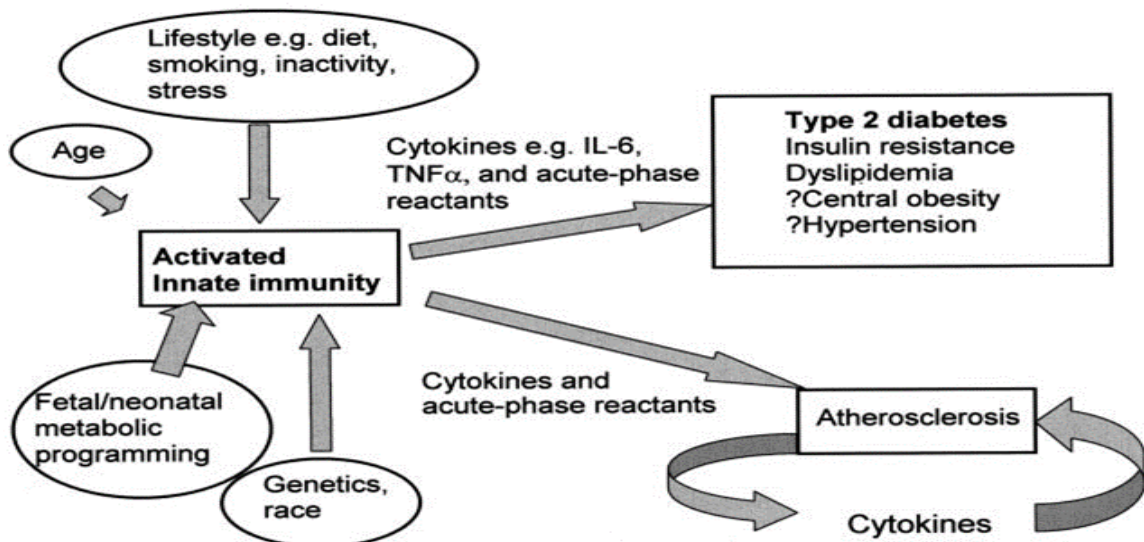


Figure 3: As shown above, *cytokine production leads to insulin resistance (and possibly impaired insulin secretion), type 2 diabetes, and other components of the metabolic syndrome, such as dyslipidemia. Activated innate immunity is a possible common antecedent in both type 2 diabetes and atherosclerosis* (Redrawn from Pickup, 2004).

A number of researchers have examined the risk factors for T2DM; these include older age, obesity, stress, hypertension, smoking, hyperlipidemia (cholesterol), diet, hyperglycemia (blood glucose levels), family history of diabetes, prior history of gestational diabetes, physical inactivity and race/ethnicity (Diabetes Basics, 2013). One well-recognized risk factor for T2DM is chronic inflammation and pancreatic islet autoimmunity (Brooks-Worrell, 2012). Thus, a major risk factor for T2DM is obesity-associated inflammation originating from visceral adipose tissue. When an individual becomes obese, several changes can occur within the adipose tissue, leading to a shift from an anti-inflammatory to a pro-inflammatory milieu, (Brooks-Worrell, 2012). These changes include: fat cell (adipocyte) hypertrophy, decreased adiponectin (an anti-inflammatory protein produced by adipocytes), increased plasma C-reactive protein

(CRP) levels, increased levels of pro-inflammatory cytokines (interleukin (IL)-6, tumor necrosis factor (TNF)- α , IL-1 β), activation of the transcription factor nuclear factor (NF) κ B, infiltration of pro-inflammatory macrophages (M1), and infiltration of pro-inflammatory CD8⁺ and CD4⁺ T cells into the adipose tissue (Brooks-Worrell, 2012). Research also conducted by Pearson et al. (2003) has shown that when obesity is accompanied with other metabolic syndrome such as physical inactivity, hypertension or blood glucose levels, the risk of developing Type II Diabetes Mellitus increase tremendously.

Animal models of Type II diabetes

Animal models have been used extensively to study the mechanism of diabetes: animal models include rodents, non-human primates and certain domesticated animals. The molecular pathways that contribute to the induction of T2DM are reviewed by Chatzigeorgiou et al. (2009). The most common type of diabetes in humans, T2DM, is a multi-complex metabolic disorder that includes both genetic background and environmental risk factors. This type of diabetes can manifest itself in multiple clinical and pathophysiological conditions that can be controlled for in animal models. Notably, since obesity is the major environmental factor in correlation to human T2DM, the chosen animal model must readily become obese to aid in the quick development of the disease.

The obese rodent models for spontaneous T2DM include the ob/ob mouse, db/db mouse and Zucker fa/fa rat are the most common studied. Interestingly, the Zucker (fa/fa) fatty (obese) rat develops the same pathophysiological characteristics as the db/db mouse

similar to human T2DM where obesity is accompanied by hyperlipidemia and hypertension (Chatzigeorgiou et al., 2009).

Non-obese rodent models are also used for a subset of human T2DM because clinical experience has demonstrated that human T2DM can also exist in the absence of an obese phenotype (Chatzigeorgiou et al., 2009). Research has shown that non-rodent models of spontaneous T2DM is found in feline, swine, dogs and non-human primate models.

These models are often used to explain the environmental T2DM risk factors such as food choices and sedentary lifestyle behavior. It has been found that felines, especially domesticated cats, are good models for T2DM because of similarities to the human condition. This is because domestic cats share the same living environment with their human owners and are exposed to the same risk factors, such as obesity and low physical activity. T2DM in felines also display insulin resistance and progressive decrease in insulin secretion, owing to a 50% loss of β -cells in adult cats that develop diabetes (Chatzigeorgiou et al., 2009).

Porcine models are used extensively in diabetes research. Considering the fact that they are similar to humans regarding cardiovascular function and anatomy, metabolism, lipoprotein profile, size, tendency to obesity, pancreas morphology, gastrointestinal structure and function. They are also regarded as a very suitable model for testing new drugs, because they develop T2DM and are thus desirable to determine the mechanism linking the cardiovascular complications of diabetes mellitus (Chatzigeorgiou et al., 2009).

T2DM can also spontaneously occur in many non-human primate species such as Cynomolgus, Rhesus, Bonnet, Macaques, Baboons and others. Non-human primates develop T2DM in an age-dependent manner, which is a major similarity for T2DM in humans. This is influenced by obesity, insulin resistance, hyperinsulinaemia and progressive hyperglycemia, because the decrease in insulin secretion creates aggregates of pancreatic islet lesions (Chatzigeorgiou et al., 2009). One such study was conducted by the American Diabetes Association using monkeys (*Macaca nigra*). This species was specifically chosen because they are known to be 95% similar to humans genetically. The authors argue “.....The results from this studies will allow some conclusions and predictions about the etiology and development of diabetes relative to the islet lesion in monkeys and human beings” (Howard, 1984)

The Problem Investigated

Understanding the mechanism of Type II Diabetes Mellitus and analyzing the research conducted on animal models, has inspired both corporate America and researchers, in designing wellness programs to alleviate the cost of this disease. Corporate wellness programs are defined as “long-term programs that also act to increase and promote employee health and reduce stress (fitness facilities, health classes, etc.)” (McFarlin and Sweeney, 2013). The treatment plan for Type II Diabetes Mellitus currently cost more than 400 billion dollar per year, which is up from \$174 billion in 2007 (Yang et al., 2012). The increase in cost of treatment is so significant that designing and implementing an employer-sponsored wellness program is imperative to combat this issue. From a public health perspective, worksite based health programs

have been praised because of the ability to reach a relatively large and contained population and engaging them in sustained health improvement efforts (Ozminkowski et al., 2002). The design of the wellness program should 1) improve the general health of employees, 2) reduce medical care costs and 3) improve employee productivity (i.e., reduce “absenteeism” and reduced on the job loss of productivity called “presenteeism”). Literature review has shown that both the private and public sectors have implemented wellness programs that targets obesity that contributes to cardiovascular diseases which is also the underlying factor for the development of T2DM. After analyzing the design of those programs, valuable insight will be provided to develop one that specifically targets and reduces the cost of treatment for T2DM.

Rational for the project

Designing and implementing an effective employer-sponsored wellness program that targets T2DM should contribute to a more cost effective health care plan and healthy individuals. The research will provide insight into what programs and designs actually worked from studies conducted with obesity and other co-morbidities relating to T2DM and a new program will be developed. If this program is implemented it could yield good results and significantly reduce the current treatment costs for T2DM (\$400 billion annually). This project will also address compliance issues and the benefit of giving employees enticing incentives that correlate with the reduction of “absenteeism” and “presenteeism which is the act of attending work while being sick”, while observing changes in work productivity and program cost effectiveness.

Significance/Contribution to the field

Experience has shown that workplace wellness programs are an important strategy to prevent the major shared risk factors for CVD and stroke, including cigarette smoking, obesity, hypertension, dyslipidemia, physical inactivity and diabetes (Carnethon et al., 2009). With this an estimated 25% to 30% of companies' medical costs per year are spent on employees with the major risk factors listed above, (Carnethon et al., 2009). In summary, worksite wellness programs that can reduce these risk factors can ultimately decrease the physical and economic burden of chronic diseases, including CVD, stroke, diabetes and certain cancers (Carnethon et al., 2009).

Therefore, the completion of this literature review, will provide a significant expansion of knowledge on the effectiveness of worksite wellness programs. Corporate America should also be able to use the information presented in the research to address any compliance issues they may face. Lastly, the research will also give corporations in America a sustainable model to continue generation of profit, allowing them to maintain their competitive edge in the market place.

Main Hypothesis

An effective employer-sponsored wellness program, targeting employees with Type II Diabetes Mellitus, should address the multiple domains (physical, emotional and social) of health and consist of the following hallmarks: 1) privacy protection, 2) reasonable enjoyment in the outcomes, 3) good compliance ensured by a wellness coach and employee incentives, 4) employee release time. Moreover, the employer must benefit financially in terms of seeing reduction in health insurance premiums, and the program should pay for itself in the long-term, thus allowing employees to develop healthy lifestyle practices that reduce “absenteeism” and promote greater health on the job, lesser “presenteeism”.

Specific Aims

1. To conduct a modified systematic review of peer-reviewed literature on worksite wellness programs designed to reduce obesity and other risk factors associated with Type II Diabetes Mellitus.

The programs selected address the multiple domains (physical, emotional and social) of health and consist of the following hallmarks: 1) privacy protection, 2) employee incentives. A search of PubMed/Medline, Cochrane Library, EMBASE and CINAHL using the terms “Occupational Health Services” and “Diabetes Mellitus” and additional mesh terms such as (Obesity, Stress, Smoking Cessation, Physical Activity, Absenteeism, Presenteeism, Diet, Worksite wellness programs, US-based firms or multinational firms home-based in the US, and studies

conducted between June 1980-present) will be used to identify a subsample of papers that could be used to characterize best practices in the field.

2. To employ the evidence-based literature to design a testable model for corporate wellness that is designed to 1) improve the general health of employees, 2) reduce health insurance premiums, and 3) create an environment where healthy lifestyle practices and productivity are enhanced by improved “absenteeism” and reduced health-related “presenteeism”.

An effective employer-sponsored wellness program should benefit the employer financially in terms of seeing reduction in health insurance premiums, and the program paying for itself in the long-term, thus allowing employees to develop healthy lifestyle practices that reduce “absenteeism” and promote greater health on the job and lesser “presenteeism”. A program will be developed based on evaluation of the interventions and programs reviewed that worked effectively and produced the best evidence-based documentation. In addition several new components will be added based on recommendations put forth by <http://infinitehealthcoach.com/employee-wellness-program-components/> such as an on-staff chef, on-staff sociologist/psychologist will be added to enhance the effectiveness of the new program. These specific additions will address issues relating to dietary intake, emotional distress and stress reduction that will eliminate “absenteeism” and “presenteeism”.

CHAPTER 2
RESEARCH METHODS

Specific Aim 1

To conduct a modified systematic review of peer-reviewed literature on worksite wellness programs on studies of obesity and other risk factors associated with Type II Diabetes.

Rational and objective

Conducting a review of peer-reviewed literature will provide valuable insight that will be used in the research to develop a more sustainable employer-based wellness program.

Approach

The analysis will be based entirely on a literature review of peer-reviewed literature using PUBMED/MEDLINE, EMBASE, CINAHL, and Cochrane Library. All papers meeting the following were selected and examined:

Inclusion criteria:

- Domestic corporations or multinationals home-based in US
- Base years: June 1980 to present
- Exercise and dietary intervention

Exclusion criteria:

- Non-Peer-Reviewed literature
- Companies home-based outside US (e.g., British corporations, etc.)

Types of studies:

- Community based

- Controlled/randomized or non-controlled

Study Duration:

- Studies lasting four weeks or longer.

Types of participation:

- Mandatory or voluntary employee participation

Types of Outcome measures:

- Glycated hemoglobin as an indicator of long-term glycemic control
- Body Mass Index
- Waist circumference
- Insulin action (fasting plasma insulin, insulin sensitivity, insulin/glucose ratio)
- Adverse events
- Morbidity and secondary outcomes (diabetes or cardiovascular-related, e.g., angina pectoris, myocardial infarction, stroke, peripheral vascular disease, neuropathy, retinopathy, amputation, erectile dysfunction, costs, quality of life changes, mortality).

Articles meeting these criteria were read and summarized and framed around articles that summarize the following related topics:

- Analyses of certain Biomarkers are essential for this research such as: HbA1C, Blood pressure, Cholesterol, and Body Mass Index.
- SAD = Standard American Diet
- NCD = non-communicable diseases (heart disease, stroke, cancer, diabetes, etc.)
- Lifestyle diseases
- Global epidemic of NCD
- Unhealthy Commodities Industries (UCI) are those involved with alcohol, tobacco, ultra processed foods and drinks (e.g., highly processed wheat, genetically altered plants, fructose containing beverages, etc.)
- UCI corporate profits and pandemics (e.g., obesity, type II diabetes, stroke, heart disease, etc.)

Anticipation results

Results from these studies were interpreted and analyzed for interventions that were effective and those which were not. After ranking the studies, those that were most effective were coupled with new components such as on-staff chef, sociologist/

psychologist etc. to develop a new and sustainable employer-based wellness program to be evaluated at a later time when suitable funding obtained.

Pitfalls

In a literature review of this type, one must be careful to avoid possible sample bias from a poorly selected search or linking terms, but the terms chosen were sufficiently broad and topic-focused to reveal papers that were corporation-based to reflect the large population of individuals in the US who have health insurance paid by corporations, and from employers who are concerned about the financial impact of obesity and chronic diseases like diabetes on health insurance cost, employee morale, absenteeism and presenteeism. The study revealed 24 studies broadly screened from an initial group of ca. 19,461 peer-reviewed papers from a search engine, PUBMED/Medline, that was to recover papers published in a comprehensive list of journals. Finally, the subset of 24 papers on the chosen topic differed in strength of design, meaning that only about half reported sufficient raw data to evaluate the quality of the study. Thus, caution will be exerted in generalizing the present finding to the larger population. The field of wellness research among corporations is relatively new, and a comprehensive study of the type to be designed in this review has not yet been conducted. However, although there are limitations to the present data set, the hope is that there is sufficient data with which to design a stronger study that touches upon all bio-, psycho- and social aspects of chronic disease management at the corporate level.

Specific Aims 2

To employ the evidence-based literature to design a testable model for corporate wellness that should 1) improve the general health of employees, 2) reduce health insurance premiums, and 3) create an environment where healthy lifestyle practices and productivity are enhanced by improved “absenteeism” and reduced health-related “presenteeism”.

Rationale and objective

Historical controls predict that costs of Type II Diabetes Mellitus treatment could be reduced significantly from current levels of 400 billion Nationwide, if a new sustainable employer-sponsored wellness program was developed. To ensure that this is feasible the data collected from the studies in the result section containing successful and unsuccessful approaches used to create a more effective wellness program based on the trends of what worked and did not work in each respective studies. Additionally, new components will be added to target stress reduction, enhance proper dietary intake and increase physical activity. It is hoped that the effectiveness of the new model be tested as a separate study.

Approach

Use current data from pertinent studies to develop a more robust employer-sponsored wellness program. These studies should have biometric measures, environmental modifications, general interventions, follow-up period, results and year of study. From this a new and sustainable program will be developed.

Pitfalls and alternative approach

In designing a wellness program based on data presented in the reviewed studies. One must be careful to avoid possible bias and must take into consideration that the implementation of such a program will need a strong financial backing that employers may be hesitant to sponsor. However; with the careful analysis of data in the reviewed studies and the recommendations above, one can be certain that the program will pay for itself in the long-run and will yield great profit for the employer. Thus reducing “absenteeism” and “presenteeism” and increasing work productivity.

Data collection and analysis

According to the Cochrane Collaboration an evidence based medicine review or systematic review “...is the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients. This means integrating individual clinical expertise with the best available external clinical evidence from systematic research” (Sacket et al, 1996). In their article, five steps for conducting a systematic review are presented and followed: 1) framing the questions for the review, 2) identifying relevant work, 3) assessing the quality of the studies, 4) summarizing the evidence and 5) interpreting the findings to achieve an effective and concise review (Khan et al, 2003). This methodology is widely used in many disciplines and was modified and used in the drafting of this research paper.

To determine the quality of the studies, one individual independently reviewed the titles, abstract sections and keywords of every record retrieved from the search with the guidance from two experts in the field. The full articles were retrieved for further

assessment when the information indicated that the study fit the review criteria. Any article that clearly did not fulfil the selection criteria, for example, the corporation conducting the wellness programs was not based in the United States or was written in another language, or had nothing explicitly to deal with community based or controlled/randomized studies was eliminated.

The reviewer independently extracted the data on the study populations, intervention and outcome in each included study, using a standard data extraction form (see Table 2. Criteria list for the methodological quality assessment of the trials and the definition of the criteria).

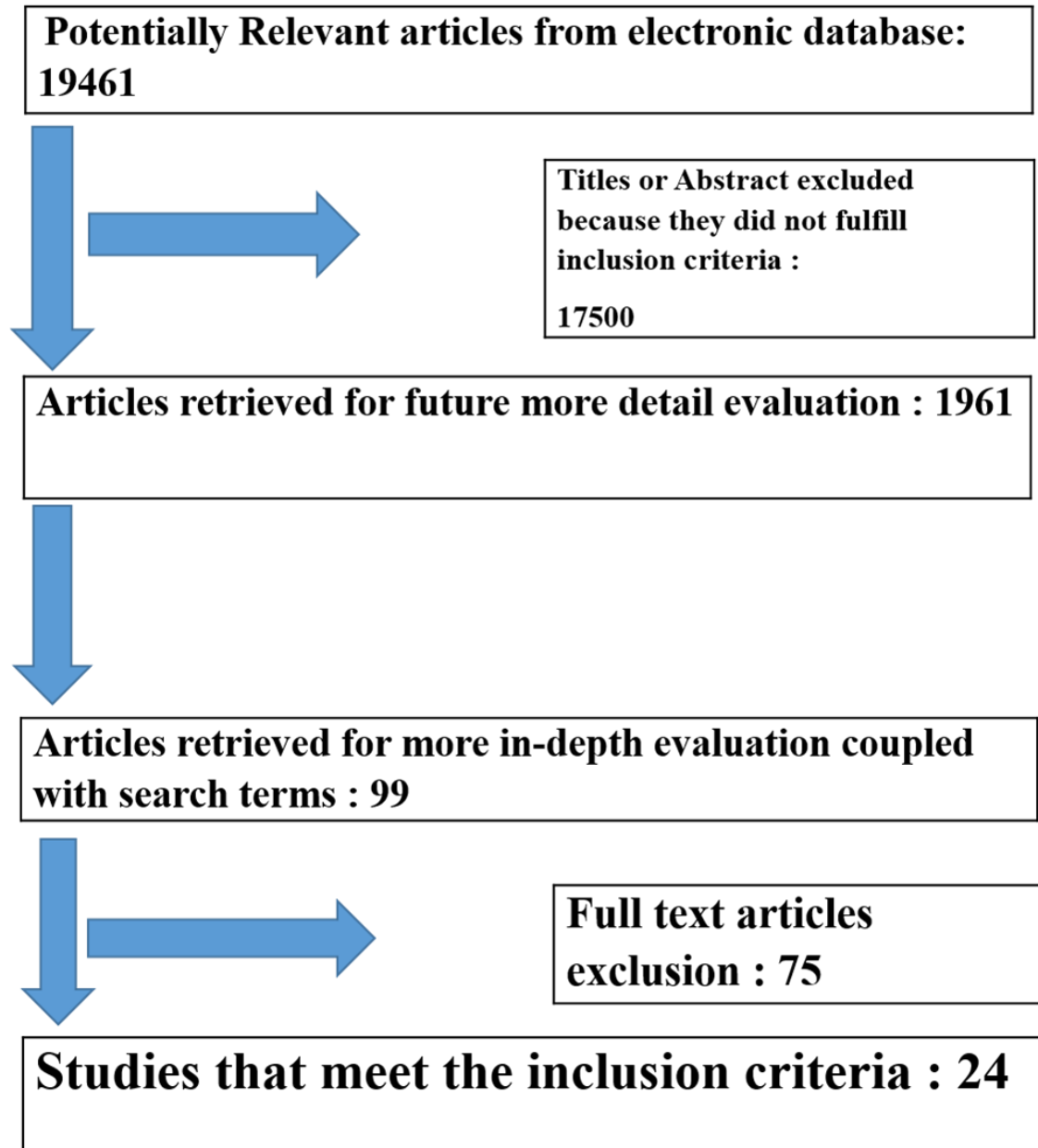
CHAPTER 3
RESULT SECTION
Introduction

In conducting this research a modified systematic review was used. This method of research was modified because the research was conducted by a single author with the guidance from two secondary reviewers who are experts in the field. One of these individuals was the thesis advisor or PI, Professor Robert Blanks, Ph.D.; the other was Tiffany Moxham, Associate University Librarian at FAU.

From the initial search terms Occupational Health Services and Diabetes Mellitus Meshed (Medical subject heading) together to yield 19,461 publications in PubMed (see Table 1). With the use of additional mesh terms (Occupational Health Services, Diabetes and Obesity) the pool was refined to 1961 studies. Additional mesh terms Occupational Health Services or Worksite wellness program alongside diabetes mellitus, obesity, US-based firms or multinational firms home-based in the US, and studies conducted between 1980-present was used to conduct additional screening that brought the total to 99. The full text for the 99 studies was read in detail and analyzed. From this pool, seventy-five were excluded because the full text did not contain sufficient information on the details of criteria (e.g., duration of intervention, characteristics of participants, control populations) of the worksite wellness programs or outcome measures related to Type II Diabetes

Mellitus. This left a population of 24 studies meeting strict research design and results that could be generalized to a larger population for better design of an evidence-based corporate wellness program for evaluating in future studies.

Table 1: Flow chart of literature search methodology.



As summarized in Table 1, a total of twenty four studies met all search criteria and were evaluated in detail. Participants were blue and white collar employees from a variety of entities such as manufacturing, state agencies, healthcare centers, educational settings, and banks. Some of these studies employed a simple (one-tiered) methodological design such as the Competitive Weight Loss study conducted by Brownell et al. (1984) while others were more complex, with multiple outcome measures and designs conducted over a period of time such as the “Eat Smart, Move More, Weight Loss” study conducted by Dunn et al. (2012) and the Institute of Health Diabetes Prevention Program study conducted by Aldana et al. (2006).

The methodological quality of the all 24 studies is summarized in Table 3. The studies included RCT (randomized community controlled trial) or CT (community or control trial). Outcome measures were reported in all 24 studies. Most included a control group but only about half (10/24) provided sufficient details to stratify and allow strict comparison of the individuals in each group.

Only nine studies actually reported a follow-up assessment time ranging from 3 months to 8 years. The nine companies used short terms interim measurements. Specifically Aldana et al. (2006) took three interim measurements at (3, 6 and 12 months). Haines et al. (2010) conducted an interim measurement after the 12 weeks. Rolando et al. (2013) did a follow up questionnaire (2-4 years). Barham et al. (2011) did monthly follow up assessments of biometrics to a total of 12 months. Ozminkowski et al. (2002) did their follow-up over a four year period, periodically measuring different biometrics and

conducting cost-analyses. Schmittiel et al. (2013), Cawley et al. (2013), Dunn et al. (2012) and Aldana et al. (2005b) did their interim assessment throughout their trials but did not specify the time frame.

Detailed summary of Individual Studies

All of the worksite wellness programs included in the review were multicomponent interventions, which means they consisted of educational sessions for raising awareness, incentives to encourage program compliance, physical activities (e.g., personal trainer), dietary guidelines and some type of environmental modifications.

The “Virtual Walking and Wellness Program” conducted by Haines et al. (2010) was judged to be the most effective program for reducing BMI, blood pressure and total cholesterol while simultaneously reducing health care costs compared to the other 23 included programs. These authors attributed program success to the use of pedometers to ensure compliance with the exercise arm of the study. There were only minor methodological limitations within the study were during the biometric testing phase of the study, i.e., not all participants fasted prior to the blood test, nor did subjects reliably rest for 5 minutes prior to having their blood pressure taken.

The Institute of Health Diabetes Prevention Program by Aldana et al. (2006) also demonstrated success because employees reported improvement in dietary changes, increased physical activity, and experienced a reduction in blood glucose and blood lipids; all factors contributing to the onset and/or severity of T2DM. Success was largely

attributed to good participant compliance with the exercise and dietary requirements for a minimum of 150 minutes of moderate-to-vigorous exercise per week, a reduced dietary fat intake to less than 25% of total calories, and increase in brisk walking or activities of similar intensity. There was cash incentives and the administering of a pedometer.

A very similar program was conducted by Barham et al. (2011) called the 12 Week Healthy Lifestyle session based on the Diabetes Prevention Program curriculum (Diabetes Prevention Program Research Group, 2002). These authors reported positive lifestyle changes, significant decrease in fat intake, and increase in physical activity, and improvement in self-reported health effects on physical functioning, and a decreased impact of poor health on quality of life. The only health domain that did not show a change in the program was self-perceived stress levels.

Cawley and Price (2013) evaluated the effects of financial incentives for participants on the overall wellness program outcomes and participation. Programs in healthy strategies were established across employees of each company while providing different financial incentives to increase weight loss. They reported that there was a decrease in BMI in the company which offered financial incentives to participants and at this site, the authors argued that there was a correlation as there was an increase in work productivity.

Brownell et al. (1984) conducted a study with 267 employees from 5 different companies in north central Pennsylvania. Participants were incentivized financially and put into competitions held in the work settings between the branch employees of three competing

banks, or employee teams of individual companies. The investigators encouraged participants to lose weight based on adjustment of incentives. Both employees and management reported positive changes in morale and employee/management relations in groups receiving compensation. Competition between branch offices (or employee groups) was also considered important for improving weight loss. The weight loss in this study was the best of all studies examined. A cost-effectiveness ratio of \$2.93/employee/yr. per 1% reduction in BMI was computed. Similarly, the Eat Smart, Move More, Weight Loss program by Dunn et al. (2012) found positive outcomes that included weight loss, reduction in blood pressure, increases in healthy eating habits and an increased in overall physical activity. These are also positive outcomes for reducing the risk factors for T2DM.

Lemon et al. (2009) studied a cohort of 899 hospital employees examined the relationship between organizational commitment to employee with employee weight loss, consumption of fruits and vegetables and less fat. A greater commitment to employee health was associated with lower BMI, healthy eating (consumption of more fruits and vegetable consumption reduced fat), and positive changes in physical activity behaviors.

A study conducted by Burton et al. (1998) revealed that after 3 months of a diet and exercise program, the subjects' mean fasting blood glucose levels fell from 197.8mg% to 179.6mg%, with corresponding decreases in glycohemoglobin and hemoglobin A1C. This illustrates that having access to information could help individuals with poor eating

habits and physical inactivity that can benefit significantly in reducing biometric factors related to T2DM.

Schmittiel et al. (2013) conducted a randomized controlled trial with employees at Kaiser Permanente, Northern California. The authors reported moderate outcomes with healthy eating, physical activity, and smoking cessation and stress management. They concluded that to see more effective results they would have had to extend the program duration to obtain health outcomes favorable to T2DM.

A wellness study of 3125 Vanderbilt University employees was conducted by Rolando et al. (2013). The study focused on self-reported symptoms of diabetes. They initiated this program by conducting a questionnaire called HRA. Some employees reported decreases in BMI, thereby reducing their chances of developing T2DM. However, many others continued to gain weight, into the obese range, thereby heightening their risk for developing T2DM.

Rodbard et al. (2008) conducted a community-based wellness study called SHIELD which is a survey that collected data from 15,132 working participants throughout America. These investigators examined work productivity and absenteeism against biometrics (cholesterol) and hypertension. Participants were stratified by BMI. These authors reported that the greatest impairment at work was among obese individuals. Those individuals who reported exercising less than 20% -34% of the time were at greater risk for T2DM and reported greater work impairment and life disruption.

Emmons et al. (1998) provided an educational program where they labelled the healthy choices in the cafeteria vending machine and displayed signage strictly enforcing the company anti-smoking policy. In their study they reported that there was a significant increase in exercise behavior compared with the control groups. There was also an increased consumption of fruits, vegetables and fiber. However, there was no change in calories consumed from fat or progress in smoking cessation.

Tamers et al. (2011) study in 2,878 employees of companies in the Greater Seattle area. They aimed to evaluate the relationship between worksite social support and improved health behaviors (diet, physical activity and BMI). The intervention was the Promoting Activity and Changes in Eating (PACE). Individuals with higher worksite social support had 14.3% higher mean physical activity scores and 4% higher mean fruit and vegetable intake compared to individuals with one-unit lower support. However; the authors reported no association between worksite social support and BMI, or with other obesogenic behaviors (e.g., overeating, sedentary life style).

The Coronary Health Improvement Project was conducted with 145 individuals at Swedish American Health System (Aldana et al. 2005a). Participants were encouraged to follow a preset diet and exercise goal while receiving advice to increase their consumption of whole grains, legumes, vegetables and fresh fruits. A pedometer was also employed to measure participants' activity every day. Their studies found a significant improvement in cognitive understanding of good nutrition and physical activity at both 6

weeks and 6 months. Participants had significantly lower body fat, blood pressure and cholesterol.

Brehm et al. (2011) followed 600 employees from eight different manufacturing companies in Kentucky. Their study focused on the various biomarkers that contributes to T2DM. They found significant time effects indicating cholesterol, LDL cholesterol, and triglyceride concentrations improved over time, as well as fasting glucose, insulin, and insulin resistance. Although a significant time effect was shown for HDL cholesterol, there was no clear pattern of improvement. Both diastolic and systolic blood pressure increased over the course of the study.

A total of 965 employees from seventeen community colleges in North Carolina were involved in a research study conducted by Finkelstein et al. (2009) that focused on use of financial incentives to improve outcomes (e.g., weight loss, BMI and absenteeism). They reported modest weight loss but this did not directly translate into measurable short-term reductions in medical expenditures or absenteeism but there were modest improvements in glycemic control, cholesterol and blood pressure.

A web-based study conducted by Cook et al. (2007) administered an assessment to 419 human resource employees at three companies in Atlanta, Georgia, Minneapolis, MN and Fountain Valley, CA. The authors measured healthful diet, eating practices, and motivation to improve a healthful diet. They reported that web-based programs were more efficient compared to the paper-based program because participants complied more

with the program. However; they saw no significant correlation with the reduction of stress or physical activity.

The 60 participants from various small companies in Calhoun and Terrell County in Georgia were in a research study conducted by Escoffery et al. (2011) they measured the effectiveness of posting nutritional information in cafeterias, vending machines against physical activity and BMI. The authors found that employees that have more access to more physical activity and cafeterias that have healthy food will increase work productivity and reduced obesity and other health related risks.

Reseland et al. (2001) conducted a research study with 184 participants that were randomly assigned to 4 different groups for analysis. Groups included diet only, exercise only and a combination of diet and exercise plus a control group. Data on dietary intake, physical fitness and demographics were collected and plasma leptin concentrations were measured before and after a 1 year intervention period. Participants were advised to increase consumption of fish, vegetables, and fiber-rich products containing complex carbohydrates and to reduce intake of saturated fat and cholesterol. They reported that BMI and fat mass decreased significantly in association with long-term reductions in food intake as well as increased physical activity. By adjusting for either BMI or fat mass, they observed a highly significant reduction in plasma leptin concentration after the diet, exercise or combined diet/exercise interventions.

Ozminkowski et al. (2002) conducted a community trial with 18,331 participants in Johnson and Johnson Health and Wellness Program. They measured 8 different factors as reported in Table 2 while giving enticing incentives. Their results demonstrate that their program provided substantial savings in corporate health care costs. After adjusting for potential confounding factors, the program was estimated to save the company an average of \$225 per employee per year for the 4 years examined after program introduction. The savings came from a reduction in hospital inpatient services, mental health visits, and outpatient service usage.

General information on physical activity and dietary education was given to 6532 participants from 68 companies by Kolbe-Alexander et al. (2013). Study participants self-reported favorable changes in blood pressure, BMI, physical activity, fruit and vegetable consumption and smoking, total cholesterol. All outcome measures were checked by an exercise physiologist or on-staff nurses. No incentives were given to participants that participated in the wellness day programs to improve adherence to the physical activity guidelines or risk reduction of having a Non-communicable disease (NCD) such as T2DM.

Bonauto et al. (2014) conducted research with 37,626 Washington state employees using the behavioral risk factor surveillance system in odd numbered years, from 2003 through 2009. The aim of their study was to estimate prevalence of obesity by occupation, physical activity and range of health behaviors associated with obesity. General health education was the intervention and the obtained results were surveyed measuring

occupational groups adjusting for demographics, occupational physical level, smoking, fruit and vegetable consumption and leisure-time physical activity (LPTA). No incentives were reported. Investigators observed a large variability in obesity prevalence, intake of fruits and vegetables, and levels of LPTA across occupations in Washington State. They also found that obesity was more prevalent in truck drivers, transportation and material moving, protective services, and cleaning and building services. Blood values demonstrated that these workers are at the risk of developing T2DM.

Fukunaga et al. (2011) surveyed 190 employees with medically confirmed type 1 diabetes, T2DM, or pre-diabetes. Participants received a general health information and information on medical costs of chronic diseases. Participants in this study indicated that diabetes had pervasive emotional and physical effects on their lives. Additionally, physical and psychological barriers, time and monetary limitations, and problems of a lack of social support with disease management. Participants in both the treatment group and the control group discussed the same barriers and service needs, even though participants in the treatment group had access to educational, motivational, dietary, and exercise supports.

Aldana et al. 2005b collected data on 6246 employees in Washoe County School District (WCSD) during a 6 year period to determine if there was a correlation between Health care costs and Absenteeism. WCSD WP offered 11 different wellness programs designed to encourage employees to engage in healthy lifestyles such as Brighten smile, Holiday weight challenge, and H2O challenge, Tame the TV, March nutrition mystery, Mount

Everest fitness challenge, Test your rest, Ironman triathlon fitness challenge, Train your brain, Exercise for life and Buckle up America! All these programs came with trained staff members and employees were encouraged to adhere to each program they were assigned to. No significant difference in health care costs were found between those who participated in any of the wellness programs and those who did not participate. There was a significant negative association between participation and absenteeism; program participants averaged three fewer missed workdays than those who did not participate in any wellness programs. The decrease in absenteeism translated into a cost savings of US \$15.60 for every dollar spent on the program.

Table 2. Criteria list for the methodological quality assessment of the trials and the definition of the criteria. Modified from Enshers et al, (2005)

Internal validity/Study design		
V ₁	Similarity of Companies	Positive if variability in include companies was controlled for
V ₂	Similarity of study group	Positive if study group were similar at the beginning of the study
V ₃	Dropout	Positive if withdrawal and dropout were <20 through the trial.
V ₄	Outcome	Data on outcome were selected with standardized methods of acceptable quality
Description criteria		
D ₁	Baseline character	Positive if an adequate description of the population was given, including most important demographic factors such as gender, age, type of work, hours per week working, educational level, baseline main outcome measures
D ₂	Company characteristics	Positive if an adequate description of included companies was given, including most important factors such as type of industry, organizational and building characteristics
D ₃	Intervention	Positive if an adequate description of the intervention(s) was given, including number of intervention aspects, nature (type) of intervention, frequency of sessions
D ₄	Follow-up	Positive if yes
Analysis		
A ₁	Intention to treat	Positive if intervention and reference subjects were analyzed according to group belonging to initial assignment, irrespective of noncompliance and interventions

Table 3. Overall score of the methodological quality rating for the included study

Methodological quality assessment criteria

First Author (year)	V ₁	V ₂	V ₃	V ₄	D ₁	D ₂	D ₃	D ₄	A ₁	Validity Score
Haines (2010)	-	+	-	+	+	-	+	+	+	2 ^a
Aldana (2006)	-	+	-	+	+	-	+	+	+	2 ^a
Cawley (2013)	-	+	-	+	+	-	+	+	+	2 ^a
Dunn (2012)	-	+	-	+	+	+	+	+	+	2 ^a
Barham (2011)	-	+	-	+	+	-	+	+	+	2
Lemon (2009)	-	+	-	+	-	+	+	N/A	+	2
Burton (1998)	-	+	+	+	+	-	+	N/A	+	3
Schmittiel (2013)	-	+	-	+	-	+	+	+	+	2
Rolando (2013)	-	+	-	+	+	+	+	+	+	2
Rodbard (2008)	-	+	-	+	-	-	+	N/A	-	2 ^a
Emmons (1998)	-	+	-	+	+	+	+	N/A	+	2
Brownell (1984)	+	+	-	+	-	+	+	N/A	+	3
Tamers (2011)	-	+	-	+	+	-	+	N/A	+	2
Aldana (2005a)	+	+	+	+	+	+	+	N/A	+	4 ^a
Brehm(2011)	-	+	-	+	+	+	+	N/A	-	2
Finkelstein(2009)	-	+	-	+	+	+	+	N/A	-	2
Cook (2007)	+	+	+	+	+	+	+	N/A	+	4
Escoffery (2011)	+	+	+	+	+	+	+	N/A	+	4
Reseland (2001)	+	+	+	+	+	+	+	N/A	+	4
Ozminkowski (2002)	+	+	+	+	+	+	+	+	+	4 ^a
Kolbe-Alexander (2013)	+	+	+	+	+	+	+	N/A	+	4
Bonauto (2014)	+	+	+	+	+	+	+	N/A	+	4
Fukunaga (2011)	-	+	+	+	+	+	+	N/A	+	3
Aldana (2005b)	+	+	+	+	+	+	+	+	+	4

Most trials are randomized controlled studies except for the trials indicated with a superscript “a” which are community controlled trials and surveys. The maximum score for methodological quality is 4 (based on validity section [V₁ to V₄] in criteria). NA, not applicable/not available; +, positive; - negative.

Table 4. Characteristics of trial included in review

Study (year)^{ref}	Subjects	Outcome measures	General intervention	Environment Modification	Follow up	Results
Haines et al. (2010) (CT) Virtual Walking and Wellness Program	120 (white and blue collar)	Organizational data; finger stick cholesterol assessment, blood glucose, Body mass index and blood pressure	Daily pedometer measurement, nutrition, stress reduction physical activity, questionnaires	Encouragement to walk about 10,000 steps per day as recommended by the center for disease control and wellness tips	Yes	Improvement in BMI, blood pressure, and total cholesterol. The program had a moderate effect on fitness, mood, health awareness, nutrition, and health.
Aldana et al. (2006) (CT) Institute of Health Diabetes Prevention Program	603 (white and blue collar)	Organizational data; finger stick for fasting glucose testing, height and weight measurement, behavior change activity	Institute of health diabetes prevention program was implemented with an emphasis on physical activity, dietary education and behavior changes activity	Encourage to achieve a minimum of 150 minutes of moderate to vigorous exercise per week, reduce dietary fat intake to less than 25% of calories and increase brisk walking or activities of similar intensity.	Yes	Employees improved diet, increased physical activity, and improved several clinical measures of diabetes as well as blood lipids. Worksite diabetes prevention programs may reduce blood glucose below pre-diabetic and diabetic levels
Cawley and Price (2013) (CT) Financial Incentive	2635 (white and blue collar) 24 worksites	Organizational data; Body mass index	Financial incentives, health suggestions	Daily emails with information about healthy and effective methods of weight loss including decreasing caloric intake, call center support and weigh in at least once a quarter in order to monitor change for weight loss	Yes	Offering health suggestions, motivated by behavioral economics coupled with financial incentives increased the weight loss in each company.

Dunn et al. (2012) (CT) ESMMWL	2574 NC state employees	Organizational data; Height, weight, body Mass Index, waist circumference, blood pressure, change of dietary habits, and physical activity behavior.	Eat smart, move more, weight loss. 15 week management deliver by trained instructors. Informational session to change dietary habit and physical activity	Mindfulness was encouraged to come back the lack of physical activity and dietary habits.	Yes	Positive outcomes related to weight, blood pressure, healthy eating, and physical activity behaviors was observed.
Barham et al. (2011) (RCT)	45 Onondaga County employees 35 (at risk for diabetes), 10 (with diabetes)	Organizational data; Medical: Weight, BMI, waist circumference, blood pressure, fasting glucose, lipid, and hemoglobin A1c levels. Psychosocial/behavioral: Health-related quality of life Short Form-12, Impact of Weight on Quality of Life Scale), physical activity (International Physical Activity Questionnaire), eating behavior (3-Factor Eating Questionnaire), National Cancer Institute Fat Screener), job satisfaction,	12 week healthy lifestyle sessions based on the Diabetes Prevention Program curriculum, followed by monthly sessions for up to 12 months	At the start of the program, participants were given a pedometer, portion plate, measuring cups and spoons, and books to monitor weights, food intake, and physical activity.	Yes	The intervention was associated with positive lifestyle changes, there was significant decrease in fat intake and increase in physical activity, improvement in how their health affected their physical function and a decreased impact of their weight on their quality of life. Although not specifically targeted, the intervention group demonstrated improvements in their eating behavior, with more cognitive restraint and less emotional eating and uncontrolled eating. No changes in stress levels.
Lemon et al. (2009) (RCT)	899 hospital employees	To examine the associations of perceptions	Weight loss program associated with the	Not specified	N/A	Greater perception of organizational commitment to

		of organizational commitment to employee health and coworker physical activity and eating behaviors with body mass index (BMI), physical activity and eating behaviors in hospital employee	consumption of more fruits and vegetables and less fat consumption, support from the organization and coworker support group.			employee health was associated with lower BMI. Greater perception of coworker healthy eating and physical activity behaviors were associated with fruit and vegetable and reduction in saturated fat consumption.
Burton et al. (1998) (RCT)	53 (white and blue collar) employees started baseline. 45 got retested at the end of the trial.	Before the start of the first program, participants completed three questionnaires, 1) diabetes questionnaire, 2) medical history and 3) history of complications. A fasting venous blood specimen was drawn for lipid levels (total cholesterol, high-density lipoprotein cholesterol, triglycerides, and low-density lipoprotein cholesterol), blood glucose, glycosylated hemoglobin, and hemoglobin A1C levels. Repeat blood testing for	Free glucose monitor upgraded to the Boehringer Mannheim Advantage glucose monitor. In addition, a box lunch with a nutritional content consistent with ADA dietary recommendations was provided at no cost to the employee for each session	Encouragement to follow the nutritional content of ADA.	N/A	After 3 months of educational programs, the subjects' mean fasting blood glucose levels fell from 197.8 mg% to 179.6 mg% (P = 0.12), mean glycohemoglobin declined from 11.5% to 10.1% (P < 0.001), and mean hemoglobin A1C declined from 9.0% to 8.3% (P < 0.001)

		fasting blood glucose, glycosylated hemoglobin, and hemoglobin A1C levels was performed 3 months after the baseline laboratory tests.				
Schmitt l et al. (2013) (RCT)	1427 patients Kaiser Permanente Northern California Next-D study	Self- reported healthy eating, physical activity, weight managemen t, smoking cessation, and stress managemen t to reduce health risk and increase health- related quality of life.	The first study evaluates a telephonic health- coaching program that provides counseling on healthful eating, active living, and weight loss to KPNC members. The second evaluation examines a postpartum glucose screening and educational diabetes prevention program for women with gestational diabetes mellitus that KPNC implemented in 2006.	Emphasis to adhere to the program.	Yes	Moderate outcomes with healthy eating, physical activity, smoking cessation and stress management. Phase 3 will be conducted with another step.
Rolando et al. (2013) (RCT)	3125 Vanderbilt University employees	Self- reported diabetes, the main outcome variable, was determined by employees' response to the HRA	Vanderbilt University wellness program aims to support the health and productivity of faculty and staff by encouraging and facilitating the adoption or	Not specified	Yes	Employees who reduced their body mass index from 30 or more to less than 30 decreased their chances of developing diabetes (odds ratio = 0.22, 95% confidence interval: 0.05 to 0.93), while those

		<p>question “Has a doctor informed you that you currently have diabetes (high blood sugar)?” Answer choices included “yes, but not taking medication,” or “yes, and taking medication.”</p> <p>Otherwise, the question was left blank.</p>	<p>maintenance of healthy lifestyle practices. Targeted health improvement programs address weight management, physical inactivity, tobacco use, stress, poor nutrition, alcohol misuse, hypertension, and high cholesterol.</p> <p>Programs include educational seminars, incentives for adoption or maintenance of positive health habits, behavior-change interventions, and a supportive physical and social environment</p>			<p>who became obese increased their diabetes risk (odds ratio = 8.85, 95% confidence interval: 2.53 to 31.0).</p>
Rodbard et al. (2008) Community based population	15,132 Community based US population	<p>Work productivity and activity impairment measuring BMI, abdominal obesity, Cholesterol, hypertension or history of coronary heart disease or stroke.</p> <p>Absenteeism recorded as how many hours</p>	<p>General health promotion information.</p>	Not specified	N/A	<p>Percentage of work impairment and proportion with severe disruption of work, family, and social life increase systemically from normal weight to obese (p<0.001). Obese individuals had the greatest impairment at work (11%-15% of work loss), greatest impairment of daily activity (20%-34%) of the</p>

was missed in 7 or more days because of health problems, Presenteeism was measured by the Likert scale of 0-10.

greatest impairment overall in the LR, HR, T2DM). Obesity and T2DM were independent predictors of overall work impairment and life disruption (p<0.001)

Emmons et al. (1998) (RT)	2,761 The Miriam Hospital, Brown University School of medicine	Data for the primary outcomes related to physical activity, nutrition, and smoking were collected from a census sample of individual employees, using self-administered surveys delivered in person or distributed to employees through the company mail. A secondary outcome for each behavior was motivation for behavior change.	The intervention protocol included a number of individually focused intervention activities, as well as strategies targeted at the social norms and health-related policies at the worksite. Such as Educational health programs, self-skill management programs, contest and monetary incentives, smoking control policy and enforcement of policy.	Cafeteria vending machine was labelled with what complied with the program. Smoking control policy was enforced and if not followed a penalty was administered to the individuals.	N/A	By the time of both the interim (intervention midpoint) and final (end of intervention) assessments, participants in the intervention condition had significantly increased their exercise behavior, compared with the control condition. There was also increased consumption of fruits and vegetables and fiber in the intervention condition by the time of the final assessment, compared with the control condition. No differences by condition were found with regard to percentage of calories from fat consumed or smoking cessation.
Brownell et al. (1984) (RCT)	267 employees from 5 companies in Northern Pennsylvania	Self-reported BMI	Three weight loss competitions were held in business/ industrial settings. One competition was between	Encouraged to lose weight based on adjustment of incentives.	N/A	Both employees and management reported positive changes in morale and employee/management relations, and both considered the competition

three banks; the other two were within industries, either between employees teams selected at random or between divisions of the industry. Financial incentives was given

important to the success of the program. The cost-effectiveness ratio (\$2.93 per 1 per cent reduction in percentage overweight) is the best yet reported.

Tamers et al. (2011) (RCT)	2,878 employees in Greater Seattle	The aim was to evaluate the relationship between worksite social support and dietary behaviors, physical activity, and body mass index (BMI).	Promoting Activity and Changes in Eating (PACE).	Not specific	N/A	No associations were found with worksite social support and BMI, or with many obesogenic behaviors. However, individuals with higher worksite social support had 14.3% higher (95% CI: 5.6%-23.7%) mean physical activity score and 4% higher (95% CI: 1%-7%) mean fruit and vegetable intake compared to individuals with one-unit lower support.
Aldana et al. (2005a) Community based US population	145 individuals at Swedish American Health System	Eligible and interested participants provided informed consent. The SAHS paid for the employees. Modern medicine and health myths, atherosclerosis, coronary risk factors, obesity, dietary	The intervention for the study was a live version of the Coronary Health Improvement Project (CHIP).	Participants was encouraged to follow preset dietary and exercise goals, increase their consumption of whole grains, legumes, vegetables and fresh fruits. A pedometer was administer to each	N/A	Cognitive understanding of the requirements for a healthy increased lifestyle increased at the end of the program. Program participants significantly improved their cognitive understanding of good nutrition and physical activity at both 6 weeks and 6 months. Participants had significantly lower

		fiber, dietary fat, diabetes, hypertension, cholesterol, exercise, osteoporosis, cancer, lifestyle and health, the optimal diet, behavioral change and self-worth.		participants and they were required to walk for at least 30 minutes and log there exercise.		body fat, blood pressure and cholesterol.
Brehm et al. (2011) (RCT)	600 employees from 8 manufacturing companies in Kentucky	Organizational data; height and weight was recorded.	Phase I: Focus groups was implemented for the managers and employers. Phase II: Worksite intervention which includes point of decision prompts.	The decision prompts included taking the stairs, choosing nutrient rich foods such as fresh fruit and vegetables, walking paths, educational materials. Vending changes and cafeteria/vending changes.	N/A	There were no significant effects of the intervention on any of the bio-measures. However, significant time effects ($p < 0.05$) indicated improvement in total cholesterol, LDL cholesterol, and triglyceride concentrations, as well as fasting glucose, insulin, and insulin resistance. Although a significant time effect was shown for HDL cholesterol, there was not a clear pattern of improvement. Both diastolic and systolic blood pressure increased over the course of the study ($p < 0.001$).
Finkelstein et al. (2009) (RCT)	965 individuals from 17 community college in North Carolina	Organizational data; height and weight, absenteeism was also analyze	Weight loss program with financial incentives	Not specific	N/A	Modest weight loss may not directly translate into measurable short-term reductions in medical expenditures or

absenteeism but has shown modest improvement in glycemic control, cholesterol & BP.

Cook et al. (2007) RCT	419 human resource employees at three companies in Atlanta, Georgia, Minneapolis, MN and Fountain valley, CA	All subjects were assessed at pretest and posttest over a 3 month period measuring attitudes toward healthful diet, eating practices, motivation to improve diet, dietary behavioral intervention, dietary self-efficacy, dietary stage of change, weight stage of change, precursor to stress, symptoms of distress and stress stage of change.	A web-based study was conducted. The control group was the web-based and the experimental group was the paper-based group. Information was given on how to address the various measures that were tested in the studies. Both groups had financial incentives.	To adhere to their respective program.	N/A	Found that the Web-based program was more efficient even though there was no significant correlation with the reduction of stress or physical activity.
Escoffery et al. (2011) RCT	60 participants from small companies in Calhoun and Terrell county in Georgia.	Interviews conducted to assess the effectiveness of cafeterias, vending machines and physical activity. BMI was self-reported.	Each participant was interviewed for eligibility and was given financial incentives to participate.	No change but just answer questions about how different changes could improve work productivity.	N/A	Survey found that if employees could have access to more physical activity and cafeterias that have better food there is a possibility that work productivity might increase and obesity will decrease.
Reseland et al. (2001) RCT	184 participants were placed in 4 different	Diet, exercise, a combination of diet and exercise,	Oslo Diet and Exercise Study, The 2 interventions were physical	The advice was individually tailored according to	N/A	Plasma leptin concentrations, body mass index, and fat mass decreased in

	groups for analysis.	and control. Data on dietary intake, physical fitness, and demographics were collected and plasma leptin concentrations were measured before and after a 1-y intervention period.	exercise and dietary change, alone or in combination, lasting 1 yr.	dietary habits and risk factor profile. Increased consumption of fish and fish products, vegetables, and fiber-rich products containing complex carbohydrates and reduced intake of saturated fat and cholesterol were recommended. The exercise program entailed supervised endurance exercise, such as aerobics, circuit training, and fast walking and jogging, 3 times/wk. Each workout lasted 60 min. The exercise group and the combined diet and exercise group were not separated during training. Attendance at each workout was recorded, as was the physical activity some participants did at home.		association with long-term reductions in food intake as well as increased physical activity. By adjusting for either body mass index or fat mass, we observed a highly significant reduction in plasma leptin concentration after both the diet and the exercise interventions. There was no interaction between the interventions, suggesting a direct and additive effect of changes in diet and physical activity on plasma leptin concentrations.
Ozminkowski et al. (2002) CT	18,331 participants in Johnson and	Johnson & Johnson H & W Program	Prevent management consisted of eight major	Financial incentive was given to all participants	4 years	Results from the evaluation of the new H & W Program indicated

Johnson H&W program	influenced the following health care utilization measures: emergency department visits, outpatient department and doctors' office visits, mental health care visits, and inpatient hospital days.	activities: (1) health risk assessment by means of the Johnson & Johnson Insight Health Risk appraisal survey; (2) referral to high- risk intervention programs known as Pathways to Change, based on HRA responses; (3) preventive health services and screening programs, with appropriate coverage for such services included in the benefit plan design; (4) a focus on health education and self-responsibility; (5) health education/training; (6) ergonomics assessments/job conditioning; (7) medical surveillance and regulatory compliance; and (8) workplace drug and alcohol awareness training.	but no specific environmental modifications	substantial savings. After adjusting for potential confounders, the Program was estimated to save the company an average of \$224.66 per employee per year for the 4 years examined after program introduction. These savings came from reductions in hospital inpatient use (\$119.67), mental health visits (\$70.69), and outpatient service use (\$45.17). Savings were offset somewhat by a very small increase in emergency department use (\$10.87 per employee per year). Most of the savings occurred in years 3 and 4 after program initiation.
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Kolbe-Alexander et al. (2013) RCT	6532 participants from 68 companies	Self-reported and clinical measures: Blood pressure, Body Mass Index, Total	General information on physical activity and dietary education was given.	No incentive was given but exercise physiologist and nurses were conducting clinical	N/A	Those participants that participated in wellness day programs and adhere to the physical activity guidelines reduced their risk of
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		cholesterol levels, physical activity, fruit and vegetable intake, smoking.		measures throughout the 12 month period.		having a NCD and also reduced the cost of medical related sickness than non-participants.
Bonauto et al. (2014) RCT	37,626 employed Washington State respondents using the Behavioral Risk Factor Surveillance System in odd numbered years, from 2003 through 2009.	The aims of this study were to estimate the prevalence of obesity by occupation, examine the association of occupational physical activity and a range of health behaviors with obesity, and identify occupations in which workers are at high risk of obesity in Washington State.	General education and surveys measuring occupational groups adjusting for demographics, occupational physical activity level, smoking, fruit and vegetable consumption, and leisure-time physical activity (LPTA).	No incentives was offered and no specifics on environmental modifications.	N/A	We observed a significant disparity in obesity prevalence, intake of fruits and vegetables, and levels of LTPA across occupations in Washington State. We identified several occupations with significantly higher prevalence estimates of obesity than that of the referent occupation, health diagnosing occupations: truck drivers, transportation and material moving, protective services, and cleaning and building services.
Fukunaga et al. (2011) RCT	190 employees was surveyed and interviewed in a focus study	Between April and September 2008, the HI-DMIE study used a 2:1 ratio stratified by diabetes type (type 1, type 2 or prediabetes) and randomly assigned 190 eligible participants into treatment (n = 128) and	General health education and conversation about changed during interviews.	Financial incentive was offered but no specifics on environmental modifications.	N/A	Participants in this study indicated that diabetes had pervasive emotional and physical effects on their lives. Additionally, physical and psychological barriers, time and monetary limitations, and a lack of social support complicated disease management. Participants in both the treatment

			control (n = 62) groups.			group and the control group discussed the same barriers and service needs, even though participants in the treatment group had access to educational, motivational, dietary, and exercise supports.
Aldana et al. (2005b) (RCT)	6246 Washoe County School District (WCSD)	To determine if the Washoe County School District wellness program impact care costs and rates of absenteeism over a 2 year period.	WCSD WP offered 11 different wellness programs designed to encourage employees to engage in healthy lifestyles. The programs are: Brighten weight challenge, H ₂ O challenge, Tame the TV, March nutrition mystery, Mount Everest fitness challenge, Test your rest, Ironman triathlon fitness challenge, Train your brain, Exercise for life and Buckle up America!	N/A	6 years	No significant difference in health care costs were found between those who participated in any of the wellness programs and that who did not participate. There was a significant negative association between participation and absenteeism; program participants averaged three fewer missed workdays than those who did not participate in any wellness programs. The decrease in absenteeism translated into a cost savings of US \$15.60 for every dollar spent on the program.

Analysis of the 24 studies versus the new program

Table 5: Analysis of Wellness component for the 24 included studies and new program.

Wellness programs	Biometric/Medical							Diet and Exercise					Environmental					Total		
	Health CC	HPM	Stress Reduction	Health evaluation	Smoking cessation	psychologist	Dietician	Buddy system	Release Time	PFT/PA	Spirituality	HC	Supplements	Coobook	Staff Chef	Budgeter	Healthy Snacking		Fall Prevention	FIN INC
Haines	1	1	1	1	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	7
Aldana 2	1	1	1	1	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	7
Cawley	1	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	5
Dunn	1	1	1	1	0	0	1	0	1	1	0	0	0	0	0	0	0	0	1	8
Barham	1	1	1	1	1	1	1	0	1	1	0	0	0	0	0	0	0	0	1	10
Lemon	1	1	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	5
Burton	1	1	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	5
Schmittiel	1	1	1	1	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	7
Rolando	1	1	1	1	1	0	1	0	0	1	0	0	0	0	0	0	0	0	1	8
Rodbard	1	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	4
Emmons	1	1	1	1	1	0	1	0	0	1	0	0	0	0	0	1	0	0	1	9
Brownell	1	1	1	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	7
Tamers	1	1	1	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	7
Aldana 14	1	1	1	1	0	0	1	0	1	1	0	0	0	0	0	0	0	0	1	8
Brehm	1	1	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	5
Finkelstein	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4
Cook	1	1	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	5
Escoffery	1	1	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	6
Reseland	1	1	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	5
Ozminkows	1	1	1	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	1	9
Kolbe-Alex	1	1	1	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	6
Bonauto	1	1	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	5
Fukanga	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4
Aldana24	1	1	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	6
14 Step pro	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	19
Programs	25	25	13	25	6	5	19	1	6	23	1	1	1	1	1	1	2	1	13	

HC= Healthy Competitions
 Health CC= Health Care Components
 FIN INC = Financial Incentive
 PFT/PA= Personal Fitness Trainer/ Physical Activity
 HPM= Health Promotion Meetings

Table 5: Depicts the comparison among the 24 studies and the new 14 step program that was created. As shown above none of the wellness programs have all 19 components that the infinite health coach determined would be most effective in targeting Type II Diabetes Mellitus, (<http://infinitehealthcoach.com/employee-wellness-program-components/>). However, the new program that is created contains all 19 elements and would be more than effective when implemented. As one can see it builds upon the already existing wellness program with additional elements such as fall prevention, spirituality, budgeter and staff chef. The 14 step program is rigorous and can be implemented in two ways according to the recently passed Affordable Care Act and will be able to not only reduce absenteeism and increase work productivity but also allows the employers to have tax breaks that would offset the HR cost for funding such program (for details see Discussion).

CHAPTER 4

DISCUSSION

As summarized in the Results section, this research was conducted using a modified systematic review approach based on the five steps put forth by (Khan et al. 2003). These steps includes 1) framing the questions for the review, 2) identifying relevant work, 3) assessing the quality of the studies, 4) summarizing the evidence, and 5) interpreting the findings. These steps were modified allowing a graduate student in training to be one of the expert arms of the study. This modification worked well to train the graduate student and to produce a conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients (Sacket et al, 1996).

Dr. Blanks, Tiffany and I developed search criteria that called down 20,000 publications to 24 studies meeting strict research design and results that could be generalized to a larger population for better design of an evidence-based corporate wellness program for evaluating in future studies. Once the papers were analyzed and reviewed, the results were formulated with current regulations to recommend the 14 step program below, the new program was designed specifically to include the necessary guidelines and criteria for compliance with Federal tax code.

Pitfalls

The methodology employed here leaves room for bias because it did not include wellness programs that were developed in other countries or literature written in other languages. The search terms themselves might have been too board or too narrow and probably not specific enough where more literature could be included. Also, there was only a few studies that explicitly detailed the length of intervention and follow up periods. Most studies did not focus heavily on how they could have possibly improved their approach to target the needs of the individual employees. It is also a possibility that some of the studies also had incomplete data or poor follow-up, such as the study conducted by Ozminkowski et al. (2002).

Interventions

Most of the Worksite Wellness Program targeted lifestyle factors to reduce the risk of Type II Diabetes Mellitus (Haines et al. (2010), Aldana et al. (2006), Cawley and Price. (2013), Dunn et al. (2012), Barham et al. (2011), Lemon et al. (2009), Burton et al. (1998), Schmittdiel et al. (2013), Rolando et al. (2013), Rodbard et al. (2008), Emmons et al. (1998), Brownell et al. (1984), Tamers et al. (2011), Brehm et al. (2011), Finkelstein et al. (2009), Cook et al. (2007), Escoffery et al. (2011), Reseland et al. (2001), Bonauto et al. (2014), Fukunaga et al. (2011) and Aldana et al. (2005b). Aldana et al. (2005a), Ozminkowski et al. (2002) and Kolbe-Alexander (2013) are the three programs that focused on reducing the risk for chronic diseases by lowering factors that also contributes to diabetes. One program focused on Absenteeism and direct Health care cost (Aldana et al., 2005b). All of the Worksite Wellness Programs included in the review were multicomponent interventions, which means they consisted of educational sessions to

raise awareness, incentives, physical activities (personal trainer), dietary guidelines and some type of environmental modifications. Schmittdiel et al. (2013) and Rodbard et al. (2008) also included an effective policy on smoking in their intervention. One study Lemon et al. (2009) included coworker support groups in the intervention to achieve health effects inside the work force and combat work-related stress. The Schmittdiel et al. (2013) study also included a coaching program to help participants with their diet and physical activity.

Environmental modification to increase physical activity was included in the studies by Haines et al. (2010), Aldana et al. (2006), Dunn et al. (2012), Barham et al. (2011), Aldana et al. (2005a), Brehm et al. (2011) and Reseland et al. (2001). Haines et al. (2010); Aldana et al. (2005a) and Barham et al. (2011) encouraged exercise by providing a pedometer to all participants. Brehm et al. (2011) encouraged workers to exercise by using the stairs instead of the elevator by means of posters and bulletin boards. Reseland et al. (2001) exercise program entailed supervised endurance exercise, such as aerobics, circuit training, and fast walking and jogging, 3 times/week. Each workout lasted 60 min. The exercise group and the combined diet and exercise group were not separated during training. Additionally, Aldana et al. (2006) and Dunn et al. (2012) just placed emphasis on physical activities but no specifications of environmental modifications was specified in their studies.

The four studies Emmons et al. (1998), Aldana et al. (2005a), Brehm et al. (2011) and Reseland et al. (2001) used environmental modifications that stimulate healthy eating and

address different types of dietary intake such as fruits, vegetables, less fat intake, fiber consumption and grains. The interventions had the educational aspects supported by pamphlets and bulletins. Emmons et al. (1998) and Brehm et al. (2011) relabeled and offered healthier choices in the cafeteria and vending machines. Cawley and Price, (2013), Burton et al. (1998), Schmittiel et al. (2013) and Reseland et al. (2001) used compliance to a specific program or guidelines of their specific program to encourage walking and eating healthier. Lemon et al. (2009), Rolando et al. (2013), Brownell et al. (1984), Tamers et al. (2011), Finkelstein et al. (2009), Cook et al. (2007), Escoffery et al. (2011), Ozminkowski et al. (2002), Kolbe-Alexander et al. (2013), Bonauto et al. (2014), Fukunaga et al. (2011) and Aldana et al. (2005b) studies did not provide detail as to the specific environmental modifications employed. For those that emphasize physical activity in their environmental modifications, the authors found a positive correlation with blood pressure, stress and changes in cholesterol.

Of the 24 studies, there were only three (Emmons et al., 1998; Aldana et al., 2005a; Kolbe-Alexander, 2013) that had participants' self-report dietary intake including: fruits, vegetables, fat and fiber. The studies by Burton et al. (1998), Brownell et al. (1984) and Aldana et al. (2005a) measured the effect of worksite wellness program, including environmental modification such as changing the food in the cafeteria, labeling food that is healthy and increasing the intake of more fruits and vegetables while encouraging more physical activity. Most studies found significant positive changes compared to controls.

Aldana et al. (2006) and Aldana et al. (2005a) studies measured the effect of worksite wellness program on dietary fat intake and both have reported a decrease in fat consumption. Emmons et al. (1998) and Brehm et al. (2011) evaluated the effect of worksite wellness program on fiber intake. Both studies reported that there was decrease in blood pressure and cholesterol level.

Many of the studies evaluated worksite wellness program effects on cholesterol, blood glucose, HbA1C and blood lipid including Haines et al. (2010), Aldana et al. (2006), Barham et al. (2011), Burton et al. (1998), Rodbard et al. (2008), Aldana et al. (2005a), Brehm et al. (2011), Finkelstein et al. (2009), Reseland et al. (2001) and Kolbe-Alexander et al. (2013). In these studies, environmental modifications were supported by encouraging participants to walk and administering pedometers, encouraging participants to follow the American Diabetes Association nutritional content and also following the Coronary Heart Improvement project (CHIP). In Virtual Walking and Wellness Program (Haines et al., 2010) and Institute of Health Diabetes Prevention Program (Aldana et al., 2006) finger- stick for the measurement of cholesterol and blood glucose was administered. In Barham et al. (2011) and Burton et al. (1998) a fasting venous blood specimen was drawn for lipids levels, blood glucose, glycosylated hemoglobin and HbA1C. Also, for Burton et al, (1998) they repeated the blood testing for fasting blood glucose, glycosylated hemoglobin, and HbA1C 3 months after the baseline laboratory test was conducted. For the remaining studies they did not specify how they measure the cholesterol level or blood glucose levels but have reported that there was a decrease.

Several other outcome measures are relevant. Finkelstein et al. (2009) found no significant changes concerning BMI in the control and experimental group. Haines et al. (2010) and Dunn et al. (2012) studies studied the effect of blood pressure and found that a reduction of stress and increase of physical activity can help with blood pressure. Rodbard et al. (2008) and Finkelstein et al. (2009) studies look at work productivity, absenteeism and presenteeism and did not find any significant changes but have reported that having good health can reduce both absenteeism and presenteeism while increasing workers' productivity. Aldana et al. (2006), Barham et al. (2011), Burton et al. (1998) and Rolando et al. (2013) studies reported the correlation of physical activity and diet on diabetes and have stated that an effective diet and increase in physical activity can decrease the onset of Diabetes.

The Design of the New Wellness program

Designing and implementing a concise and effective wellness program can prove to be rather challenging. However; with the review and analysis of other reported programs it is much easier and effective to design a new and more efficient employer-based corporate wellness program. From the twenty-four studies included in this research one can easily see that there were missing key components that should be included in an effective corporate wellness program (see Figure 5). From all twenty-four studies only Barham et al. (2011) had at least 10/19 component that a rigorous and effective employer sponsor wellness program likely should contain.

All twenty-four studies targeted some aspect of Health care component, Health Promotion Program and Health evaluations. These are the preliminary steps in designing an effective wellness program, however, when addressing the issue relating to physical activity (PA) or access to a personal fitness trainer (PFT) only twenty-two studies out of the twenty-four had that component. Finkelstein et al. (2009) and Fukunaga et al. (2011) are the two studies that did not include a PA or PFT component because they were more focused on participants in the study that dealt with absenteeism or indicated that diabetes had pervasive emotional and physical effects on their lives.

Out of the twenty-four studies only eighteen actually dealt with the issues concerning a healthy diet or providing access to a dietician. Cawley and Price (2013), Rodbard et al. (2013), Brownell et al. (1984), Brehm et al. (2011); Finkelstein et al. (2009) and Fukunaga et al. (2011) are the ones that did not have this component. For the ones that had the dietary component they either gave advice on what individuals should consume through the research or they observed and made environmental changes to enhance proper nutrition.

Twelve studies out of the twenty-four had a stress reduction component or focused on reducing stress. All twelve found that reducing stress could actually reduce the onset of Type II Diabetes or other relatable metabolic syndromes are Haines et al. (2010), Aldana et al. (2006), Dunn et al. (2012), Barham et al. (2011), Schmittdiel et al. (2013, Rolando et al. (2013), Emmons et al. (1998), Brownell et al. (1984), Tamers et al. (2011) and

Aldana et al. (2005). The other 12 did not mention a component involving stress reduction.

Twelve studies out of the twenty-four studies had a financial incentive component. From the list these studies realized that individuals are more prone to commit to a health program when there are some sort of financial benefits no matter how much it is. These studies included Cawley and Price (2013), Dunn et al. (2012), Barham et al. (2011), Rolando et al. (2013), Emmons et al. (1998), Brownell et al. (1984), Aldana et al. (2005a), Finkelstein et al. (2009), Escoffery et al. (2011), Ozminkowski et al. (2012), Fukunaga et al. (2011) and Aldana et al. 2005b.

Five studies out of the twenty-four studies allowed employees job release time to participate in the wellness program. These studies are Haines et al. (2010); Aldana et al. (2006), Dunn et al. (2012), Barham et al. (2011) and Aldana et al. (2005a). The other nineteen studies did not mention or incorporate an element that could be recognized as on the job release time. For those that had this component they measured the results and track progress by the use of pedometer or other unreported devices.

Five studies included a smoking cessation component in their wellness program. These studies were conducted by Barham et al. (2011), Schmittiel et al. (2013), Rolando et al. (2013), Emmons et al. (1998) and Ozminkowski et al. (2012). The result from the studies demonstrated that targeting smoking can help reduce the cost of health care problems relating to Type II Diabetes mellitus. They went about handling the issues in

different ways such as placing smoking inhibition signs around the workplace or simply fining anyone that broke the no smoking policy.

Only four studies included a component concerning sociological or psychological issues. These studies demonstrated that targeting someone's emotional state is effective in improving symptoms (as suggested by the psychosocial model of health- see Fig. 2 and 7) reduces any symptoms of metabolic syndrome symptoms that share similarities to T2DM. These studies are Barham et al. (2011), Tamers et al. (2011), Brehm et al. (2011) and Ozminkowski et al. (2012). They test participant's emotional state through self-reported questionnaires and counseling.

Emmons et al. (1998) was the only study that included the component of healthy snacking. In this study they removed all the unhealthy snacks out of the cafeteria and vending machines and only included healthy choices. On the other hand only Brownell et al. (1984) included a healthy competition component. They pair individuals off in groups and add financial incentives then they allowed them to compete against each other to lose the weight. In the end the team that lost the most weight get a certain amount of money. Needless to say individuals lost a lot of weight.

Out of the twenty-four studies none of them reported having components such as issuing a cookbook for those who do not know how to cook or hiring an on the staff chef that can prepare meals and do cooking demonstration during the work week. Other components that were missing includes a budgeter that can assist individuals with money so they can

spend wisely and purchase healthier choices, a fall prevention program that assist everyone especially the elderly population with on the job issues concerning fall or issues relating to outside of the work force, a buddy system that can keep employees accountable with losing weight and the quitting of smoking if need be. Research conducted by Kishore et al., 2011 reported that individuals who were insulin resistant and had a Vitamin D deficiency, saw a 37% difference and increase in hepatic insulin sensitivity after two months of vitamin D supplements. Which means Vitamin D supplements are needed as a cofactor in the body as well as spirituality that can assist more with stress reduction and meditation.

Cost and Tax Status of Funded Health Plans and Corporate Wellness Programs:

As health care costs continue to rise, an employer-paid health plan can be one of the most valuable and important benefits provided by an employer. Nearly 90% of employers offer wellness incentives, or financial rewards or prizes to employees who work toward getting healthier, according to a recent survey from Fidelity Investments and the National Business Group on Health. That's up from 57% of companies in 2009. The perks are also worth more now: \$521 per employee on average, compared with \$260 four years ago. When an employer pays the cost of an accident or health insurance plan for his/her employees, the coverage is often extended to an employee's spouse and dependents. These benefits, paid by the employers, are not wages and are not subject to Social Security, Medicare, and FUTA taxes, or federal income tax withholding. Other tax-free employee fringe benefits offered by employers can include: long-term disability

insurance, group term life insurance, disability insurance, dependent care assistance and other (e.g., stock options, employee discounts on goods and services, etc.).

A wellness tax credit was not part of the original Patient Protection and Affordable Care Act (PPACA), or health care reform act or simply called “Obamacare”. However, as was true before this sweeping legislation went into effect, the expense of an employer-provided wellness program for employees is deductible as an employee business expense (section 162 of the IRS code). New regulations that went into effect January 2014, further clarify wellness-related PPACA regulations as well as identifying new options for employers.

Wellness programs are those designed to promote better health or prevent disease and fall into two categories for strict legal and compliance reasons; Health-Contingent Wellness Programs, and Participatory Wellness Programs. To avoid discrimination based on employee health status, **Health-Contingent Programs** require employee participants to actually perform an activity or achieve a specific outcome(s) to receive a reward or added compensation from the company. Under these new regulations, incentives for “Health Contingent Wellness Programs” can be rewarded up to 30% of the value of the plan (or 50% if exclusively tied to tobacco cessation). In contrast, **Participatory programs** do not require employees to meet a particular standards (e.g., blood pressure, cholesterol level, BMI, etc.), nor do they provide a reward for healthy employees to become involved with programs. “Participatory Wellness Programs” will continue to face no limits on

incentives paid to employees. (<http://www.nolo.com/legal-encyclopedia/final-rules-wellness-programs-under-obamacare>. Accessed 6/15/2014).

The Federal Government has not yet implemented specific wellness tax credits under Obamacare, but the States are beginning to do so. For example, the Massachusetts legislature enacted legislation in 2012 providing that employers that initiate a wellness programs for their employees will be eligible for an annual wellness tax credit of up to \$10,000. The credit is in the amount of up to 25% of the cost of implementing an employee wellness program. Costs in the initial year that exceed that figure may be carried over into subsequent years for credit against future tax liabilities (please consult an accountant to confirm all details). The Massachusetts Department of Public Health is expected to issue regulations with further details tied to the tax credit in the near future. For employers who do not yet have a wellness program in place, this new tax credit provides an additional reason to do so.

Kentucky and Indiana have produced studies on the value of a worksite wellness tax credits. The Kentucky plan is summarized at <http://www.healthimpactproject.org/resources/document/Home-HIA-Executive-Summary-2012-FINAL-22212.pdf>. In Indiana, the mandated Small Employer Qualified Wellness Program Tax Credit (Indiana Code 6-3.1-31.2) provided (up until Dec of 2011) a state wellness tax credit of 50 percent of the costs incurred by an Indiana small business for providing a qualified wellness program to employees. The future of these programs is uncertain, but likely similar legislation would be extended to other states and to small corporations (<100 employees) who work more than 25 hours per week.

Which corporations are eligible to claim the tax credit for eligible wellness program expenditures? To claim tax credits for these programs, an employer would be required to obtain a certification by the Secretary of Health and Human Services (in coordination with the Director of the Center for Disease Control and the Secretary of the Treasury) that its program meets the definition of a “qualified wellness program”. In order for a program to be a qualified wellness program under the new proposal, all employees would be required to be eligible to participate in the program. Further, under the proposal, a qualified wellness program includes four components: 1) health awareness training (such as health education, preventive screenings and health risk assessment); 2) employee engagement (such as mechanisms to encourage employee participation); 3) behavioral change (elements proven to help alter unhealthy lifestyles such as counseling, seminars, on-line programs, self-help materials), and 4) have a supportive environment (such as creating on-site policies encourage healthy lifestyles, eating, physical activity and mental health). For an employer with 500 or more employees, to be a qualified wellness program, a program would be required to include all four components. For an employer with less than 500 employees, to be qualified wellness program, a program would only be required to include at least three of the four components.

In addition, to be a qualified wellness program under the proposal, the program would be required to be consistent with evidence-based research and best practices, as determine by the Secretary of Health and Human Services, such as research and practices described in the Guide to Community Preventive Services and Guide to Clinical Preventive Services and the National Registry for Effective Programs. Finally, another option would apply all of the criteria described above as well as provide employers with 50 or fewer

employees with a credit limited to \$400 per employee. The credit would not have a sunset requirement for those employers.

The 4 Part-14 Step Wellness program

Conducting a modified systematic review has provided the necessary insights needed to create a new and concise wellness program that includes the 4 main component that is required by the Affordable Care Act in order for employers to get a tax break from the IRS. To specifically treat disease entities such as obesity and T2DM, the program has to meet certain specific criteria of what is termed a fully qualified health contingent wellness program. If the corporation proposes to conduct a general health promotion program instead, i.e., a participatory wellness program, the requirements are less stringent, and the company need only create a program that contains any three of the four listed below). These basic components have been expanded based upon the systemic review of current literature to include specific parts as follows:

- 1) HEALTH AWARENESS TRAINING (health education, preventive screenings and monitoring of health risk assessments):
 - 1a. On-site Doctor or Nurse- help with on-site assessment, care and training.
 - 1b. Health awareness training, health education, preventative screening and health assessment. – Regular meeting to conduct health checks and biometric screenings.
And monthly updates to educate staff on healthy lifestyle choices help with

precursors for T2DM. Data from the studies have shown that the lack of information concerning healthy living affects many aspects of a thriving company.

1c. On-site sociologist/psychologist- It's very important to address obesity as the key player in developing T2DM from a physical, emotional and social stand point. If individuals are dealing with social and emotional issues they tend to accumulate weight over time. However, having an on-staff counselor could help combat the stressors in employees' life and decrease health related cost.

2) EMPLOYEE ENGAGEMENT (mechanisms to encourage employee participation):

2a. Release time and incentives (monetary and other) – Encouraging 5-15 minutes to stretch and walk around, can help relieve the strain that employees are faced with in corporations and allow them to refocus. Thus maximizing work-productivity.

2b. A buddy system- Apart from having a personal fitness trainer having a gym or work-out buddy can also give the extra push some people need to continue with their work-out regime or simply to quit smoking.

2c. Provide dietary leptin/fiber supplements and vitamins/minerals - vitamins and minerals are coenzymes and co-factors needed for various functions in the body.

Many individuals lack these supplements in their diets so investing money to pay for these supplements can reduce health related complications, thus reducing “presenteeism” and eliminating “absenteeism”.

3) BEHAVIORAL CHANGE (elements proven to help alter unhealthy lifestyles such as counseling, seminars, on-line programs, self-help materials):

3a. On staff registered Dietician – To assist employees in corporations with their dietary intakes and offer advice on diet. He/she can also give cookbooks to employees who really want to learn to make healthier meals.

3b. On staff chef - Collaborate with dietician in developing healthier cafeteria food. Provide cooking classes at the company that is tasty, affordable and healthy.

3c. A financial accountant/budger. This person will be able to take the recommendations of the dietician and chef to help each employee regardless of their budget, to purchase healthier food choices, food preparation, and program affordability.

3d. Healthy competitions- According to Brownell et al. (1984) health promotion competition with monetary incentives can enhance motivation and social support. One suggestion is to have departments within a company compete against each other at least once a month at a company picnic or at least encourage every member of the company to train for a marathon that benefits a cause.

3e. Personal Fitness trainer- Several studies has expound on the idea of having facilities for physical activity. However; an effective wellness program should have a personal trainer that can work with employees who need motivation and someone to hold them accountable. The personal fitness trainer will help individuals set realistic goals to maintain weight loss and even administer a pedometer to measure how much an individual exercise for that day (Haines et al., 2010). He/she will also be in charge of implementing a program gearing towards fall prevention.

3f. Vending machines/Cafeterias – The provision of healthier meals in the cafeteria will be plan and supplied by the on staff chef. The chef alongside the dietician advice

healthier choice snacks for the vending machines. Escoffery et al. (2011) conducted a research on several manufacturing companies in America proves that getting rid of the unhealthy meals illustrates great weight loss in company workers.

4) SUPPORTIVE ENVIRONMENT (strong administrative support and on-site policies encourage healthy lifestyles, eating, physical activity and mental health):

4a. Prohibit smoke/alcohol consumption - Try to create a smoking free environment by educating individuals about the risk associated with secondary smoking and smoking in general. Have employees be more pro-active about their health. Also advise employees to minimize on the amount of alcohol they consume per day as related to health problems.

4b. Stress- Try to create an environment that is less stressful for the workers by administer headphone where they can listen to their choice of music. This could definitely decrease hypertension and on the job stressors. Another way is by cultivating an atmosphere geared towards spirituality by hiring a Tai Chi or eastern meditator to help employees harness such skill sets.

Summary

In conclusion, the research conducted for the proposed wellness program incorporates findings from this study and adds to the in-depth analysis of corporate wellness programs conducted by the RAND Corporation (Mattke et al., 2013). The research is also in accordance with the recently passed Patient Protection and Affordable Care Act which enacted sweeping changes in funding of health care in the United States, including preventative care and tax status of corporate health benefits and wellness programs. If implemented by corporations and small business owners it is hoped that employers would realize a reduction in “absenteeism” and “presenteeism” which is the major loss of profits and productivity in businesses. They should also see reduction in health care premiums and morale of employees.

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