

INVESTIGACION

Diabetes knowledge and physical activity increase through child to parent communication

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Abstract

Type 2 Diabetes is a metabolic condition that occurs when impaired insulin effectiveness (insulin resistance) is accompanied by the failure to produce sufficient b cell insulin. Type 2 diabetes has increased dramatically in children and adolescents. There is a clear association between diabetes and lifestyle (i.e. nutrition, obesity and physical activity). **Objective:** To increase participants' knowledge about diabetes and the three keys to prevention: maintaining a healthy weight, being physically active, and eating a healthy diet. Other goals were increasing the physical activity (PA) of participants and determining if health messages delivered through child to parent communication were effective. **Methods:** The diabetes knowledge and physical activity intervention targeted 14 parents/guardians of second grade students. Once all baseline questionnaires were completed, a six week in-

tervention utilizing one-page, colorful newsletters called «Pedometer Pete's Diabetes Prevention ACTION PLAN.» The Action Plan newsletters were sent home on a weekly basis with the second grade students. Newsletters were sent home including directions for parents encouraging them to read and return them to their child's teacher. **Results:** both pre and post questionnaires were completed by 14 subjects. Results from the intervention showed a significant increase ($p < 0.05$) in total diabetes knowledge. There was a mean increase in the number of correct responses of 3.57 ± 3.20 from pre to post total diabetes knowledge scores. Results from the self-reported physical activity surveys showed a significant increase in moderate physical activity from a mean of 120 ± 64 to $234 \pm 184(53)$ min/wk ($p < 0.05$). **Conclusion:** This study showed that a six-week intervention study utilizing brief one-page, double-sided newsletters was effective in increasing total diabetes knowledge, parental physical activity and family physical activity. These results support the use of child to parent communication in delivering health messages and promoting behavior changes.

Key words: Type 2 Diabetes, insulin resistance, lifestyle, physical activity, children.

Aumento en el conocimiento acerca de la diabetes y de la actividad física a través de la comunicación transmitida por los niños a sus padres

Resumen

Diabetes tipo 2 es una condición metabólica en la cual la insulina no actúa en forma efectiva (resistencia a la insulina) y es acompañada por una falla de las células beta del páncreas para producir suficiente insulina. La prevalencia de diabetes tipo 2 está creciendo en forma desproporcionada entre niños y adolescentes. Existe una clara asociación entre diabetes y estilo de vida (nutrición, obesidad y actividad física). **Objetivo:** Incrementar entre los participantes (14 padres/acudientes) el conocimiento acerca de la diabetes y los tres factores claves para prevenirla: mantener un peso saludable, estar físicamente activo y consumir una dieta adecuada. Además incrementar la actividad física de los

participantes y determinar si los mensajes sobre salud transmitidos por los niños a sus padres fueron efectivos. **Metodología:** Estudio de intervención. 14 padres o acudientes de los niños de 2 grado completaron 2 cuestionarios pre y post. Durante las seis semanas de intervención, se envió semanalmente a casa, con los niños participantes un boletín informativo llamado “Pedometer Pete’s Diabetes Prevention ACTION PLAN”. Este incluía direcciones para los padres o acudientes motivándolos a leerlas y devolverlas con los niños a la profesora. **Resultados:** 14 padres completaron los cuestionarios, el conocimiento acerca de la diabetes incrementó significativamente ($p < 0.05$), después de las seis semanas de intervención incrementó el promedio de respuestas correctas de 3.57 ± 3.20 entre el cuestionario pre y post. Actividad física moderada incremento significativamente en promedio de 120 ± 64 a 234 ± 184 (53 min/sem) ($p < 0.05$). **Conclusión:** seis semanas de intervención demostró un significativo incremento en el conocimiento de los padres acerca de la diabetes y en la actividad física moderada.

Palabras clave: Diabetes mellitus, resistencia a la insulina, estilo de vida, actividad física, niños.

INTRODUCTION

Diabetes is a metabolic condition in which the body fails to produce enough insulin. Type 1 diabetes (T1D) results from autoimmune destruction of insulin producing beta cells, which leaves the patient dependent on insulin injections for survival. Type 2 diabetes (T2D) occurs when impaired insulin effectiveness (insulin resistance) is accompanied by the failure to produce sufficient beta cell insulin (1).

Diabetes is the fifth leading cause of death by disease in the United States (2). The incidence of

Type 2 diabetes has increased dramatically over the past several decades in the U.S and the world. Diabetes is increasing in both sexes, all ages, races and educational levels (3)

There has been growing concern about the rising prevalence of type 2 diabetes in children and adolescents. In the US, up to 45% of the newly diagnosed diabetics in pediatric age group have T2D (4). This rise in diabetes rates in children reflects, at least in part the growing prevalence of obesity in this age group (5).

In 2000, the prevalence of overweight was 15.5% among 12 to 19-year-olds, 15.3% in 6 to 11-year-olds, and 10.4% in 2-5-year olds. This prevalence has more than tripled in the last 20 years. A 2002, Yale study showed that 25% of obese children aged 4 to 10 years and 21% of obese children aged 11 to 18 years have impaired glucose tolerance and are at high risk for developing diabetes (6). Obese children and adolescents have increased total body fat and increased visceral fat. In obese adolescents, the quantity of visceral fat is directly correlated with basal and glucose-stimulated hyperinsulinemia and inversely correlated with insulin sensitivity. Additionally, in a study of African American children, a higher BMI was associated with a decrease in insulin-stimulated glucose metabolism and an increase in fasting insulin level (7). Diabetes, both type 1 and type 2, is associated with several macrovascular and microvascular complications, which result in large increases in morbidity and mortality (8). T2D complications can be delayed and perhaps even prevented through blood glucose control (a preprandial blood glucose concentration between 70 and 120 mg/dl and a postprandial concentration of less than 180 mg/dl). The United Kingdom (U.K) progression Prospective Diabetes

Study showed that intensive control of blood glucose resulting in a median HbA1c value of 7.0% showed an overall decrease in microvascular complications by 25% (9).

The complications associated with diabetes have caused an increase in health care costs placing an enormous economic burden on the health care system. A person diagnosed with type 2 diabetes at age 15, could require 50 or more years of medical care at a cost of more than \$600,000 (10, 11).

Several risk factors for type 2 diabetes exist, but some are not modifiable like age, family history, and ethnicity, while some related to lifestyle can be modified as obesity and physical activity (12).

There is a clear association between diabetes and lifestyle (i.e. nutrition, obesity and physical activity). Because risk is elevated with increasing body mass index (BMI) and decreasing physical activity levels, a possible explanation of the dramatic increase in diabetes in the US can be found by looking at the current lifestyle trends of Americans (13,14).

Current data shows that Americans are consuming, on average, an addition 500 kilocalories a day compared to the 1970s. Portion

sizes are increasing significantly (15,16,17). This increase in kcal consumption is exacerbated by the fact that Americans are not physically active. Almost 50% of young people aged 12-21 years are not vigorously active and physical activity levels severely decline in adolescence (18).

Latin America is not the exception. The prevalence of type 2 diabetes is 1.2% to 8%, being higher in the urban areas. The estimated total of number of cases of diabetes in Latin America is expected to doubled by 2025 and to be higher than in the US, Canada and Europe by that time (19). Epidemiological studies in Colombia indicate that diabetes prevalence is increasing in the last few years and rates are somewhat higher in women than in men, in Bogota 8.9% versus 7% respectively. The trends of increasing diabetes type 2 in urban areas compared with rural areas are probably due to changes in the lifestyles, dietary habits and physical activity (19).

Efforts to identify effective prevention strategies have been made. Studies about lifestyle modifications (improved physical activity, diet and weight control) have had a significant impact on reducing the risk of developing type 2 diabetes. Two significant clinical studies have supported

the prevention of Type 2 diabetes: The Finnish Diabetes Prevention Study and the Diabetes Prevention Program (United States) (20, 21). These two studies support the results from two earlier studies on the prevention of diabetes: The DaQing IGT and Diabetes Study (22) and the 6-year Malmo feasibility study (23).

Both the DPP and Finnish Diabetes Prevention Study offer strong evidence that lifestyle modifications can help prevent diabetes. However, before widespread prevention can be achieved, it is imperative that the general population has knowledge about diabetes, its risk factors and complications and the benefits of lifestyle modifications to prevent the disease. There have been limited studies on the public's knowledge about diabetes; however, the studies that have been conducted indicate that diabetes knowledge levels need to be increased.

In a study of diabetic parents' perceptions about their child's risk for diabetes, parents were unaware of the possibility of prevention. Both weight reduction and increased physical activity were not seen as preventive strategies against the development of type 2, in addition, many parents held the belief that eating too much sugar increased risk, and reducing sugar intake would the-

refore decrease diabetes risk, this is a common misconception about diabetes (24). A second study with siblings of type 2 diabetes patients, only 38% recognized an increased risk of diabetes despite of the strong link between risk and family history. Also, there was no perceived increase in risk due to high BMI (25).

The primary goal of this study was to increase participants' knowledge about diabetes and the three keys to prevention: maintaining a healthy weight, being physically active, and eating a healthy diet. Two other goals were increasing the physical activity (PA) of participants and determining if health messages delivered through child to parent communication were effective.

An important component of this intervention was utilizing child to parent communication. Other studies have attempted to involve the family to enhance knowledge, attitudes and health behaviors (26). The San Diego Family Health Project showed a significant improvement in physiologic and behavioral outcomes related to diet and physical activity of families. Schools were used to recruit and access families and were the meeting sites for the educational sessions (27). In addition, the CATCH program had a specifically designed family com-

ponent to enhance the nutrition and physical activity of third to fifth grade elementary school students in order to prevent cardiovascular disease. The study design used was similar to the CATCH study because it relied on children bringing home skill building activity to complete with their parents (28). However, the CATCH school plus family intervention was not different than the school only intervention (29). In spite of these negative results from the CATCH study, the logic that family involvement would increase the learning of health messages by children and their parents and the incorporation of these messages into family lifestyle was so strong, this study was designed to assess the effectiveness of child to parent communication for the prevention of type 2 diabetes and obesity.

METHODS

Setting & sample

This diabetes knowledge and physical activity intervention study was conducted as a educational component of Program ENERGY. Program ENERGY is a science enrichment program in the classroom and gym setting aimed at preventing obesity and type 2 diabetes in children (K-6). Program ENERGY focuses on inquiry-based science enrichment

using examples from food, nutrition, physical activity, biology of body weight, and blood sugar regulation. It is a primary goal of Program ENERGY to teach healthy behavioral choices. Program ENERGY is delivered on a weekly basis and includes classroom activities (60 min) and participatory physical activity (30 min). During the 2001-2002 school year, Program ENERGY was initiated at Putnam Elementary School in Fort Collins, Colorado. The school was selected for its large Hispanic population, the high percentage of student eligible for free and reduced lunch (70%), and its unmet needs in science and math.

The diabetes knowledge and physical activity intervention targeted the parents/guardians of all second grade students enrolled in Program ENERGY. The Colorado State University Human Research Committee approved this project. Consent forms, both English and Spanish, were sent home with the second grade students. The consent form was accompanied by a letter explaining the goals of the study and the nature and scope of the intervention. Consent forms were completed and returned by all participants in the study. Eighteen consent forms were returned (49%). Final data analysis included 14 parents/guardians.

Intervention

Once all baseline questionnaires were completed, a six-week intervention utilizing one-page, colorful newsletters (double-sided) to inform participants about diabetes and how it can be prevented were begun. The title of the newsletters was «Pedometer Pete's Diabetes Prevention ACTION PLAN». The Action Plan newsletters were sent home on a weekly basis with the second grade students. The newsletters were given to the students every Friday at the end of their 30-minute physical activity session. Newsletters included directions for parents encouraging them to read the newsletter, keep the newsletter and return it the following Monday to their child's teacher.

Each newsletter included the following sections: FYI (For Your Information), Eat Well, Get Fit, and the To Do List. If space allowed, some newsletters contained a section called Fact or Fiction. Other supplemental information/sections were added as needed.

The FYI section of the newsletters focused on providing general diabetes knowledge to the reader. Eat well provided simple, but important concepts in nutrition relating to preventing diabetes and controlling weight. The

Get Fit section offered the reader tips on physical activity. The To Do List was aimed at helping the reader set small, attainable goals relating to diabetes prevention and overall health. The Fact or Fiction section addressed common myths about diabetes.

Newsletter #1 served as an introduction to diabetes and why individuals should empower themselves *with knowledge about diabetes*.

Newsletter # 2 expanded upon the relationship between weight and diabetes. *The concept of Body Mass Index (BMI, was introduced.*

Newsletter #3 in the series switched the focus to *children and diabetes*.

Newsletter #4 asked the readers *could you have diabetes and not know it?* This newsletter also contains a supplemental section called, Fast Facts. This section briefly outlined all the complications associated with diabetes and the effects they have on health.

Newsletter #5 offered the reader *A Dozen Do's for Diabetes Prevention*. This newsletter gave the reader twelve important steps in preventing diabetes. The following *Do's* were given to the reader:

1. Do know that you can prevent diabetes.
2. Do empower yourself with lots of information about diabetes.
3. Do your best to make healthy food choices.
4. Do work to maintain a healthy, stable weight.
5. Do get your body moving! Try to be physically active every day.
6. Do know the risk factors for diabetes.
7. Do watch the serving sizes you are eating.
8. Do walk whenever and wherever you can.
9. Do know the warning signs of diabetes.
10. Do see your doctor right away if you experience any of the warning signs for diabetes.
11. Do realize that small changes can make a big difference.
12. Do take control of your health.

Each of these points was expanded upon in the newsletter.

Newsletter #6 was used as a review for the material found in the previous five newsletters. The

focus of the newsletter was *what you should know about diabetes*.

The following topics were reviewed:

1. What is diabetes?
2. Who is at risk for diabetes?
3. Can I do anything to prevent diabetes?
4. What are the warning signs of diabetes?
5. How do I know for sure if I have diabetes?
6. What can I do to prevent diabetes in my children?

Variables and their measures

All subjects who completed and returned the consent forms were given two questionnaires for a baseline assessment on diabetes knowledge and self-reported physical activity level.

The diabetes knowledge questionnaire included 19 items and it was intended to assess general knowledge about diabetes. This questionnaire was adapted from a 24 item questionnaire used in the Starr County Diabetes Education Study (30, 31). This 24 item questionnaire had a reliability coefficient, assessed using Cronbach's coefficient α , of 0.78 supporting repeatability and con-

sistency. On the 19-item diabetes knowledge questionnaire, subjects were given three choices for answering the questions «yes», «no», and «I don't know». A score of one was assigned for a correct answer, a score of zero was assigned for an incorrect answer, and a score of zero was assigned for an «I don't know» response.

The self-reported physical activity questionnaire was adapted from a Center for Disease Control and Prevention telephone questionnaire. This questionnaire requested information on the frequency and duration of walking, moderate physical activity, vigorous physical activity, and resistance training. In order to determine the total time in minutes per week for a given activity, the response for days per week was multiplied by the time spent participating in that activity each session. For estimation of total time spent on a given activity, the midpoint of the time interval selected by each participant was used. For example, if a subject responded that they walked 4 days a week for 20 to 30 minutes; score was determined by multiplying 4 days by 25 minutes (the midpoint of the selected time interval). Time intervals listed on the questionnaire were: 10-20; 20-30; 30-40; 40-50; 50-60, 60+, 1 hr, 2 hr, 3hr, and 4 hr. For the op-

tion of 60+, a time value of 60 minutes was used. For the options of 1 hr, 2 hr, 3 hr, and 4 hr, no values were assigned given no subjects responded with these time intervals.

Data collection procedures

Participants were given the choice of a paper and pencil questionnaire sent home with their child, a telephone questionnaire conducted by a graduate student at Colorado State University (CSU), or home visit by a graduate student at CSU. Twelve of the 14 participants in the final data analysis chose the paper and pencil version, 2 participants requested completion of the questionnaires by phone. All telephone questionnaires were conducted by the same person. For participant's completing the pencil and paper version, they were asked to return the questionnaire to their child's teacher within 10 days. All participants completed the within the 10 days time limit.

At the end of the six-week intervention, both the diabetes knowledge questionnaire and the self-reported physical activity questionnaire were administered for a second time. Questionnaires were administered the same way parents requested for the baseline questionnaires, either a paper or pencil version or over the tele-

phone. Parents completing the paper and pencil version were given 10 days to return the questionnaires to their child's teacher. If questionnaires were not received in the 10-day time period, the parents were contacted by telephone. There was a 64% return rate of the questionnaires, within the 10-day time period. Three parents did not return their questionnaires in the given time limit and were contacted by telephone. All 3 of these parents, choose to complete the questionnaire over the telephone.

After the completion of the six-week intervention and after all post-intervention questionnaires were complete, parents were given the answers to the diabetes knowledge questionnaire. The answers were sent home with the parent's second grade child.

Statistical methods

Data was analyzed only for those subjects who complete both baseline and post-intervention questionnaires (n = 14). Both diabetes knowledge data and self-reported physical activity data was analyzed using the Statistical Package for the Social Sciences (SPSS) software program version 11.0.

A paired sample t-test was conducted the total knowledge score comparing pre and post-inter-

vention diabetes knowledge. Total diabetes knowledge score was calculated by adding the number of correct responses on the 19 items. The maximum score was 19 and the minimum score was zero. A paired sample t-test was also used to compare pre and post intervention self reported physical activity.

The information obtained from the self-reported physical activity questionnaire was used to determine total minutes per week for the following activities: walking, moderate physical activity, and vigorous physical activity. (The method for determining total minutes per week is explained in Variables and Their Measures.)

RESULTS

Out of 37 parents invited to participate in the study, 16 parents agreed to participate. However two parents did not complete both pre and post questionnaire and were dropped from the study, leaving the final number of subjects equal to 14.

Results from the intervention showed a significant increase ($p < 0.05$) in total diabetes knowledge among the parent participants. The pre and post intervention parental diabetes knowledge scores are shown in Figure 1. Af-

ter the intervention, the percentage of correct answers increased on fifteen of the 19 items, decreased on two items and did not change on the remaining two items. The scores on each of the 19 items are shown in Table 1.

Importantly, total diabetes knowledge did increase significantly ($p < 0.05$) Figure 1.

Before the six-week intervention the mean percentage of correct answers on the diabetes knowledge questionnaire was 57% (43% incorrect). After the intervention was completed the percentage of correct answers rose to 76% (24% incorrect). There was a mean increase in the number of correct responses of 3.57 ± 3.20 from pre to post total diabetes knowledge scores. These results demonstrate that the six-week intervention significantly increased diabetes knowledge of the parents of second graders participating in Program ENERGY.

Results from the self-reported physical activity surveys showed increases in the total time per week the parents in the study spent participating in the following activities: walking, moderate activities (i.e. brisk walking, bicycling, vacuuming, gardening, or any activity that causes some increase in breathing or heart rate), and vigorous physical activity

Table 1
Responses to diabetes knowledge questionnaire pre and pos intervention

Item	Pre-intervention # of participants answering correctly*	Post-intervention # of participants answering correctly*
1. Eating too much sugar and other sweet foods is a cause of diabetes.	6	11
2. The usual cause of diabetes is lack of effective insulin in the body.	9	13
3. Diabetes is caused by failure of the kidneys to keep sugar out of the urine.	3	5
4. In untreated diabetes, the amount of sugar in the blood usually increases.	9	9
5. If I am diabetic, my children have a higher chance of being diabetic	9	14
6. Diabetes can be cured.	12	11
7. A fasting blood sugar level of 210 is too high.	5	11
8. Regular exercise will increase the need for insulin or other diabetic medication.	7	13
9. There are two main types of diabetes: Type 1 and Type 2.	8	12
10. Medication is more important than diet and exercise to control diabetes.	13	12
11. Diabetes often causes poor circulation.	7	14
12. The way I prepare my food is as important as the foods I eat.	14	14
13. Diabetes can damage the kidneys.	10	12
14. Diabetes can cause loss of feeling in hands and feet	8	9
15. Shaking and sweating are signs of high blood sugar.	1	3
16. Frequent urination and thirst are signs of low blood sugar.	2	3
17. A diabetic diet consists mostly of special foods.	8	12
18. Losing weight can lower blood sugar levels and improve diabetes management.	10	11
19. Maintaining your weight or losing weight decrease the chance of having diabetes.	10	12

* out of 14 participants.

(i.e. running, aerobics, heavy yard work, or any activity that causes large increases in breathing and heart rate). The pre and post intervention self-reported time spent by parents engaged in physical activity are shown in Figure 2. Walking time increased from a mean of 123 ± 136 (48) [$\bar{x} \pm SD$ (sem)] min/wk to 170 ± 87 (31) min/wk. Vigorous physical activity increased from a mean of 41 ± 57 (15) min/wk to 64 ± 62 (17) min/wk. There was a significant increase in moderate physical activity from a mean of 120 ± 64 (53) to 234 ± 184 (53) min/wk ($p < 0.05$).

DISCUSSION

The six-week intervention using brief one-page, double sided, colorful newsletters and motivational challenges in this study resulted in a significant increase in diabetes knowledge and self-reported physical activity through child to parent communication.

Parents had a significant increase ($p < 0.05$) in diabetes knowledge as well as moderate physical activity time (min/wk). These results demonstrate the effectiveness of this intervention and child to parent communication in this study.

The results from this intervention are consistent with previo-

us studies of knowledge of diabetes. These studies found that patient's knowledge of diabetes increases with an intervention focusing on diabetes knowledge and/or education. These studies are the basis of education programs for people with diabetes (32-38). However, this intervention is unique in that it focused on diabetes knowledge in individuals who did not have diabetes. Currently, most diabetes knowledge studies focus on people who already have diabetes. In addition, many of these studies are based on one-on-one counseling or group classes. This study did not include either of those components. Also, this study not only looked at changes in knowledge, but also how the change in knowledge affected behavior. The results indicate that as participants knowledge about diabetes and how it could be prevented increased so did self-reported parental and family physical activity levels. Another unique feature of this intervention was the use of the children participating in a school-based science and health enrichment program focused on the prevention of obesity and type 2 diabetes to communicate and encourage the incorporation of these health and prevention messages and behaviors into the family lifestyle.

Figure 1. Total diabetes knowledge

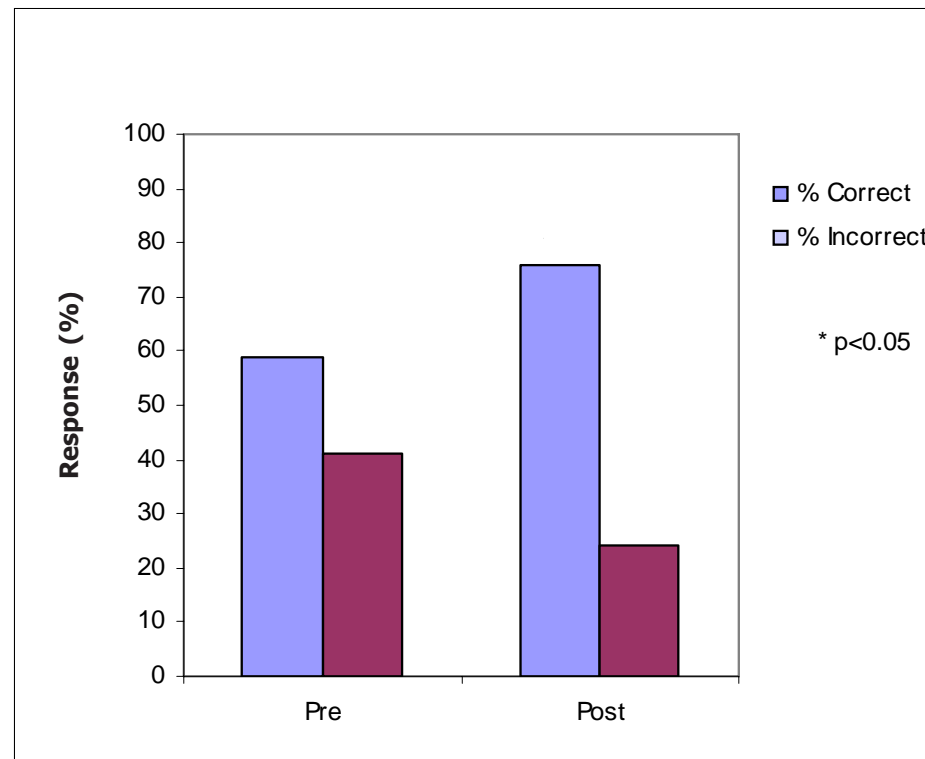
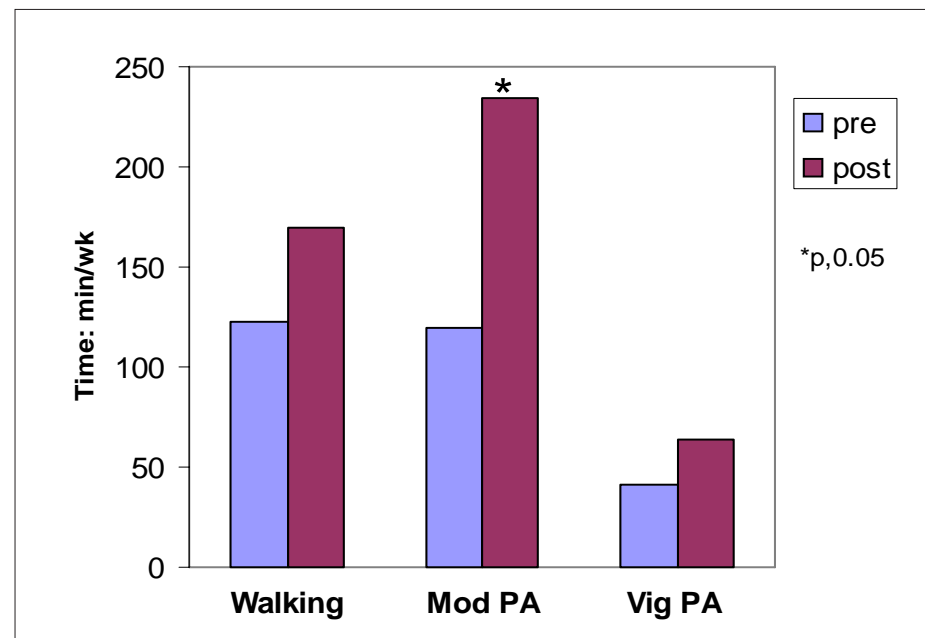


Figure 2. Self-Reported Physical Activity



The implications of this study are potentially important for the prevention of type 2 diabetes and obesity in children and adults in schools and homes throughout the nation. First, this intervention provides a feasible, easily reproducible, relatively low-cost and effective method to increase diabetes knowledge and parental and family physical activity. This intervention could be replicated in any school or school district. Program ENERGY is planning to replicate this intervention in other schools in the Poudre School District and in other cities and then disseminate these materials to all interested people.

Second, the results of this study will provide awareness that knowledge about diabetes and its prevention, and family physical activity can be increased and provide a model and encouragement to others to aggressively provide similar interventions. Diabetes and obesity prevention efforts require shared commitment and resources to implement. The results of this study should encourage others to undertake these important efforts. Third, based on the success of the child to parent communication in this study, this hypothesis and its experimental testing have been incorporated into Program ENERGY. Indeed, child to parent communication of health and prevention messages

and incorporation of health behaviors into the family lifestyle has become the dominant hypothesis of this school-based science and health enrichment program focused on the prevention of obesity and type 2 diabetes.

Although this intervention shows positive results in both knowledge and behavior change, there are some limitations. Because only 14 subjects participated in the intervention, the results may not be representative and therefore it may be inappropriate to generalize the results, before results can be applied to a larger audience, it would be important that this study or a similar studies be replicated with a larger sample size. Also, the six-week length of the intervention could be a possible limitation. Although likely, it is not known if knowledge and physical activity would have been sustained or increased even more if the intervention was continued over a longer time period. Based on the returned «Get Movin' Challenge» worksheets, it is assumed that the parents did read the Action Plan newsletters, but within the study design there was no confirmation if parents actually were reading the information sent home. However, the significant increase in diabetes knowledge suggests that most of the participants read the materials that were sent home. The lack of fo-

low-up after the end of intervention is another limitation of this study. It is unknown if the increases in diabetes knowledge and moderate physical activity were sustained, increased or decreased after the conclusion of the intervention. A final limitation was the method of tracking physical activity. All physical activity was self-reported and, therefore, has the potential of being biased. Parents could have simply reported more physical activity because they believed it would please the investigators or to help their children win the challenge.

Given the effectiveness of this intervention, the extension and replication of this study is warranted. Potential extensions and future extensions of this project could include using methods of obtaining additional assessments of parental and family physical activity levels and determining if parents truly read the newsletters sent home.

A possible extension would be to use pedometers to measure the parental and/or family (both parents and children wearing pedometers) physical activity and comparing pre, during and post-intervention step counts. Also, participants could be interviewed by an independent inves-

tigator to determine the parental reaction to the newsletter and to assess if newsletters were read.

Other future efforts could include a control group to allow for the discrimination between outcomes related to the intervention and outcomes related to external factors. Another important addition to a future intervention would be adding a method of obtaining individual and family medical history. This would allow investigators to identify subjects with a family history of diabetes, which could have an effect on diabetes knowledge.

Overall, this intervention showed that a six-week study utilizing brief one-page, double sided newsletters was effective in increasing total diabetes knowledge, parental physical activity and family physical activity. These results support the use of child to parent communication in delivering health messages and promoting behavior change.

A practical application of this study is to replicate it in Colombia where the prevalence of type 2 diabetes has increased in last years, showing that education on prevention of diabetes type 2 is necessary.

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