The Characteristics and Needs of Children and Adolescents Diagnosed with Type 2 Diabetes Mellitus in Santa Clara County, California

Shoshanah M. Orzech[1], Clarie B. Hollenbeck[1], Paige Reddan[2], and Lucy M. McProud[1]

[1]*San Jose State University*
[2]*LifeScan, Inc.*

Abstract

Objective: The study objectives were to examine the characteristics and perceived needs of children and adolescents diagnosed with type 2 diabetes. **Design**: Data were gathered via self-administered questionnaires pertaining to demographics, family history of type 2 diabetes, physical characteristics, lifestyle/exercise behaviors, dietary behaviors and interests in meeting other youth with type 2 diabetes. Subjects and their parents/guardians were asked to complete separate questionnaires and afterwards, each youth participated in a follow-up interview related to diabetes management. **Subjects**: Participants (N=14) were obtained from a population of youth diagnosed with type 2 diabetes seeking medical care at the Kaiser Santa Teresa Pediatric Endocrine Clinic in Santa Clara, CA. Eleven of the subjects were Latino (79%) and the remaining 3 were Asian American (21%). Subjects ranged in age from 10 to 18 years with a mean age of 13.8 ± 2.3 years. The mean age at diagnosis was 12.7 ± 2.3 years with a range from eight-and-a-half years to 17 years when first diagnosed. The mean body mass index (BMI) of the participants was 33.5 ± 6.2 kg/m^2. **Statistical Analysis**: Descriptive statistics were utilized for all analyses including discrete and continuous data to determine counts, percentages, means, and standard deviations. **Results**: The youth characteristics in the present study were consistent with previous studies that have examined the demographics, physical characteristics, and family history of type 2 diabetes among youth in the United States. Acanthosis nigricans, a hyperinsulinemic condition, was present in 10 of the 14 (71%) of the youth and most were overweight or obese with a mean BMI of 33.5 ± 6.2 kg/m^2. A positive family history for diabetes was evident in most subjects, however, this positive history did not lead to an increase in diabetes knowledge among youth. Most youth subjects were sedentary and were more likely to make dietary changes than exercise changes to manage their diabetes. Interests in attending youth summer camps or family camps geared towards diabetes education were quite high. As the characteristics and diabetes risk factors of type 2 diabetes among youth continue to be identified, and as it continues to increase in this population, culturally appropriate prevention programs will need to be designed and implemented to address the needs of this unique population.

Keywords: Children, Adolescent, type 2 diabetes, obesity

Introduction

Type 2 diabetes has been traditionally considered a disease that affects adults over age 40, however, it is now becoming more prevalent among children and teenagers. Until recently, type 2 diabetes accounted for two percent to three percent of all children diagnosed with diabetes mellitus in North America (Glaser, 1997). Over the past five years there has been a ten-fold increase in children under age 18 diagnosed with type 2 diabetes (Buck, 1999).

Currently, of all newly diagnosed cases of type 2 diabetes within the United States, between eight to 46 percent are children under age 18. This wide range of youth diagnosed with type 2 diabetes reflects the unequal distribution among the various ethnic groups who exhibit this condition (Libman & Arslanian, 1999). In

addition, current percentage estimates of newly diagnosed children and adolescents with type 2 diabetes have been extrapolated from existing studies examining specific populations with this disease (Sones, 2001). For example, the Pima Indian youth of Arizona reportedly have the highest rates of type 2 diabetes in the world. The current prevalence of type 2 diabetes among Pima Indian youth within the 15-to-19-year age group is 51 per 1,000 compared to a prevalence of 4.5 per 1,000 for all U.S. American Indian populations. The prevalence of type 2 diabetes among youth from other ethnic groups within the U.S. has not been extensively researched and population-based prevalence estimates are currently unavailable (Centers for Disease Control and Prevention, 2002). Recent studies, however, indicate that the populations most at risk for type 2 diabetes include American and Canadian Indians, African-Americans, Pacific Islanders, Hispanics, Japanese, and Asian Indians (Ehtisham, Barrett, & Shaw, 2000). State and county statistics documenting the prevalence of type 2 diabetes in youth within California are also unavailable.

While the epidemiology, pathophysiology, and medical management of type 2 diabetes in adults has been extensively studied, very little is known about the disease in children. In adulthood, type 2 diabetes is associated with genetic, environmental and lifestyle risk factors such as obesity, high energy consumption, and low levels of physical activity (Pinhas-Hamiel et al., 1999). In childhood, however, the particular risk factors and characteristics associated with type 2 diabetes are just beginning to be identified.

The majority of children diagnosed with type 2 diabetes display certain traits and characteristics that differ from a diagnosis of type 1 diabetes. Children diagnosed with type 1 diabetes are typically of normal weight, do not have a family history of diabetes, rarely present with acanthosis nigricans, are dependent on insulin for survival, and are predominantly Caucasian (Libman & Arslanian, 1999). Current literature suggests that most youth diagnosed with type 2 diabetes are in middle to late puberty, are overweight or obese, have a strong family history of type 2 diabetes, and demonstrate signs of insulin resistance and hyperinsulinemia manifested either as acanthosis nigricans (AN), a cutaneous skin condition, polycystic ovarian syndrome (PCOS), or hirsutism (Beck et al., 2001**;** Glaser, 1997; Libman & Arslanian, 1999; Scott, Smith, Cradock, & Pihoker, 1997; Treviño, Marshall Jr, & Hale, 1999). Early identification of the characteristics and diabetes risk factors among children and adolescents may lead to early detection of diabetes and help delay the onset of this life-long disease.

The emerging population of youth diagnosed with type 2 diabetes in the United States, particularly among certain ethnic groups, will require intervention programs on a community level to address the specific needs of this growing population. At present, educational programs and youth/family camps for children and adolescents diagnosed with type 2 diabetes are extremely limited or unavailable. Prevention programs for this population will need to be culturally appropriate, focus on family involvement, and examine existing lifestyle and nutrition behaviors to increase quality of life and decrease some of the preventable health risks associated with this disease. This exploratory study was designed to ascertain the characteristics and perceived needs of youths with type 2 diabetes so that future programs could be developed and implemented.

Methods

Research Design and Study Population

Qualitative research methods were utilized to gather information on the characteristics and perceived needs of children and adolescents diagnosed with type 2 diabetes in Santa Clara County.

Fourteen youth between the ages of 10 and 18 years diagnosed with type 2 diabetes and their parents/guardians were surveyed at the Kaiser Santa Teresa Pediatric Endocrine Clinic in San Jose, California. Following the survey questionnaire, which assessed demographics, anthropometrics, lifestyle behaviors, and nutrition and exercise behaviors, each youth participated in a follow-up interview to obtain

qualitative information related to his/her diabetes knowledge, perceptions, and management.

The criteria used at the Pediatric Endocrine Clinic to distinguish the diagnosis of a child or adolescent with type 2 diabetes versus type 1 diabetes included: 1) presence of overweight (BMI $\geq$ 25.0 < 30.0 kg/m^2) or obesity (BMI $\geq$ 30.0 kg/m^2), 2) family history of type 2 diabetes, 3) negative antibody markers for type 1 diabetes including anti-insulin, anti-islet cell, and anti-GAD antibodies, 4) the eventual cessation of exogenous insulin.

The principal investigator, as well as the endocrinologists and nursing staff of the Kaiser Santa Teresa Pediatric Endocrine Clinic, conducted recruitment for the study. Subjects and their parents/guardians were invited to participate in the study during medical check-ups with the endocrinologists or via phone calls by the principal investigator.

Informed written consent was obtained from both parents and youth. Subjects were asked to complete a twenty-minute survey containing questions on demographics, family history, diabetes management, lifestyle behaviors, nutrition behaviors, and diabetes risk factors. Upon completion of the questionnaires, subjects were asked if they would participate in a short 15-minute follow-up interview to answer additional questions about their diabetes management. Both the survey questionnaires and follow-up interviews took place in a private office at the Kaiser Santa Teresa Pediatric Endocrine Clinic. To ensure confidentiality of subjects, the questionnaires and follow-up interviews were not associated with any personally identifying information and were identified only by study code. Approval for the study was obtained from the Kaiser Permanente Institutional Review Board, the Kaiser Permanente Central Research Committee, and the San Jose State University Human Subjects Institutional Review Board.

Questionnaires

Two questionnaires were developed for self-administration, one for the child or adolescent and one for the parent/guardian. The youth questionnaire contained four sections with 26 questions. The first section asked questions related to youth characteristics such as age, gender, ethnicity, and any recent weight changes. Body mass index (BMI; kg/m^2) was calculated from weight and height. The first section also included questions related to diabetes knowledge and management including hemoglobin A1c, use of oral medications, number of medical visits since diagnosis, and reported nutrition or exercise changes since diagnosis. The second section of the youth questionnaire contained questions related to lifestyle behaviors such as how many hours per day spent in front of TV/computer, participation in any after-school activities, and organized sports participation. The third section contained questions related to youth nutrition behaviors such as favorite foods, soda consumption, fast-food intake, and fruit and vegetable intake. The fourth section contained questions related to perceived needs such as interests in meeting other youth with type 2 diabetes, and interests in attending a diabetes summer camp or family camp. The youth questionnaire was modeled after surveys previously developed and used to determine the characteristics of youth diagnosed with type 2 diabetes (Pinhas-Hamiel et al., 1999; Treviño et al., 1999; Hanley et al., 2000).

The parental questionnaire contained one section with eight questions concerning demographics, parity, family history of type 2 diabetes, and the presence of hyperinsulinemic conditions such as acanthosis nigricans, polycystic ovarian syndrome (PCOS), and hirsutism within their child.

Follow-up Interview

The follow-up interview was developed to delve further into youth management of type 2 diabetes. Questions included knowledge of normal blood sugar ranges, comfort with testing blood sugar in front of friends and family members, diabetes knowledge prior to diagnosis, foods that challenge blood sugar control, and

both the challenges and "positive experiences" associated with living with diabetes.

Data Analysis

Both questionnaires and follow-up interviews were coded for entry into a spreadsheet to ensure confidentiality of subjects. Descriptive statistics were utilized for all analyses including discrete and continuous data to determine counts, percentages, means, and standard deviations.

Results

The results of the study are presented in the following six categories: 1) youth characteristics; 2) parent characteristics; 3) youth knowledge and diabetes management; 4) youth lifestyle behaviors; 5) youth nutrition behaviors; and 6) youth perceptions and perceived needs.

Youth Characteristics

Of the 14 subjects, males and females were equally represented (Table 1). Two of the subjects were siblings. Eleven of the subjects were Latino while the rest were Asian American. Subjects ranged in age from 10 to 18 years with a mean age of 13.8 years (± 2.3). The mean age at diagnosis was 12.7 years (± 2.3) with a range from eight-and-a-half years to 17 years when first diagnosed. The mean body mass index (BMI) of the participants was 33.5 kg/m^2 (±6.2). The 90th percentile of BMI for the pediatric population varies with age, gender, and ethnicity but is 27 kg/m^2 or less for the population as a whole (Pinhas-Hamiel, et al., 1999). Twelve of the participants had a BMI greater than 27 kg/m^2 and of those 12 participants, two subjects had a BMI of more than 40 kg/m^2. Only two participants had a BMI less than 27 kg/m^2. Secondary hyperinsulinemic conditions were present in the majority of subjects. Acanthosis nigricans (AN) was present in 10 of the participants and of those 10 youth with AN, three participants had an additional hyperinsulinemic condition: two with PCOS and one with hirsutism. Four subjects (29%) reported no other insulin resistant conditions other than diabetes.

Parent Characteristics

Of the 13 parent/guardian respondents (two of the 14 subjects were siblings), 10 were the mothers of the youth with type 2 diabetes (Table 2).

Table 1
Clinical Characteristics of Youth Diagnosed with Type 2 Diabetes Mellitus

Categories	Values	No.
Gender		
Male	50%	7
Female	50%	7
Ethnicity		
Latino[1]	79%	11
Asian American[2]	21%	3
Age (yrs) (mean ± std dev)	13.8 ± 2.3	14
Age at diagnosis (yrs) (mean ± std dev)	12.7 ± 2.3	14
Height (cm) (mean ± std dev)	164.5 ± 8.1	14
Weight (kg) (mean ± std dev)	91.3 ± 21.9	14
BMI[3] (kg/m^2) (mean ± std dev)	33.5 ± 6.2	14
Hyperinsulinemic conditions		
AN[4]	71	10
AN with PCOS[5]	(20)	(2)
AN with Hirsutism	(10)	(1)
None	29	4

[1]Includes Mexican American and other Hispanics; [2]Includes Filipino and Pacific Islanders; [3]Body Mass Index; [4]Acanthosis nigricans; [5]Polycystic ovarian syndrome

Table 2
Characteristics of Parents of Children Diagnosed with Type 2 Diabetes Mellitus

Categories	Percent	No.
Relationship[1]		
Mother	77	10
Father	8	1
Other	15	2
Primary Language		
English	62	8
Spanish	38	5
Parity		
Nulliparous	8	1
Primiparous	15	2
Multiparous	69	9
Unknown	8	1
History of GDM[2]		
Yes	31	4
No	46	6
N/A	23	3
Presence of type 2 DM[3]		
Yes	69	9
No	31	4
Parental Relatives with type 2 DM[3,4]	62	8
Mother	39	5
Father	15	2
Grandmother	15	2
Grandfather	31	4
Aunt	39	5
Uncle	15	2
Cousin	23	3
Other Relatives	23	3
None		

[1]N = 13 since two of the youths were siblings; [2]Gestational Diabetes Mellitus
[3]Diabetes Mellitus; [4]N › 13 since some subjects had multiple family members with type 2 diabetes

In eight of these 10 cases, the mother had type 2 diabetes and of these mothers, four indicated a history of gestational diabetes mellitus (GDM). One father was noted to have type 2 diabetes. English was the predominant language spoken in 9 of subjects and of the remaining 5 spoke Spanish as their primary language. In three cases, the child/adolescent had to act as a translator. Nine of the 13 participants were multiparous and of these nine, three subjects had more than one child with type 2 diabetes. Ten respondents indicated a positive family history of type 2 diabetes and had at least one first- or second-degree relative with type 2 diabetes. Only three respondents reported no family members with type 2 diabetes. Of the 10 subjects who indicated a positive family history for type 2 diabetes, seven subjects had one first-degree relative, and three subjects had two first-degree relatives with type 2 diabetes.

Youth Knowledge and Diabetes Management

Eleven of the 14 subjects required an oral agent to manage their diabetes (Table 3). Of these 11 participants, six subjects also required insulin therapy either upon initial diagnosis or after they had recently gained weight. Only two subjects were able to manage their diabetes without oral medications or insulin. One of these subjects discontinued oral agents after losing a substantial amount of weight as a result of significant dietary and exercise changes. Six of subjects had no knowledge of their number of medical visits since diagnosis and 8 of subjects had no knowledge of their hemoglobin A1c. Despite a strong family history of diabetes, only half of subjects reported any knowledge of type 2 diabetes before they were diagnosed with the disease. Of the subjects with prior diabetes knowledge, all 7 reported that they knew about diabetes because their mother or father had the disease. The majority of subjects (79%) had knowledge of "normal" blood sugar ranges and 11 of the 14 subjects reported testing their blood sugar. Subjects tested their blood sugar between one to four times per day with a mean of 1.8 tests per day (± 1.4). Of the 11 subjects who tested their blood sugar, four subjects only felt comfortable testing in front of their family members, six felt comfortable testing in front of anyone, and one subject did not feel comfortable testing in front of anyone.

Table 3
Knowledge and Management of Diabetes in Youth Diagnosed with Type 2 Diabetes Mellitus

Categories	Percent[1]	No.
Treatment		
None	14	2
Oral Agent	36	5
Insulin	7	1
Combination	43	6
No. of medical visits since diagnosis		
0 –5	14	2
6 – 10	21	3
11 – 15	7	1
> 16	14	2
Don't know	43	6
Knowledge of HbA_{1c}[2]		
Yes	43	6
No	57	8
Knowledge of DM[3] before diagnosis		
Yes	50	7
No	50	7
Knowledge of normal BS[4] ranges		
Yes	79	11
No	21	3
Testing of BS		
Yes	79	11
No	21	3
No. of BS test per day (mean ± std dev)	1.8 ± 1.4	14
Comfort with testing BS[5] in front of:		
Family	36	4
Anyone	55	6
No one	9	1

[1]Unless otherwise noted; [2]Hemoglobin A_{1c}; [3]Type 2 diabetes mellitus; [4]Blood sugar
[5]Based on number of subjects who tested blood sugar (n = 11)

Youth Lifestyle Behaviors

On average, 13 subjects spent 4.1 hours (± 2.0) per day in front of a television or computer (Table 4). One subject's response was excluded due to questionable accuracy of their response to the question. None of the subjects reported involvement in any after-school activities. While eight subjects reported that they enjoyed exercise, only four subjects actually participated in any organized sports activities. Additionally, 10 subjects reported that they had not made any changes in exercise habits since they were diagnosed with type 2 diabetes. The four subjects who did make exercise changes after diagnosis reported involvement in activities such as football and soccer, walking on a treadmill, dancing and running at school, and weight training.

Table 4
Lifestyle Behaviors of Youth Diagnosed with Type 2 Diabetes Mellitus

Categories	Percent	No.
Time spent in front of TV/computer[2] hr/day (mean ± std dev)	4.2 ± 2.0	13
Participation in organized sports		
Yes	29	4
No	71	10
Enjoys exercise		
Yes	57	8
No	14	2
Sometimes	29	4
Changes in exercise habits since diagnosis		
Yes	29	4
No	71	10
Changes is food choices since diagnosis		
Yes	79	11
No	21	3
Weight Changes since diagnosis		
Lost	21	3
Gained	14	2
Lost and regained	21	3
No change	7	1
Don't know	36	5

[1]Unless otherwise noted
[2]One subject was excluded because of questionable accuracy

Dietary changes were more evident. Eleven subjects reported that they had made changes in their food choices since they were diagnosed with type 2 diabetes. Subjects reported that they no longer ate "junk food," reduced fat intake, ate smaller portions, started counting carbohydrates, cut down on sweets and sodas, ate more vegetables, started reading food labels, and consumed more water. Five of the 14 subjects did not know if they had experienced any recent weight fluctuations and three subjects reported that they had lost weight only to re-gain it. Three subjects reported that they had recently lost weight and two subjects claimed that they had recently gained weight. Only one subject reported no recent changes in body weight.

Youth Nutrition Behaviors

When asked to list three favorite foods, the most frequent responses from participants included: 1)

burgers and meat; 2) pizza; and 3) vegetables and salad (Table 5). Other fast-foods that were listed with less frequency included French fries, hot dogs, fried rice, and ice cream. Only one subject reported eating his/her favorite foods seven days per week. Most of the youth (8 of 14, 57%) consumed his/her favorite food less than three times per week. In addition, 8 out of 14 subjects reported that they consumed soda less than three times per week. The majority of youth (11 of 14) consumed fast food less than three times per week while only one youth claimed to eat fast-food everyday. Vegetable consumption was not as common as fruit consumption as eight subjects ate vegetables less than three times per week. In contrast, nine subjects reported that they consumed fruit on a daily basis. Finally, the most common foods believed to cause an increase in blood sugar included: 1) candy and sweets; 2) carbohydrates such as bread, pasta, potatoes, and rice; 3) fast-food; and 4) soda.

Table 5
Dietary and Nutritional Behaviors of Youth Diagnosed with Type 2 Diabetes Mellitus

Categories	%	No.
Top 3 favorite foods[1]		
Burgers/meat	64	9
Pizza	57	8
Vegetables/salad	36	5
Consumption of favorite food per week[2]		
Everyday	7	1
3 – 6	29	4
< 3	57	8
Unknown	7	1
Soda consumption per week		
Everyday	21	3
3 – 6	21	3
< 3	57	8
Fast food consumption per week		
Everyday	7	1
3 – 6	14	2
< 3	79	11
Vegetable consumption per week		
Everyday	21	3
3 – 6	21	3
< 3	57	8
Fruit consumption per week		
Everyday	64	9
3 – 6	14	2
< 3	21	3
Food believed to increase BS[1, 3]		
Candy/Sweets	43	6
Carbohydrates[4]	43	6
Fast foods	29	4
Soda	29	4

[1]N > 14 because of multiple responses
[2]N = 13 because of one non-response
[3]Blood sugar
[4]Includes bread, pasta, potatoes and rice

Youth Perceptions and Perceived Needs

Four out of 14 subjects reported that the greatest challenge of living with type 2 diabetes was testing blood sugar and giving themselves insulin injections (Table 6). An equal number of subjects reported that making dietary changes was a hardship. One subject revealed that the fear of death was the hardest part of living with diabetes. When asked what kind of advice to give other youth diagnosed with type 2 diabetes, six out of 14 subjects suggested dietary changes and five subjects recommended an increase in exercise. Six subjects reported weight loss as the most "positive experience" since diagnosis.

Table 6
Perceptions and Perceived Needs of Youth Diagnosed with Type 2 Diabetes Mellitus

Categories	Percent	No.
Changes with DM[1]		
Testing BS/Injection	29	4
Changing eating habits	29	4
Fear of death	7	1
None/Don't know	36	5
Advice to other youth with type 2 DM[1,2]		
Watch what you eat	43	6
Exercise	36	5
Take care of yourself	14	2
Monitor and test BS[3]	14	2
Positive changes since diagnosis		
Weight loss	43	6
None/Don't know	29	4
Eating healthier	14	2
BS control	7	1
Started exercising	7	1
Interests in meeting youth with type 2 DM		
Yes	57	8
No	43	6
Interest in summer camps with type 2 youth		
Yes	57	8
No	43	6
Interest in family camps		
Yes	57	8
No	36	5
Don't know	7	1
Desired meeting locations		
Community center	43	6
School	29	4
Not interested	14	2
Community center and school	7	1
Home	7	1

[1]Diabetes Mellitus
[2]N > 14 due to multiple responses
[3]Blood sugar

Four subjects either couldn't think of any positive experiences or believed there hadn't been any positive experiences since being diagnosed with diabetes. Eight youth expressed some interest in meeting other children or adolescents with type 2 diabetes. The same number of subjects expressed interest in attending either a summer camp specifically for youth with type 2 diabetes or a family camp. Six subjects reported an interest in meeting other youth with type 2 diabetes at their community center. Four subjects preferred to meet these youth at school.

Discussion

Youth Characteristics

Type 2 diabetes in children and adolescents appears to be the result of a combination of factors such as genetic predisposition, obesity, the presence of secondary hyperinsulinemic conditions, physical inactivity, and poor dietary behaviors. While this study is based on a small sample size, the findings are consistent with previous studies that have examined the characteristics of these youth. In regards to ethnicity, studies that have examined the prevalence of type 2 diabetes have also shown higher rates of type 2 diabetes among Hispanic youth compared to other ethnic groups (Fagot-Campagna, et al. 2000). In California, it is reported that Mexican-American children have higher rates of type 2 diabetes than do Caucasian children (Libman & Arslanian, 1999). The present study also demonstrates high rates of type 2 diabetes among Latino youth. In comparison, the youth treated at the Kaiser Santa Teresa pediatric endocrine clinic with type 1 diabetes are predominantly Caucasian.

Since puberty marks a brief period of insulin resistance as compared to prepubertal children or adults, it is not surprising that the mean age at diagnosis for these youth was 12.7 years (± 2.3). Most children who are diagnosed with type 2 diabetes are between 10 to 19 years old, with the majority of diagnoses occurring at 13 years of age or during mid-puberty (Libman & Arslanian, 1999). While pubertal children represent most of the diagnoses for type 2 diabetes among youth, children as young as 10-years-old have been identified with this disease (Fagot-Campagna et al., 2000). In the present study, three children had been diagnosed at age 10 or younger with the youngest diagnosis occurring at age eight-and-one half. Currently, the youngest child diagnosed with type 2 diabetes has been reported as a four-year-old Pima Indian child (Fagot-Campagna et al., 2000).

Physical characteristics such as BMI, revealed that 12 out of 14 subjects (86%) had a BMI greater than 27 kg/m^2, indicating a high incidence of overweight and obesity. In comparison, an estimated 13 percent of children between six to 11 years and 14 percent of adolescents ages 12-19 years within the United States are overweight (Centers for Disease Control and Prevention, 2002).

Mexican-American children, in particular, are reported to be susceptible to the development of obesity due to factors such as genetic predisposition, cultural factors, and dietary behaviors (Neufeld, Raffel, Landon, Chen, & Vadheim, 1998). Previous studies have also shown that in Mexican Americans, diabetes incidence increases significantly when combined with an increase in BMI (Haffner, Hazuda, Mitchell, Patterson & Stern, 1991). It is also known that a high BMI in childhood is associated with insulin resistance and that obesity, inactivity, and diets comprised of high-calorie low nutrient dense foods can contribute to the early onset of type 2 diabetes (Cook & Hurley, 1998).

Perhaps as significant as the high incidence of overweight and obesity within these youth with type 2 diabetes was the finding that 10 of the 14 subjects were noted to have acanthosis nigricans, a cutaneous manifestation of hyperinsulinemia resulting in excessive pigmentation and thickening of the skin into soft irregular folds (Glaser, 1997; Stuart, Pate & Peters, 1989). As many as 60 percent to 70 percent of all children diagnosed with type 2 diabetes have acanthosis nigricans (Glaser, 1997). This condition is found in seven percent of school-aged children and is most prevalent among children who are

overweight, or from African-American or Hispanic populations (Libman, & Arslanian, 1999). An estimated sixty to seventy percent of children of Hispanic or African-American ethnicity are reported to have acanthosis nigricans (Glaser, 1997). In this study, three of the subjects with acanthosis nigricans also presented with another hyperinsulinemic condition, either PCOS or hirsutism.

Family History and Diabetes Management

Consistent with the literature, the majority of subjects (11 of 14) had at least one first-or second-degree relative with type 2 diabetes, and quite strikingly, 9 of the 14 subjects' mothers had been diagnosed with type 2 diabetes. Previous studies have suggested that a positive family history of type 2 diabetes, specifically within Mexican-American populations, is a genetic factor that may be a contributor to the early onset of type 2 diabetes within youth (Glaser, 1997; Treviño et al., 1999). One of the reported risk factors associated with type 2 diabetes among youth includes a positive family history of diabetes in a first- or second-degree relative including being an infant of a mother with gestational diabetes (Beck et al., 2001). Among other risk factors, a positive family history of type 2 diabetes is also used at the Pediatric Endocrine Clinic to differentiate between a diagnosis of type 1 and type 2 diabetes.

Even with evidence of a strong family history of type 2 diabetes, only half of the subjects indicated that they were familiar with the disease before they were diagnosed. In regards to diabetes management, 11 of the 14 subjects reported that they tested their blood sugar at least once per day. Blood sugar control is an important aspect of diabetes management and may help to minimize or reduce diabetes-related complications such as blindness, nephropathy, neuropathy, and cardiovascular complications later in life. Previous studies have suggested that Hispanic populations, as compared to non-Hispanic populations, develop diabetes-related complications within the first five- to 10 years of initial diagnosis (Neufeld, et al. 1998). Individuals who are diagnosed with diabetes during childhood or adolescence may be exposed to hyperglycemia for much longer periods than their adult counterparts thereby increasing their chances of developing diabetes-related complication earlier in life.

Lifestyle, Exercise, and Nutrition Behaviors

Lifestyle behaviors, such as TV/computer viewing and exercise habits revealed that most subjects spent an average of 4.1 (± 2.0) hours per day in front of the television or computer and had not made any efforts to increase their level of physical activity. It has been reported that Mexican-American children spend significantly more time in front of the television set than non-Hispanic white children (Treviño et al., 1999). Perhaps these youth had little interest in organized sports participation or found it challenging to participate in sports activities. Interestingly, eight out of 14 subjects claimed that they enjoyed exercise and 36 percent of subjects would recommend an increase in physical activity to other youth diagnosed with type 2 diabetes. One the other hand, only four subjects reported exercise changes, and three participants increased their activity level through individual exercise activities such as running, walking, and weight lifting.

Dietary changes proved much more common than exercise changes as 11 of the 14 subjects claimed that they had made some significant dietary changes after their diagnosis. Soda and fast-food consumption were listed as foods that most subjects consumed less than three times per week despite an obvious interest in fast-food items such as pizza and hamburgers. The decrease in fast-food and soda consumption may have been related to the changes in dietary behaviors since diagnosis. While vegetable consumption was low among most subjects, vegetables and salad were listed as a favorite food among 5 of the 14 subjects. Participants were more likely to consume fruit and 9 of the 14 subjects reported eating fruit seven days per week. Latino children in general, are reported to eat fewer servings of fruits and vegetables as compared to Caucasian and African-American children (Treviño et al., 1999).

Perceived Needs

The data clearly indicate a strong interest in youth/family summer camps geared towards diabetes education. Eight out of 14 youth expressed an interest in meeting other youth with type 2 diabetes and attending youth/family camps. Currently, summer camps and prevention programs specifically targeting Latino and African-American youth do not exist within many states and counties in the United States including Santa Clara County, despite these being the populations that comprise most of the newly diagnosed cases of type 2 diabetes mellitus among youth.

The characteristics described in the present study are consistent with previous studies that have examined the demographics, physical characteristics, and family history of type 2 diabetes in North American children and adolescents. While some of the environmental factors that contribute to type 2 diabetes are both recognized and preventable, the rates of type 2 diabetes among youth, specifically in certain ethnic groups, are on the rise. Additionally, a family history of diabetes does not necessarily equate to increased knowledge of the associated diabetes risk factors that may minimize early-onset of this disease.

As the characteristics and diabetes risk factors of type 2 diabetes among youth continue to be identified, prevention programs will need to be designed and implemented. Summer camps and school-based education programs are available for children with type 2 diabetes in certain parts of the United States and Canada. These camps and school-based education and prevention programs have been established because type 2 diabetes has been recognized in Native American youth for over 15 years (Rosenbloom, Joe, Young & Winter, 1999). It has been shown that a child who attends a summer camp for two consecutive years is more likely to adopt lifestyle changes that lead to improved diabetes management (Cook, & Hurley, 1998). Diabetes education programs for this population will need to be culturally appropriate and focus on family involvement to increase the quality of life and decrease some of the preventable health risks associated with this disease.

The youth diagnosed with type 2 diabetes are reported to be a challenging population to work with due to poor blood sugar control, missed appointments with physicians and diabetes educators, and the pressure to conform to the lifestyle behaviors of their peers. As more youth are diagnosed with type 2 diabetes at increasingly younger ages, they will be living with the disease for much longer periods of time than their adult counterparts, potentially facing higher medical costs and more diabetes complications including cardiovascular disease and hypertension at younger ages. Due to the recent increase of cases of type 2 diabetes among youth, support programs and services have yet to be developed and implemented to address the needs of this unique population.

It is also clear that family involvement and positive role models will be integral in the success of the self-care required of youth who are diagnosed with type 2 diabetes. Finally, the community programs developed for this population will need to focus on the diverse cultural needs since the majority of youth cases with type 2 diabetes are found in the Latino, Native- American, and African- American populations.

References

Beck, J. B., Brandt, E. N., Blackett, P., & Copeland, K. (2001). Prevention and early detection of type 2 diabetes in children and adolescents. Journal - Oklahoma State Medical Association, 94, 355-361.

Buck, T. B. (1999). Type II diabetes in children. Tennessee Medicine: Journal of the Tennessee Medical Association, 92, 418-419.

Centers for Disease Control and Prevention. (2002). CDC Projects: Children and diabetes. Retrieved November 2004, from http://www.cdc.gov/diabetes/projects/cda2.htm

Cook, V. V., & Hurley, J. S. (1998). Prevention of type 2 diabetes in childhood. Clinical Pediatrics, 37(1), 123-141.

Ehtisham, S., Barrett, T. G., & Shaw, N. J. (2000). Type 2 diabetes mellitus in UK children – An emerging problem. Diabetes UK, 17, 867-871.

Fagot-Campagna, A., Pettitt, D. J., Engelgau, M. M., Burrows, N. R., Geiss, L. S., Valdez, R., et al. (2000). Type 2 diabetes among North American children and adolescents: An epidemiologic review and a public health perspective. The Journal of Pediatrics, 136, 664-672.

Glaser, N. S. (1997). Non-insulin-dependent diabetes mellitus in childhood and adolescence. Pediatric Clinics of North America, 44, 307-337.

Haffner, S. M., Hazuda, H. P., Mitchell, B. D., Patterson, J. K., & Stern, M. P. (1991). Increased incidence of type II diabetes mellitus in Mexican Americans. Diabetes Care, 14, 102-108.

Hanley, A. J. G., Harris, S. B., Gittelsohn, J., Wolever, T. M. S., Saksvig, B., & Zinman, B. (2000). Overweight among children and adolescents in a Native Canadian community: Prevalence and associated factors. American Journal of Clinical Nutrition, 71, 693-700.

Libman, I., & Arslanian, S. A. (1999). Type II diabetes mellitus: No longer just adults. Pediatric Annals, 28, 589-593.

Neufeld, N. D., Raffel, L. J., Landon, C., Chen, Y.-D. I., & Vadheim, C. M. (1998). Early presentation of type 2 diabetes in Mexican-American youth. Diabetes Care, 21, 80-86.

Pinhas-Hamiel, O., Standiford, D., Hamiel, D., Dolan, L. M., Cohen, R., & Zietler, P. S. (1999). A setting for development and treatment of adolescent type 2 diabetes mellitus. Archives of pediatrics & adolescent medicine, 153, 1063-1067.

Rosenbloom, A. L., Joe, J. R., Young, R. S., & Winter, W. E. (1999). Emerging epidemic of type 2 diabetes in youth. Diabetes Care, 22, 345-354.

Scott, C. R., Smith, J. M., Cradock, M. M., & Pihoker, C. (1997). Characteristics of youth-onset noninsulin-dependent diabetes mellitus and insulin-dependent diabetes mellitus at diagnosis. Pediatrics, 100, 1, 84-91.

Sones, M. K. (2001). Center for Disease Control and Prevention Press Release. Retrieved November 2004, from http://www.cdc.gov/od/oc/media/pressrel/r2k1226.htm

Stuart, C. A., Pate, C. J., & Peters, E. J. (1989). Prevalence of acanthosis nigricans in an unselected population. The American Journal of Medicine, 87, 269-272.

Treviño, R. P., Marshall Jr., R. M., & Hale, D. E. (1999). Diabetes risk factors in low-income Mexican-American children. Diabetes Care, 22, 202-207.

Acknowledgements

We would like to acknowledge the medical staff at the Kaiser Santa Teresa Pediatric Endocrine Clinic as well as all the study participants who offered their time and support for this research project. Special thanks to Drs. Tawni Holmes and Kathryn Sucher for their valuable assistance and editorial comments in the preparation of the manuscript.

Author Information
Shoshanah M Orzech, MS, RD
Department of Nutrition and Food Science
San Jose State University
San Jose, California 95192-0058

Clarie B. Hollenbeck, PhD*
Associate Professor
Graduate Research Coordinator
Department of Nutrition and Food Science
San Jose State University
One Washington Square

San Jose, CA 95192-0058
Ph. 408-924-3106
Fax.: 408-924-3114
E-Mail: clariebh@casa.sjsu.edu

Lucy M. McProud PhD, RD
Department of Nutrition and Food Science
San Jose State University
San Jose, California 95192-0058

Paige Reddan MS, RD, CED
LifeScan, Inc.
Milpitas, CA 95035

* corresponding author