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Research Article

# Self Management Level among Children with Type 1 Diabetes Attending a Residential Diabetes Camps; A 2-Years Review, Ras Al Khaimah, United Arab Emirates, 2017

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**Abstract**

Type 1 diabetes is one of the most common endocrine conditions in childhood. Approximately 86,000 children under 15 year are estimated to develop type 1 diabetes annually worldwide. In 2015 the number of children with type 1 diabetes exceeded half million. Therapeutic education is central to the management of diabetes, especially in children and adolescents. Diabetes Self-Management Education (DSME) in residential camps exposes children and adolescents with Type 1 diabetes to intensive self-management education in a short-term recreational camp setting. Albasma Camp for children with Diabetes was established in 2008, to educate children about diabetes management in an enriching, diabetes-friendly environment. The aim of this study is to assess the effect of short-term residential camps in improving the practice and skills of diabetes self-management among children attending a seven-day diabetes camp where 306 diabetic children participated from different states of United Arab Emirates. Data was collected using pretested questionnaire, check list and Focus Groups Discussion. The study found that there was a strongly significant improvement in the overall Diabetes Self-Management (DSM) practices of the study participants pre and post the camp (P-value<0.00).and the majority of the study participants did not exposed to any hyper (67%) or (58%) hypoglycaemic episodes during the 6 months following the camp. Highly statistically significance between participant ages and average HbA1c pre and post camp (p value < 0.00) for the between the age of 8 and 12 years, however, among the participants aged 13 to 14 there was a statistically significance in HbA1c values compared to age only before attending the camp, but after the camp the relationship was not significant (P- value > 0.05). Existence of first degree relatives with diabetes, and experience of attending a previous camp duration of diabetes were not significant factor in the study. The study concluded residential diabetes camps had a positive impact on glycemic control in children living with type 1 diabetes. The study recommended repeated educational programmes to assure continuity of diabetes management and controlling glycaemia in children with diabetes. The study suggested further studies with more duration of follow up

## Introduction

Diabetes Mellitus is characterized by a state of chronic hyperglycemia resulting from a diversity of aetiologies, environmental and genetic, acting jointly [1] (Figure 1). Chronic hyperglycemia, from whatever cause, leads to a number of complications – cardiovascular, renal, neurological, ocular and others such as inter current infections [2]. According to WHO, there will be an alarming increase in the population with type 1 diabetes mellitus, both in the developed and developing countries over the next two decades WHO, 2008 (Figure 2). Epidemiological data indicate the most common age of onset of type 1 diabetes is from 10 to 14 years, with the incidence of diabetes increasing worldwide [3].

In order to prevent mortality and complications related to diabetes, diabetic patients need to maintain a healthy lifestyle by following the proper diet, regular exercise and adherence to their treatment plan (Figure 3). Self-management is the cornerstone of diabetes care and patients are responsible for the day-to-day control of their diabetes. Lifestyle strategy is based on a patient centered approach through patient education as an essential part of health care for people with diabetes [4].

There are several different forms of diabetes (Tables 1,2 and 3). Type 1 diabetes is an autoimmune disease in which the pancreas ceases to produce insulin. This occurs most often in children and young adults. Type 2 diabetes is a metabolic disorder that results from the body's inability to either make enough insulin or to use insulin properly ADA, 2012.

Diabetes care is provided in a wide variety of settings and the improvement in outcomes is largely dependent on long term




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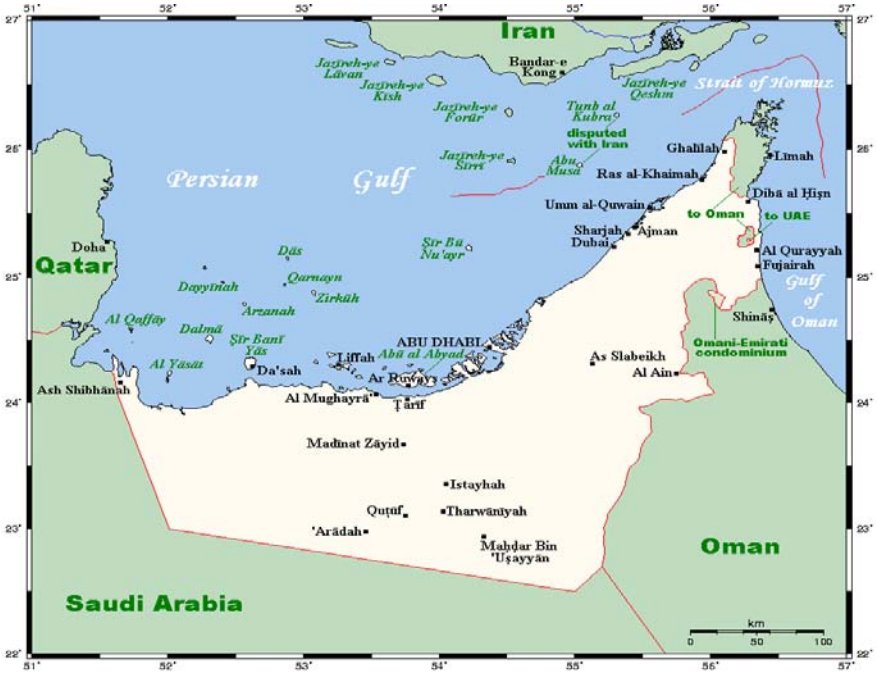


**Figure 1:** The map of United Arab Emirates.

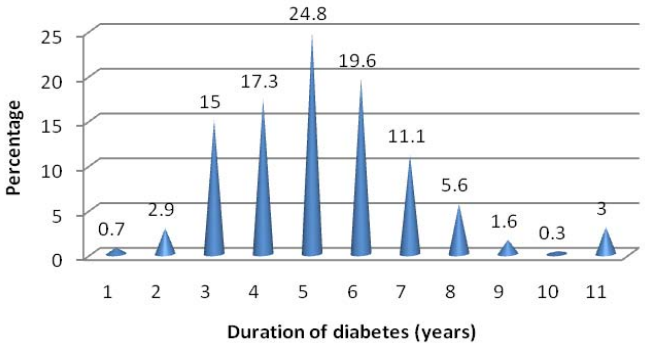


**Figure 2:** The distribution of the study participants according to the duration of diabetes (N=306).

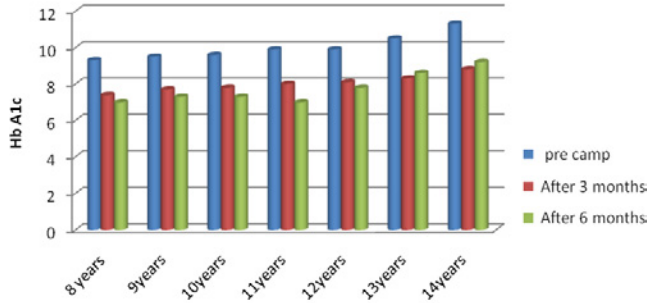


**Figure 3:** Correlation between age (in years) and average HbA1c.

preventive care delivered by a coordinated team of health care providers [5].

Therapeutic education is central to the management of diabetes, especially in children and adolescents [6].

Camps for children and adolescents living with diabetes represent an ideal environment for education [7].

Diabetes camps give children with diabetes an opportunity to independently manage their diabetes in a safe environment away from home (Figure 4). Diabetes Self-Management Education (DSME) in summer camps exposes children and adolescents with Type 1 diabetes to intensive self-management education in a short-term recreational camp setting ADA, 2012.

The aim of diabetes camps is to allow for a camping experience in a safe environment. Another important goal is to enable children with type 1 diabetes to meet and share their experiences with one another

**Table 1:** Socio-demographic characteristics of the study participants (N = 306).

| Variable | Sub variables | No. | % |
|---|---|---|---|
| **Age *** | 8 years | 29 | 9.5 |
| | 9 years | 23 | 7.5 |
| | 10 years | 49 | 16 |
| | 11 years | 47 | 15.4 |
| | 12 years | 54 | 17.6 |
| | 13 years | 48 | 15.7 |
| | 14 years | 56 | 18.3 |
| **Gender** | Male | 170 | 55.6 |
| | Female | 136 | 44.4 |
| **Family member with diabetes** | Yes | 39 | 12.7 |
| | No | 267 | 87.3 |
| **Experience of attending a previous camp** | Yes | 31 | 10.1 |
| | No | 275 | 89.9 |

*Mean age = 11; SD = 1

**Table 2:** Self- management practices of the participants pre and post the camp (N = 306).

| Category | Skill and Practices | Practice Scores | | | | p- value |
|---|---|---|---|---|---|---|
| | | Pre- camp | | Post-camp | | |
| | | Mean | SD | Mean | SD | |
| Insulin Administration | The child adjust insulin dose based on result of BGL | .0261 | .15982 | 2.0000 | .00000 | 0.000 |
| | The taking insulin dose on time/Adjust insulin pump on time (for pump users) | .0131 | .11377 | 2.0000 | .00000 | 0.000 |
| | The child inject insulin/ fix the pump needle (for pump users) | .0229 | .14975 | 2.0000 | .00000 | 0.000 |
| | The child rotate the site of injection/Site of the needle (for pump users) | .0131 | .11377 | 2.0000 | .00000 | 0.000 |
| | The child adhere to the safety procedures (single use objects, hand-washing, ect) | .0163 | .12699 | 2.0000 | .00000 | 0.000 |
| | The child follows guidelines of insulin storing | .0131 | .11377 | 2.0000 | .00000 | 0.000 |
| Nutrition | The child create own meal plan and discuss options | .0163 | .12699 | 1.9902 | .09869 | 0.000 |
| | The child counts carbohydrates in each meal and snack | .0131 | .11377 | 2.0000 | .00000 | 0.000 |
| | The child choose low cholesterol, low-fat food | .0033 | .05717 | 1.9967 | .05717 | 0.000 |
| Exercise | The child do physical exercise daily | .0261 | .17917 | 1.9935 | .08071 | 0.000 |
| SMBG | The child can use a meter properly to guarantee accurate results | .0098 | .09869 | 2.0000 | .00000 | 0.000 |
| | The child can follow monitoring schedule | .0163 | .12699 | 1.9771 | .14975 | 0.000 |
| | The child adhere to the safety procedures in using the meter | .0033 | .05717 | 1.9935 | .08071 | 0.000 |
| | The child following proper supplies storing | .0033 | .05717 | 1.9902 | .09869 | 0.000 |
| | can interpret blood glucose values and make decisions in diabetes treatment plan | .0131 | .13964 | 1.9935 | .08071 | 0.000 |
| Hyper-glycaemia | The child can recognize symptoms of hyperglycemia | .0098 | .09869 | 1.9902 | .09869 | 0.000 |
| | The child can manage mild hyperglycemia | .0033 | .05717 | 1.9837 | .12699 | 0.000 |
| | The child can prevent hyperglycaemia | .0033 | .05717 | 1.9869 | .11377 | 0.000 |
| Hypo-glycaemia | The child can recognize symptoms of hypoglycemia | .0163 | .17100 | 2.0000 | .00000 | 0.000 |
| | The child can manage mild hypoglycaemia | .0000 | .00000 | 2.0000 | .00000 | 0.000 |
| | The child can prevent hypoglycemia | .0000 | .00000 | 1.9837 | .12699 | 0.000 |

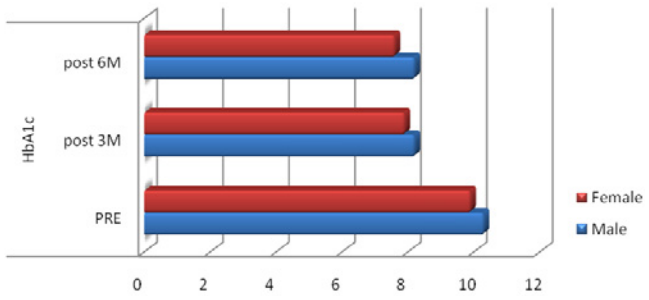


**Figure 4:** Correlation between gender and average HbA1c (N=306).

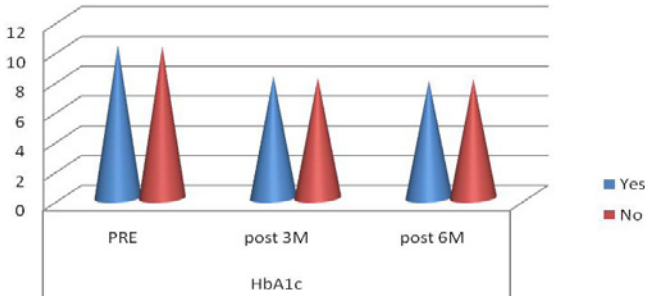


**Figure 5:** The comparison participants with family member with diabetes and average HbA1c (N=306).

while they learn to be more personally responsible for their disease. In the camp setting, the recreational, educational, social and health care needs of children can be met in a safe, enjoyable and productive environment [8].

According to Community evidence guide rules, evidence is insufficient to assess the effectiveness of education in summer camps, based on the lack of a sufficient number of quality studies examining health outcomes [9].

Al Basma Camp for Diabetic Children, Ras Al Khaimah, will be organized by the Ministry of Health, Ras Al Khaimah Medical District, is an educational event for the diabetic children using fun and recreation as an educational method (Figure 5).

The aim of the camp is to educate the diabetic children in United Arab Emirates, how to lead a normal and healthy life by practicing healthy habits and self care of their diabetes, and how to become a responsible person in the society.

## Research problem

According to the Global estimates of type 1 diabetes in children (<15 years) for 2015, the number of children with type 1 diabetes reached 542,000. Number of new type 1 diabetes cases per year is 86,000, and the annual increase in incidence is 3%. In many countries, limited access to medicines, supplies and self-management education, lead to severe health complications and early death in children with diabetes (Table 4). People with type 1 diabetes need to follow

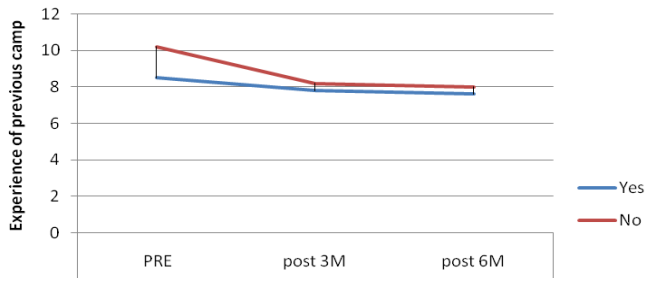


**Figure 6:** Relationship between attending a previous camp and average HbA1c (N=306).

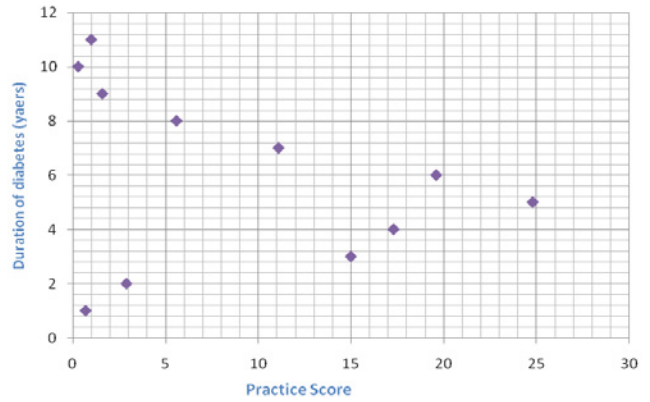


**Figure 7:** Correlation between the duration of diabetes (years) average the practice score (*P0 = 527).

a structured self-management plan that includes insulin use, blood glucose monitoring, physical activity and a healthy diet IDF, 2015.

**Rationale:** Diabetes camps have become a common part of medical practice worldwide [8] (Figure 6). Albasma Camp for Children with Diabetes was established in Ras Al Khaimah Emirate in March 2008, as a first diabetes camp in United Arab Emirates. Since establishment an until now, no studies was done to evaluate the effect of the camp on improving glycaemic control among children with type 1 diabetes who attend the camp.

According to the result of the study of Knowledge, attitude and practice of the diabetic patients in Ras Al Khaimah in 2011, the study found that the scores of practice was very low compared to the knowledge and attitude scores of the study participants [10] (Figures 7 and 8). The study recommended developing new strategies to improve the level of the skills and practices related to diabetes self-management towards reaching individual objectives of glycemic control.

### Objectives

**General objective:** To assess the effect of short-term residential camps in improving the practice and skills of diabetes self-management among children attending a seven-day Al Basma residential diabetes camp, RAK, 2014 - 2015.

**Specific objectives:** To assess changes in skills and practices related to the insulin administration among the camp participants pre and post the camp.

To measure changes in skills and practices related to the nutritional control among the camp participants pre and post the camp.

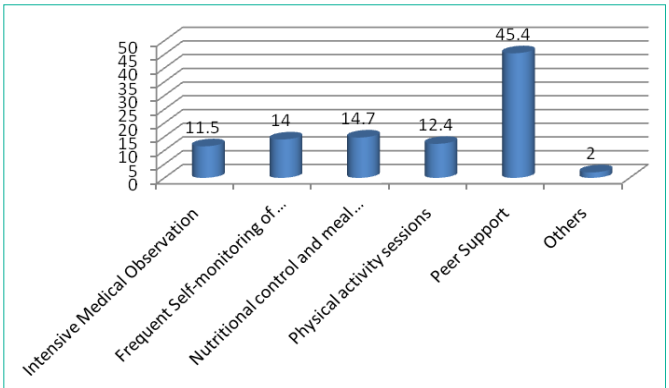


**Figure 8:** Factors helped the participant in gaining high glycemic control scores during the camp.

**Table 3:** Distribution of the participants Hb A1c values pre camp, after 3 month and after 6 month (N = 306).

| Hemoglobin A1c Values* | Pre camp | | After 3 months | | After 6 months | |
|---|---|---|---|---|---|---|
| | Freq. | % | Freq. | % | Freq. | % |
| <6.0% | 0 | 0 | 0 | 0 | 2 | .7 |
| 6.1 - 7.0% | 0 | 0 | 23 | 7.5 | 85 | 27.8 |
| 7.1 - 8.0% | 4 | 1.3 | 177 | 57.8 | 121 | 39.5 |
| 8.1 - 9.0% | 70 | 22.9 | 48 | 15.7 | 35 | 11.4 |
| 9.1 - 10.0% | 121 | 39.5 | 43 | 14.1 | 30 | 9.8 |
| 10.1 - 11.0% | 34 | 11.1 | 10 | 3.3 | 11 | 3.6 |
| 11.1 - 12.0% | 43 | 14.1 | 1 | .3 | 18 | 5.9 |
| 12.1 - 13.0% | 15 | 4.9 | 4 | 1.3 | 3 | 1.0 |
| 13.1 - 14.0% | 13 | 4.2 | 0 | 0 | 1 | .3 |
| 14.1 - 15.0% | 6 | 2.0 | 0 | 0 | 0 | 0 |

*Normal value of the participant age group is (8%) [5].

To appraise the effect of attending the diabetes camp in changing behaviors related to physical activity among children with diabetes.

To identify the effect of the camp in the skills of monitoring blood sugar among the camp participants.

To assess the effect of diabetes cam in reducing short term complications; hyper and hypoglycaemia.

### Hypothesis

Attending a residential camp of self-management education improves glycemic control among children with type 1 diabetes

**Null-hypothesis:** Attending a camp of self-management education has NO effect on improving glycemic control among children with type 1 diabetes.

## Methods and Materials

### Study area

The United Arab Emirates (UAE) is an Arab country in the southeast region of the Arabian Peninsula, is a constitutional federation of seven emirates; Abu Dhabi, Dubai, Sharjah, Ajman, Umm al-Qaiwain, Ras al-Khaimah and Fujairah. The federation

**Table 4:** Shows the distribution of participants according to occurrence of hyperglycaemia (with or without DKA) pre and post camp (N=306).

| Variable | | Pre- camp | | Post- camp | | P - Value |
|---|---|---|---|---|---|---|
| | | No. | % | No. | % | |
| Occurrence of Hyperglycaemia | yes | 304 | 99.3 | 129 | 42.2 | 0.000 |
| | No | 2 | 0.7 | 177 | 57.8 | |
| Number of times of Hyperglycaemia episodes | 0 | 2 | 0.7 | 180 | 58.8 | 0.000 |
| | 1 | 32 | 10.5 | 119 | 38.9 | |
| | 2 | 212 | 69.3 | 7 | 2.3 | |
| | 3 | 60 | 19.6 | 0 | 0 | |
| The most common cause of Hyperglycaemia | Related to insulin dose | 277 | 90.5 | 94 | 30.8 | 0.000 |
| | Related to nutritional factors | 25 | 8.2 | 35 | 11.4 | |
| | Related to physical activity | 4 | 1.3 | 0 | 0 | |
| | others | 2 | 0.7 | 0 | 0 | |

**Table 5:** Distribution of participants according to the occurrence of hypoglycaemia episodes pre and post camp (N=306).

| Variable | | Pre- camp | | Post- camp | | P – Value |
|---|---|---|---|---|---|---|
| | | No. | % | No. | % | |
| Occurrence of Hypoglycaemia | yes | 306 | 100 | 101 | 33 | 0 |
| | No | 0 | 0 | 205 | 67 | |
| Number of times of Hypoglycaemia | 0 | 0 | 0 | 205 | 67 | 0 |
| episodes | 1 | 15 | 4.9 | 101 | 33 | |
| | 2 | 102 | 33.3 | 0 | 0 | |
| | 3 | 181 | 59.2 | 0 | 0 | |
| | 4 | 5 | 1.6 | 0 | 0 | |
| | 5 | 3 | 1 | 0 | 0 | |
| The most common cause of Hypoglycaemia | Related to insulin dose | 277 | 90.5 | 94 | 30.8 | 0 |
| | Related to nutritional factors | 25 | 8.2 | 35 | 11.4 | |
| | Related to physical activity | 4 | 1.3 | 0 | 0 | |
| | others | 2 | 0.7 | 0 | 0 | |

was formally established on 2 December 1971. It occupies an area of 83,600 square km along the south-eastern tip of the Arabian Peninsula. Qatar lies to the west, Saudi Arabia to the south and west, and Oman to the north and east. The capital and the largest city of the federation, Abu Dhabi, is located in the emirate of the same name. The total population in 2016 is 9,157,000,000 according to United Nation estimates. More than 200 different nationalities live in UAE National Bureau of Statistics, 2016 (Table 5).

The climate of the UAE generally is very hot and sunny. The hottest months are July and August, when average maximum temperatures reach above 50°C (122.0°F) on the coastal plain. Average minimum temperatures in January, February and March are between 10 and 14°C (50.0 and 57.2°F). The average annual rainfall in the coastal area is fewer than 120 mm (4.7 in), but in some mountainous areas annual rainfall often reaches 350 mm (13.8 in). The Jebel Jais mountain cluster in Ras al Khaimah has experienced snow only three times (2004, 2009 and 2017) since records began.

The official language is Arabic, though English is widely spoken, particularly in business transactions.

Albasma Camp for Children with type 1 diabetes was conducted in Ras Al Khaimah, one of the seven emirates that make up the United Arab Emirates federation. It is located near the northernmost point of the country along the Arabian Gulf.

**Albasma Camp for Children with Diabetes:** The Health Education Department of Ras Al Khaimah Medical District is committed to improving the lives of children and adults affected by diabetes through prevention, education and service. The greatest success is seeing these children develop the skills to take charge of their diabetes. Training programs focus on three steps: education, gaining confidence and building leadership.

Albasma Camp for children with Diabetes was established in 2008. From the beginning, the focus of the camps has been to provide children living with type 1 diabetes opportunities to enjoy a faithful camp experience while having all of their diabetes needs monitored by a dedicated team of trained medical professionals.

At camp, children learn about diabetes management in an enriching, diabetes-friendly environment. Diabetes education in the camp is experiential; meaning that learning how to better manage diabetes happens through doing.

Camp staff: The General Supervisor, Technical coordinator, and the camp medical staff consists of resident physicians, nurses, diabetes educators, medical and nursing students, registered dieticians.

**Camp arrangements and preparations:** Preparation of the camp starts several months prior the camp that includes: Announcing, sending invitations to the participants, registration, checking safety measures, training of the staff, and regular meetings.

## Educational programme

Each day of the camp programme is made up of activities, workshops, training courses, competitions, educational songs, focus group discussions, physical activity sessions as well as five participant presentations in the evenings.

**Physical activity during the camp:** Physical activity was closely monitored during camp and all campers' perception of physical activity may have changed after being exposed to it in a controlled setting.

Sports activities and interactive workshops give participants the opportunity to share and discuss with their peers, ask questions and test their ideas and thoughts.

Each evening, five participants were invited to make their presentations that they had prepared in advance of the camp and reviewed by the scientific committee of the camp.

**Nutritional education in the camp:** The intervention for all participant was exactly the same and included self-management lessons such as diabetes specific nutrition lesson including nutrition facts labeling, portion sizes, and insulin dose related to carbohydrate intake, demonstration and training on insulin injection and carbohydrates counting, well as self-monitoring of blood glucose by using glucometers.

## Medical observation

The Health-care staff of the camp is responsible of the follow up of the glycemic control for all participants in addition to treatment of any emerging problems all over the camp days.

Each 10 children are observed by 2 staff nurses who are responsible about monitoring the behavior of diabetic children and the improvement in the skills they gain during the camp as well as teaching them.

All glycemic readings were recorded by the in-charge nurse, as well as the skills checklist in the first and last day of the camp.

After camp ended, there were two meetings at 3, and 6 months post-camp. A charity lunch was held as a follow up meeting, with coordination with three deputed laboratories to do the Hb A1c Test for the participants.

Participants, who could not attend the follow up meeting, are requested to do the test and send the results by email.

## Study design

Field interventional pre and post design, used to evaluate the impact of short-term residential camps in improving diabetes self-management and glycemic control among children attending a seven-day residential diabetes camps.

All participants were exposed to standard diabetes self-care education provided by a highly trained and qualified staff according to the Guidelines of the American Diabetes Association ADA, 2012 such as nutrition education sessions, insulin adjustment sessions, physical activity programmes.

The intervention included three phases:-

**Phase I**

- Questionnaire filled by the parents and sent along with medical report and consent three months before the camp.
- Observational Checklist filled in the first day of the camp.
- Hb A1c test at arrival time It measures average glycaemic control over the past three months ADA, 2013.

**Phase II**

Educational program covering the following areas: (Appendix..)

- Diabetes disease process and treatment options (demonstration, Focus group discussions).
- Nutritional management
- Physical activity
- Self-monitoring of blood glucose, and using the results to improve control.
- Insulin injection, adjustment, and storing.
- Preventing, detecting, and treating acute complications.
- Preventing (through risk reduction behaviour), detecting, and treating chronic complications.

**Phase III**

- Post camp questionnaire
- Hb A1c blood test: 3and 6 month after the camp

## Study strategies

As each camper arrived for the check-in procedure, staff collected the consent forms and gave the camper an index card with their pre-assigned code number. Three stations were arranged in the dining room with one being the nutrition staff, another the nursing staff, and the third for this study.

Experienced and trained staff interviewed the participants using a pre–constructed questionnaire and an observational checklist.

Intensive pre- designed educational programme was provided to the diabetic children using simplified educational methods, such as songs, role plays, competitions, workshops, storytelling and focus group discussions (see the photos in Appendix).

## Study population

All the children with type 1 diabetes who attended the camp for the years 2014, 2015.

## Inclusion criteria

The target population in this study constituted subjects according to the following criteria:

- Diagnosed with type 1 diabetes for at least 1 year
- Ages Eligible for Study: 8 to 14 years
- Genders Eligible for Study: Both genders

### Study sampling

**Sample size:** 306 children with Type 1 diabetes who attended Al-Basma Camp for Children with Diabetes 2014 - 2015.

### Methods of data collection

**Data was collected through: Questionnaire:** Diabetes Self-Management Questionnaire was composed of 21 items, had been categorized into four categories that represent different aspects of diabetes self-management practices, examine a range of diabetes management aspects in order to assess the participant's ability to follow basic self-management skills, such as:

- The skills the participant has in insulin management.
- Nutritional management especially carbohydrate counting.
- Skills related to the self-monitoring of blood glucose.
- Changes in lifestyle in concentration on physical activity.
- The ability to prevent and manage short term complications associated with the disease.

Scores of the pre-camp questionnaire were analysed in order to determine the areas in which the camp may need to focus on for the educational and training programme.

**Observational checklist:** The observational checklist contained the same skills of the questionnaire, the only difference that it was filled according to the direct observation of the participants' practices in the first and last day of the camp.

- Blood Test Results
- Daily glycemic records
- Hb A1c blood test done for all participants at arrival in the first day, after 3 month, and 6 month following the camp.

When campers arrive at the camp, the staff drew blood to test each camper's haemoglobin A1c. These blood samples were coded by camp staff with the same code numbers used in each camper's questionnaire form and sent to the lab for interpretation. Haemoglobin A1C values are then returned to camp staff within 24 hours.

The observational checklist forms of all participants were collected on the last day of the camp.

An overall mean haemoglobin A1C value was calculated for all participant. Average practice scores, for the pre- and post-questionnaire as well as the observational checklist were calculated and compared statistically to the haemoglobin A1C mean values.

### Study variables

All practices and skills related to the diabetes self-management were considered as dependent variables; while age, gender, previous camp experience, family member with diabetes, as well as the duration of diabetes were the independent ones.

### Data analysis

Data obtained from the pre- and post-questionnaire, checklist, and lab results were compiled in Excel. Overall scores as well as scores for each individual question were compiled and means calculated.

Data was analyzed by computer software using Statistical Package for Social Sciences (SPSS) program version 17. Results are presented as mean and standard deviation or median for continuous variables and as count (percentage) for discrete variables. Means were compared by repeated measure ANOVA, paired t test or independent t test where appropriate and medians by the Wilcoxon rank sum test. Where necessary, continuous variables were categorized using the median as cutoff. A P-value $< 0.05$ was used to characterize statistically significant results.

### Ethical consideration

The following ethical concerns were taken:

- The study proposal was presented to the members of Gezira, University, Sudan.
- Permission was granted and a letter was directed to the Health Education Department to allow the research to be conducted.
- A consent letter was sent to the parents before the starting day.
- All participants were assured about the anonymous and confidentiality of the study. The participation is voluntary and the data collected as well as the personal information like name, contact details or address will not be used for any other further purposes.

## Discussion

The study was done on a sample of 306 the total participants registered in Albasma Camp for Children with Diabetes in Ras Alkaimah, UAE for the years 2014-2015. For this study, participants completed pre and post questionnaire and observational checklist along with a follow up data obtained six months after participating in camp.

Information regarding the socio-demographic profile such as age, gender, existence of a family member diagnosed with diabetes and previous experience of attending camp specific for diabetes, showed in found that; mean age of the study participants was (11±1) years, with majority (66%) between below the age of 12 years (according to the inclusion criteria of the camp, all participants' ages ranged between 8 to 14 years old), The study results showed that the majority (55.6%) of the participants were males, (40.6%) of the participants have family members diagnosed with diabetes, (90%) of the participants did not attend a previous diabetes camp. Participants reported an average 6 years of being diagnosed with diabetes and the duration range was (1-11) years.

In order to examine any changes in partipants' Diabetes Self-Management (DSM) practices and skills, the DSM checklist was filled on both the first and last day of the camp

The study found a highly statistical significance in practice scores of the participants on skills related to insulin administration pre and post the camp (P-value=0.00) as revealed in. Results of the study of Sukru et al., suggest that there is an important increase in insulin

administration performance post attending a diabetes camp when compared to results before attending the camp.

In the study showed a significant relationship between skills of diet such as meal planning and carbohydrates among a study participants pre and post the camp. These results correlate with the results of Whipple, which found that attendance at type 1 diabetes camp improves nutrition skills in children and adolescents.

Results of our study found a significant relationship between the participants' practices related to physical exercise pre and post the camp, the mean score was 0.03 pre camp compared to 1.99 post camp, (p-value=0.00). While the study of [8] found that there was significant improvement in the sports skill performance scores among the participants after attending the camp.

Regarding the skills of Self-Monitoring of Blood Glucose (SMBG), the study results showed highly statistical significance (P-value<0.00) between SMBG practice scores pre and post the this is consistent with results achieved by Takashi et al., which showed that, there was improvement in the skills related to self-monitoring of blood glucose and glycemic control after attending an educational camp.

The study results and table found a highly significance in practice scores related to recognizing and managing mild hyperglycaemia and hypoglycaemia pre and post the camp, (p-value=0.00). These results correlate with the results of a meta study by Mark, et al. concluded that, diabetes camps for children with type 1 diabetes is the significant effect in improving skills and practices of DSM skills related risk factor of hyper and hypo glycaemic [11].

In a comparison between HbA1c values pre, after three months and after six months post the camp, as shown in the study results found elevated average HbA1c values 10%±1.54 for the samples obtained on the opening day of the camp, while the results after 3 months and after 6 months after attending the camp showed statistically significant improvement in average HbA1c (8±1.1%) and (7.7±1.54%) respectively. These results agreed with the results of a study conducted by Mercuri et al. report HbA1c decreases when comparing pre to post 4 and 7 months (10.3±2.3% and 8.8±1.8%, respectively) but not with the third average Mercuri et al., In a study by [8] although, the average HbA1c values showed a trend towards improvement from pre to three months post camp, but the six months there was a rebound of HbA1c in the children who attended the camp. A Thai study by, [12] reported an initial significant drop in HbA1c three months after camp, followed by an increase at six months, the same study noted a positive correlation between the number of daily capillary blood glucose, and the decrease in HbA1c. Similar results were found by Semiz and Garcia.

A recent study in a group of sub-Saharan African children and adolescents living with type 1 diabetes observed no significant immediate impact at three months of the camp on glycemic control, however, a significant decrease in HbA1c (P-value <0.05) 12 months after their first participation in a diabetes camp [13].

The study results in table (4.3) showed that, (98%) of the participants HbA1c values pre the camp were over the normal range compared to (32%) after 3 months and (43%) after 6 months [according to the American Diabetes Association recommendation for target blood glucose levels for children with type 1 diabetes, the normal value of the age group of the study participant is (8%) ADA, 2014]. This is similar to the results of the study conducted by Karguzel et al, participants were also exposed to nutrition and diabetes education focused on insulin regimens and glycemic control that showed, there was a significant decrease in HbA1c at 6 and 12 months post camp. Unlike to Santiprabhob et al.'s study that reported individuals with pre camp mean HbA1c values of 6.9±0.9% presented an increase after 3 months 7.5±1.1% (p = 0.036) [12].

Comparing results pre and post the camp, our study showed highly significance in physical exercise scores among the study participants (p-value =0.00) as shown in, whereas a study conducted in Hong Kong found no change in the physical activity scores after attending a comp for diabetic children [14].

Regarding SMBG practice scores, the study results showed highly statistical significance (P-value<0.00) between SMBG scores pre and post the this is consistent with results achieved by a study conducted among children with type 1 diabetes attended a 5-day camp in Cameroon reported that the practices of SMBG (p = 0.005) were significantly associated with lower HbA1c levels [13], this was similar to the results of the study for 73 children aged 8- to 14-years attending a diabetes camp done by Sonica et al., that found the skills related to the SMBG were significantly improved from pre to post camp [15,16], while negative affect related to blood glucose monitoring with age reported by [17].

The study conducted a comparison between the frequency of occurrence of sever hyperglycaemia and hypoglycaemia episodes the child was exposed to during the six months before and the six months immediately following the camp.

## Results

found 99.3% and 100% of the study participants had hyperglycaemia and hypoglycaemia respectively, at least one time during the six months period before attending the camp. After a long term of follow up (6 months), significant improvement was found in number of hyper and hypo glycaemia episodes, 19%, 70%, respectively, of the participants experienced three episode or more of hyper and hypoglycaemia pre camp, that was significant when compared to 0% post camp (P-value=000), and the majority of the study participants did not exposed to any hyper (67%) or hypo (58%) glycaemia episodes during the 6 months followed the camp. This is relatively agreed with the study by [18-28] which observed that, the number of hospitalization, with a hypo or hyperglycaemia related conditions, after attending a camp specialized for children and adolescents decreased significantly during the 3 months of post camp follow up (p = 0.045).

The most common cause of hyperglycaemia hypoglycemia among the study participants (90.5%) was related to the insulin dosing. A study by Miller et al. found that, on the last camping day, children had fewer episodes of hypoglycaemia than during the first day (0.7±0.9 *vs.* 1.1±1.2, P<0.001) [29].

The study conducted a comparison between the average glycemic control assessed by average HbA1c values pre, after three months and after six months, and demographic profile of the participants [30-42].

The study results explained in the highly statistically significance between age and average HbA1c pre camp, after 3months and after 6 months post camp (p value < 0.00) for the participants ages of 8-12 years, however, Among the participants aged 13 to 14 there was a statistically significance in HbA1c values compared to age only before attending the camp, but after the camp the relationship was not significant (P- value > 0.05). This correlates with the study by Hunter et al. that found clear differences across campers' ages regarding DSM skills which increased among the youngest campers, 2nd–5th graders, but not among the older ones (6th–10th graders) [43-48]. In contrast, of the study of Mesmin et al. that found no significant association between age and average HbA1c levels [49,50].

Referring to gender issue, the mean HbA1c was nearly the same between males and females, the results showed no statistically significant difference was detected in the mean score among males and females compared to HbA1c before attending the camp (P-value > 0.05), but there is statistical significant relationship between gender and HBA1C after 3 months and 6 months of camp (P- value < 0.05). This was coincide with the result reported that, attending Camp Sweeney improves glycemic control, with more persistent improvement in girls compared with boys, also notable gender differences were found in girls persistent and significant improvement in HbA1c compared to boys (p-value =0.02) average HbA1c after 6 months [51-55].

Showed a statistically significant relation (P-value<0.05) between the average HbA1c pre the camp (P-value<0.05) and the attendance of previous diabetes camp, but there is no statistical significance between the average HbA1c after three and six months (P-value>0.05), these results agreed with the results obtained by Giorgadze et al. that found the HbA1c values were shown to be significantly lower in participants who attended the camp 4 times respectively compared to those who attended the camp for 2 times (p < 0.05), the first mean HbA1c values obtained were: 8.4±1.1% for the 4 times year participants and 11.0±2.6% for the 2 times participants [56-69]. And the study by [70-101] that found repeated attending of a camp specialized for diabetes improved the outcomes related to diabetes self-management in children and adolescents attended camp Ho Mita. While our results were incompatible with the results of study of Bialeschki et al. which examined a summer camp; which found that, new participants obtained more gains in terms of personal development than returning participants [97].

Figure 4.6 showed no statistical significant relationship between overall practice scores and duration of diabetes, (P value > 0.05), while a study in USA found that, youth with short diabetes duration reported significantly more diabetes self-management practice than participants with a longer duration [98]. That was inconsistent with the study of the Impact of a pioneer diabetes camp experience on glycemic control among children and adolescents living with type 1 diabetes in sub-Saharan Africa by Mesmin et al. that found an association between the reduction of HbA1c and diabetes duration (p = 0.041) [99].

Interesting results obtained from the feedback of the study participants who gained higher scores in the evaluation of DSM during a focus group discussion on the last camping day, the question was about the factors help participants to adhere to the diabetes self-management practices, 45% of the participant's mentioned the peer support as the most effective factor, this complied with the results found by Santiprabhob et al. suggested that, diabetes camps provide a valuable time for adolescents with diabetes to have peer support and to learn and practice diabetes self-management skills [100]. While a study by [101,102] supported the psychosocial benefits of a camping experience for children with type 1 diabetes. These findings could be used by the Health Care Providers as evidence to support the benefits of sending children with type 1 diabetes to residential summer camp.

## Conclusion

Attending camp for children and adolescents living with diabetes is associated with a significant decrease in HbA1c values three six months after camp.

Attendance at a diabetes camp is associated with a significant improvement in self-management skills in children with type 1 diabetes.

Change in the nutritional practices among the camp participants pre-camp compared to post-camp was very significant.

A higher SMBG practice scores was related to better metabolic control found in improvement in HbA1c values.

In terms of short-term acute complications, the study found a significant decrease in the frequency of Hyperglycemia and Hypoglycemia episodes during the six months post camp in comparison to the six months pre camp.

The study findings showed a statistically significant relationship between the average HbA1c pre the camp and the attendance of previous diabetes camp (P-value<0.05), this may recommend re-attending a diabetes camp for assuring continuity on adopting healthy practices related to diabetes self-management in children with type 1 diabetes.

From the camping experience, children became more experienced in making decisions about food choices and activities. This leads to a greater self-management of their overall living with type 1 diabetes.

## Recommendations

- According to the positive effect of the camp in reducing risk of hypo and hyperglycaemia, which could be associated with less health care utilization, and reduce the economic burden on governments and the cost of treating these emergencies.
- Health care professionals can use this data to plan for programs that contribute to the improvement of children's ability of self-efficacy in learning to live with their illness improving their self-efficacy in learning to live with their illness.
- Diabetes camps should not only provide diabetes self-management education or glycemic control measures, but also the social aspects of disease management that are needed to ensure continuous disease control.
- Health departments should conduct regular educational programs to assure continuity of diabetes management and controlled glycaemia in children with diabetes.
- For prospective studies on the same camp, we recommend more studies on the psychological aspects related to this age group.

Psychosocial outcomes could be important for these short-term interventions.

- A comparison of residential diabetes camps in different regions, communities, or population characteristics, can determine the impacts on overall glycaemic control among participants would vary significantly or not.

- Further studies are needed to determine the effectiveness of DSME in recreational camps on self-efficacy and other psychosocial mediators, behavior change, and quality of life.

- Long-term maintenance interventions need to be examined: repetitive interventions are likely needed to maintain any gains from the initial intervention.

- The optimal frequency of the camp experience needs to be determined.

- Studies with longer follow-up intervals are also needed.

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