An observational study on usage of insulin and self-injection practises among patients with diabetes attending to Diabetic Centre and Medical outpatient clinics of a tertiary care hospital of Northern Sri Lanka

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Research Article

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Abstract

Background: Prevalence of diabetes increasing world-wide particularly in low income countries. Management of diabetes sometimes requires insulin injection due to various reasons. Proper usage of insulin and injection techniques are important for diabetes control among who requires insulin. This study was aimed to assess current insulin practices and associated complications.

Methods and material: This was a cross sectional study conducted among diabetes patients attended all medical clinics and Diabetic Centre in Jaffna teaching Hospital which is the only tertiary hospital in the Northern Sri Lanka in May 2020. Insulin practices retrieved by using interviewer administered questionnaire. Data was analyses by using SPSS 26.

Results: Out of 360 patients 64.2% were female and mean age was 58.19 (12-89). Majority (61.9%) of them belongs to low income category and most (73.3%) of them using insulin more than 1 year. Main reason for the insulin initiation was oral hypoglycaemic failure (81.7%) and majority of them (80.0%) were using twice daily premixed insulin regime followed by daily basal insulin (11.4%) and basal bolus insulin (5.6%) regime. Most of the participants (81.4%) reported they do cleaning of the injection site before injection and 89.7% usually rotate the injection site. Approximately half of them (50.8%) inject themselves and majority use syringes (91.4%). Common injection site complications reported were skin changes (25%), followed by 15.3% persistent swelling (15.3%) and thinning of skin (7.8%). Angle of injection (P=0.039) and insulin regime (P<0.001) showed statistically significant association with skin changes. High proportion of participants 68.6% (95%CI: 63.7%-73.2%) experienced hypoglycaemia, using syringes 2.21 times (95%CI: 1.05-4.64) more risk of compare to pen users and missing meals 2.22 times more risk of hypoglycaemic events (95%CI: 1.18-4.17). Majority of them reported reusing the needles for injection (83.6%) and 35% were disposing needle into common garbage pin.

Conclusion: This study revealed significant gaps in current insulin practices from expected norm and hypoglycaemic events alarmingly high among participants. Exploring Continuous Glucose Monitoring Devices or flash monitoring can be a mitigation strategy and urgent attention from health professionals needed to improve the safe insulin practices.

Background

Diabetes is one of the major non communicable diseases which causes morbidity and mortality (e.g.: blindness, kidney failures, heart attacks, stroke and lower limb amputation) around the world (1). Large amount of money are spent on this disease and its complications annually. According to World Health organisation the number of people with diabetes has risen from 108 million in 1980 to 422 million in 2014(2). The global prevalence of diabetes among adults over 18 years of age has risen from 4.7% in 1980 to 8.5% in 2014 (2) and rising prevalence is more rapid in middle- and low-income countries (2). Type 2 diabetes patients usually responds life style measures such as diet control and exercise and oral hypoglycaemic agents (OHA). But some of them acquires resistance to OHA and needs insulin ultimately.
Reported annual incidence of OHA failure varies from 3-30% (3). Main reasons for this are poor compliance with diet and beta-cell function deterioration. On the other hand Type 1 Diabetes patients and some diabetes Type 2 diabetes patients requires insulin right from the start (primary OHA failure)(3).

Human insulin, insulin analogues, and glucagon-like peptide-1 receptor agonist are common injectable used in management of diabetes (4).

Many patients on insulin having highly fluctuating blood glucose level and ultimately end up in repeated hospital admissions. The knowledge regarding insulin and its injection practises (including correct injection techniques and storage practices) are important for keeping the blood sugar under control. Specific best practices recommendations regarding insulin injection techniques are essential for patients with diabetes as well as health professions (4) in order to address string blood sugar control. Insulin site local reactions (Lipodystrophy) are common due to repeated reuse of needles and improper or lack of rotation of injection sites (5). Two types of lipodystrophy reported in the literatures namely lipohypertrophy (LH) and lipoatrophy (LA) and LH is a thick firm “rubbery” feeling swelling which retards insulin absorption significantly and leads to adversely effect on diabetes control. So rotation of injection sites and avoidance of needle reuse can prevent LH which in turn improves glucose control (5, 6). So it is well known fact insulin type, injection techniques and site of injection can all affect the onset, degree, and duration of insulin activity (7). Management of diabetes requires regular blood sugar assessment, oral medications and insulin injections. These procedures generate sharps within the household and improper disposal has the potential to cause public health problems such as personal injury and propagation of blood borne infections via needle stick injuries. As such storage of insulin and proper sharp disposal education is a part of insulin management among patients (8).

Despite major studies which reveals that proper control of blood sugar can decrease the micro and macro vascular complications but still less importance is given to the proper technique, rather only insulin doses are being increased. Sri Lanka is a Lower Middle-Income country where 3 percent of the Gross Domestic Product (GDP) is spent on healthcare service and free medications (9). Proper insulin technique can reduce the amount of insulin medication and there by decrease the expenditure on this expensive drug and further, proper control of diabetes can reduce the complications and thereby reduce the burden of disease related complications. There are not many studies in Sri Lanka regarding insulin usage practices. A descriptive cross-sectional study among ambulatory patients with diabetes using insulin, who were being followed up at the North Colombo Teaching Hospital Sri Lanka revealed poor insulin usage related practices (10). But there has been no research done in Northern Sri Lanka in regards to insulin usage practices yet. So in this study the usage of insulin, the injection technique, storage practices and sharp disposal practices were assessed and associated factors explored with selected practices in addition to this study also identified the incidence of hypoglycaemic events and associated factors.

**Methods And Materials**
This was an institutional based descriptive cross sectional study conducted among diabetes patients all medical clinics and Diabetic Centre in Jaffna teaching Hospital which is the only tertiary hospital in the Northern Sri Lanka. Most of the patients in this region follow their clinic in this institution. All diabetes patients following medical and endocrinology clinics who are on insulin and age 12 years or more were included in the study during study period (1st May 2020 to 31st May 2020). As our clinic patients are adults with 12 or more years of age, it was difficult to explain and obtain the inform consent in children and mostly insulin injection practices are not carried out by themselves, only patients above 12 were included in the study. Also mentally incompetent or pregnant women were excluded from the study as many pregnant women use insulin for a transitional period. Sample size was calculated by using the following formula (11):  

\[ n = \frac{z^2 \times P \times (1-P)}{\varepsilon^2} \]

As it is a cross sectional study z is the Z score, ε is the margin of error, N is population size and \( \hat{p} \) is the population proportion a margin of error of (ε) 5%. Assumed a population proportion of 0.5. Z for a 95% confidence level is 1.96. Adding 10% of non-responders gave estimated sample size of 425. On average 550 patients on insulin are attend in all the medical clinics and Diabetic centre in Teaching hospital Jaffna monthly. Therefore, all the diabetic patients using insulin attended during study period to medical clinic and Diabetic Centre were included. The duplication was avoided by using clinic numbers. Altogether 360 patients (85% of the estimated sample) were completed the study. An interviewer administered questionnaire was used (Additional File 1). The study tool has been developed from personal long-time experience of the investigators on insulin usage and extensive literature review. These questions were also be used in many studies published in peer review journals and also validated by five physicians working in Teaching hospital Jaffna. Ethical approval was obtained from ethical review committee of Faculty of Medicine, University of Jaffna.

Data collection team consisted of two trained data collectors who are senior house officers in medicine and by the principal investigator (PI). Both data collectors were given adequate training by PI and guidelines to minimize observation variability and to increase the quality of data. Data were collected before and during clinic consultations. If the patient was not aware of the type of insulin and oral hypoglycaemic agents, information were abstracted from clinic book after the consent from patient. Skin changes (atrophy/hypertrophy) were confirmed by the principal investigator. Data were computerized and analysed with statistical packages of SPSS 26 version. The descriptive findings of the study were shown with the help of tables, pie charts and bar charts. Chi-square test was used to identify the association and P value < 0.05 considered as statistically significant. Findings of important percentage presented with a 95% confidence interval.

**Results**

**Background characteristics of patients (socio demographic and insulin usage factors):**

Three hundred and sixty (360) patients who are using insulin as part of their treatment completed the study. Socio demographic characteristics of the participants were summarised in Table 1. Majority
(64.2%) of them were female and mean age of the participants was 58.19 (Range: 12-89). Two hundred fifty five of them (60.8%) reported completion of secondary school and 11 of them (3.1%) never attended a school. Most of them (86.4%) married and 27 (7.5%) were widowed. Two hundred and twenty three (61.9%) of them were falls into low income category (Less than Rs.25000 family income) and 33.3% were in middle income category (Rs-25001-Rs50000).

The background characteristics of insulin usage among the patients were summarized in Table 2. Majority (38.9%) of them were using insulin for 1-5 years and 124 (34.4%) were using it for more than 5 years. Main reason for the insulin initiation was oral hypoglycaemic failure (81.7%) and 17 patients (4.7%) preferred insulin over oral hypoglycaemic agents. Among the 360 insulin users 22 (6.1% CI: 4.0-9.0) were identified as Type I Diabetes. Majority of them (80.0%) were using twice daily premixed insulin regime followed by daily basal insulin (11.4%) and basal bolus insulin (5.6%) were common regime in use. Eight seven patients (24.2%) believed they can stop insulin at point in future. Concomitant use of oral hypoglycaemic agents were common among patients (55.8%). Metformin was the common oral hypoglycaemic agent (49.4%) prescribed as showed in Figure 1.

**Insulin techniques related practices among participants**

Various insulin technique related practices assessed among participants and results were summarized in Table 3. Large number (293) of participants (81.4%) reported they do cleaning of the injection site before injection site and 89.7% usually rotate the injection site while 8.9% do some times. As showed in Figure 2, 78 patients (21.7%) mentioned the use abdomen as sole injection site, 72 patients (20.0%) inject in upper arm only and 35 patients (9.7%) solely inject on thigh. Remaining participants (48.6%) use multiple sites of the body for injecting insulin.

Approximately half of the participants (50.8%) inject insulin themselves while approximately same percentage (49.2%) use other for injecting insulin. Majority patients (56.1%) pinch the skin before injection, 71.9% inject at the angle around 45 degrees while 22.5% inject at 90 degree angle. Most the participants use syringes (91.4%) and only 8.6% uses pen insulin type. Significant proportion reported reusing the needles for injection (16.4% CI: 12.8-20.5%) and 35% of participants disposing needle into common garbage pin. Further 11.4% of them disposing into garbage dump and 1.7% dumping into the toilet pits. Significant proportion (48.6% CI: 43.5%-53.8%) of patients not received any health education regarding disposal of needles.

**Injection site complications**

Common complications assessed were tabulated in Table 4. Ninety participants (25%; CI: 20.7-29.7%) identified suffered from skin changes, followed by 15.3% (95% CI: 11.8-19.2) with persistent swelling and 7.8%; (95% CI: 5.3%-10.9%) were reported wasting or thinning of skin. Association between skin changes and different injection techniques were analysed and summarized in Table 5. Among the several factors analysed angle of injection (P-0.039) and insulin regime (P<0.001) statistically significant association. Rotating the site, cleaning the site, reusing the needle, pinch the skin before injection, type of insulin used
(Syringe vs. Pen) and who inject insulin were not significantly associated with skin changes (P>0.05). Angle of injection practices (which was significantly associated with skin changes) analysed with several demographic factors to see whether in significant differences and results summarised in Table 6. Factors sex, civil status, family income and educational status not significantly influencing on angle injecting insulin practice (P>0.05).

Insulin storage practices:

Majority of the participants (91.1%) reported storing the insulin in refrigerator but 7.2% reported storing in natural containers and 1.7% storing in room temperature. Among the participants who storing in refrigerators 69.8% storing at door while 3.7% storing at deep freezer and 26.5% storing in shelf. While travelling 30.2 of them carrying in container with ice pack but 37.8% mentioned they carry in hand bag (Table-7).

Hypoglycaemia and associated factors:

Quite significant proportion of participants 68.6% (95%CI: 63.7%-73.2%) experienced hypoglycaemia. Most commonly they reported palpitation and sweating (28.6%) symptoms followed by sweating only (12.2%), palpitation only (8.1%), and 5.3% reported palpitation and headache. 4.7% reported loss of consciousness and palpitation and 2.2% reported loss of conscious only (Table-8). Seventy three patients (20.3%) reported they miss meals after injection and also majority of them (64.4%) getting insulin injection after meals. Seventy one of the participants (19.7%) adjust their insulin doses on their own and 68.9% of them have glucometer but only 73.8% of them only used the glucometer less than one week duration before interview. Also majority of them (56.4%) did not carry glucose /jelly beans in case any hypoglycaemic event. Various factors examined to explore the association with hypoglycaemic events (Table-9). Type of insulin (Syringe) (P-0.033) and missing meals (P-0.012) were significantly associated with hypoglycaemic event. But socio demographic factors such as sex and educational status, concomitant use of oral hypoglycaemic or adjusting the insulin dose by themselves not significantly associated with hypoglycaemic events (P>0.05). Using syringes 2.21 times (95%CI 1.05-4.64) more risk of developing hypoglycaemia compare to pen users. Likewise missing meals 2.22 times more risk of hypoglycaemic events (95%CI: 1.18-4.17). Finally as showed in Figure 3, 37.2% of participants received information regarding insulin usage from doctors and for 21.39% main source was nursing officers. Meanwhile 28.3% of them were reported they get information from both doctors and nursing staffs.

Discussion

In spite of increased attention given by published literatures (7, 12, 13, 14 &15) on correct insulin usage practices and injection techniques, our study indicates significant gaps between recommended practices and current insulin injection techniques, storage and disposal practices among patients who requires insulin in Northern Sri Lanka as reported in previous studies in other parts of the world (16-19). It is also
well known fact that correct insulin technique is essential for desired glycaemic control (20). Even though insulin pens gaining popularity around the world, majority (91.4%) of our study population using syringes. In addition it was noted 7.2% of the participants storing the insulin in a natural containers and 1.7 % of them storing in room temperature. Even though current use insulin pens, cartridges and vials can be stored at room temperature between 15-25 degrees Celsius (C) for several days (8, 21) as in Northern Sri Lanka (Tropical country) most of day's temperature exceeds 25 degrees C and authors believe it has an impact of insulin potency which supported in the literature as well (22). Similarly non-use insulin (back up insulin) need to be store in refrigerator where freezing not possible such as door of refrigerator (22) but 3.7% of the patients reported they store the insulin deep freezer. Again this practice potentially affect the insulin potency. Further only 30.2 percent of the patients using a container with ice pack to carry insulin while travelling. Others not using the recommended practices (some carries in hand bag and some use plastic containers with cotton).

Common recommended body sites for insulin injection are abdomen, thigh and upper arm (23, 24). It is also recommended to rotate the sites. In this study most the participants inject insulin in abdomen followed by upper arm and thigh (Figure 3) when considering the alone site. And also majority of them (89.7%) reported they usually rotate the sites. So they use more than one sites for insulin injections. In the study done in Nepal reported all participants use thigh or/and abdomen for insulin injection (16). Similarly another study in India reported most of the Indian injectors use abdomen as main site followed by thigh and arm and some also used buttocks (25). But in our study around 8.9% of the participants reported they rotate the sites some times while another 1.4% not rotate the site at all. Even though cleaning of insulin injection sites not usually recommended in out of the hospital setting it is recommended use the clean hands and clean sites (8). In the current study majority of them (81.4%) reported cleaning the sites. Previous study in Nepal reported ¾ of their participants/their relatives clean their hands before injection (16). It is recommended to pinch the skin (1-2inch portion) and fat between thumb and the index finger and fold need to maintained for 5-10 seconds after injection(26). In our study 43.9% reported they did not pinch the skin before injection. Further around 16.4% of the participants reported they reuse the needle for injection. But this percentage was high in previous study reported in Nepal where patients reuse same needle on average (median) 16 times (16). Similarly a national survey in India reported 92.5% of the patients reused the needles (25) and another study in India reported patients used each needle on average 6 times (27). Reusing needle loose the sterility and sharpness (8, 28) might increase the local site reactions, injection site pain and infection (8, 28 & 29). As predicted significant high number of injection site complications reported among this study participants such as skin changes (25%), persistent swelling (15.3%) and wasting and thinning of skin (7.8%). Further our study also revealed significant association between skin changes and angle of injection (P=0.039) and insulin regime (P<0.0001). Even though rotating the injection site is a significant prevention measures for preventing LH (30) our study failed to show and association with skin changes and rotation of sites (P=0.169).

Hypoglycaemia is an important complication of insulin therapy but it is often overlooked (31). Most importantly our study showed significant number of patients (68.6%95%CI: 63.7-73.2) were experienced hypoglycaemic symptoms. Missing meals after injection (P=0.012) and type of insulin (syringe) (P=0.033)
were significantly associated with hypoglycaemia among our study participants. But most of the patients did not take mitigation action such as keeping glucose/Jelly beans (56.4%) ready in case of anticipated hypoglycaemia which raises the significant patient safety issue. A study in Ethiopia revealed same findings; majority (93.9%) experienced hypoglycaemia due to skipped meal and (51.9%) of them due to physical exercise without taking foods (32). Another study in Brazil also revealed 91.7% Type 1 Diabetes mellitus patients and 61.8% Type 2 DM patients experienced at least one hypoglycaemic incident in their study period but that study also revealed awareness regarding hypoglycaemia among the participants was poor (33). Due to the invent of devices of interstitial glucose level which is closely related to blood glucose level now it is possible to monitor blood glucose level continuously. Continuous Glucose Monitoring (CGM) or Flash Monitoring allow us to mitigate to improve the glycaemic control and mitigate any hypoglycaemic events. There are evidences supporting its use (34) but due to its cost and less evidences in Type 2 diabetes to support its use are big barriers to implement CGM (34). There are no CGM devices available yet in our region but authors recommends to explore its role in our population as high rate of hypoglycaemic events notes in this study. Finally we also assessed practices of needle disposal and 35% of participants disposed needle into common garbage pin, 11.4% of them disposed into garbage dump and 1.7 % dumping into the toilet pits. In spite of that majority (48.6% CI: 43.5%-53.8%) of patients did not received any health education regarding disposal of waste. Another study in Sri Lanka specifically looked the waste disposal practices also revealed same kind of results (68% disposed into a common household garbage bin) (10).

**Limitation:**

Our study also had few limitations as we conducted this study based on patients recall and records from the clinics there might be a potential information bias, direct observation of injection techniques by trained health care workers would avoid this bias. Even though this is single centre study, as Jaffna Teaching hospital only tertiary institution in Northern Sri Lanka findings of our study can be generalised to Northern Sri Lanka. However this study is probably first evidence from Sri Lanka comprehensively analysed various practices related to insulin therapy to add further value with existing literature around the world.

**Conclusion**

Our study revealed significant gaps between recommended practices in insulin usage and injection techniques and current practices among diabetes patients using insulin particularly injection techniques such as not pinching the skin before injection, angle of injection and reusing the needles. In addition storage of insulin and waste disposable were also particular concern. Further local site complications such skin changes, injection site swelling and wasting and thinning of skin were common among participants. Alarmingly hypoglycaemic incidents were common but awareness of preventing incidence was poor among the patients. This highlight the important patient's safety issue. Authors believe this is an urgent public health issue in our region and we recommend health professionals should give more attention to educate the insulin users regarding their proper use and injection techniques in addition to
promote proper storage and proper disposal habits. Not only educating patients using insulin but also continuous monitoring of techniques is essential to overcome this important diabetes management issue to improve the desirable glycaemic control and prevent diabetic related complications.

**Declarations**

Ethics approval and consent to participate Ethical clearance was obtained from the Ethical Review Committee of Faculty of Medicine, University of Jaffna. Permission to carry out this study was obtained from the Director, TH, Jaffna and written consent was obtained from the participants after explaining the purpose and the nature of the study

**Consent to publish** - Not applicable as there is no individual data in any form

**Availability of data and material:** Data can be provided on request from NS or NR

**Competing interests** - The authors declare that none of the authors has competing interests.

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**Authors’ contributions**

SN, TP, MA conceived the study. SN, TP and MA involved in the data and sample collection. NR did analysis. NS and NR wrote the manuscript. All authors read and approved the manuscript.

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**Abbreviations**

DM-Diabetes Mellitus

LH-Lipohypertrophy

LA-Lipoatropy
OHA-Oral Hypoglycaemic Agents

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Tables

Table 1: Sociodemographic characteristics of patients using insulin for their diabetes (n=360).
| Variable          | Categories                         | Statistics       |
|-------------------|------------------------------------|------------------|
|                   |                                    | Mean(+/SD)       |
|                   |                                    | Range            |
| Age               |                                    | 58.19(+/-13.59)  |
|                   |                                    | 12-89            |
| Sex               | Male                               | 129              |
|                   | Female                             | 231              |
|                   | Percentage (%)                     | 35.8             |
|                   |                                    | 64.2             |
| Educational Status| Never been to school               | 11               |
|                   | less than grade 5                  | 76               |
|                   | Up to O/L                          | 203              |
|                   | Up to A/L                          | 45               |
|                   | Passed A/L without degree          | 7                |
|                   | Graduate/Diploma                   | 14               |
|                   | Postgraduate/Profession            | 3                |
|                   | Don't know                         | 1                |
|                   | Civil status                       |                  |
|                   | Married                            | 311              |
|                   | Unmarried                          | 19               |
|                   | Divorced                           | 2                |
|                   | Separated                          | 1                |
|                   | Widowed                            | 27               |
|                   | Family Income                      |                  |
|                   | Less than Rs25000                  | 223              |
|                   | Rs25001 to 50000                   | 120              |
|                   | Rs50001 to 75000                   | 9                |
|                   | Rs75001 to 100000                  | 6                |
|                   | More than Rs100000                 | 2                |

**Table2: Background features of Insulin Usage among Participants (n=360)**
| Variable                          | Categories                  | Number | Percentage (%) |
|----------------------------------|-----------------------------|--------|----------------|
| Duration of Insulin Usage        | Less than 1 year            | 96     | 26.7           |
|                                  | 1 to 5 years                | 140    | 38.9           |
|                                  | More than 5 years           | 124    | 34.4           |
| Reason for Insulin initiation    | Oral hypo-glycaemic failure | 294    | 81.7           |
|                                  | Type 1 Diabetes             | 22     | 6.1 (CI: 4.0-9.0) |
|                                  | Patient preference          | 17     | 4.7            |
|                                  | Others                      | 27     | 7.5            |
| Insulin regime                   | Basal bolus regime          | 20     | 5.6            |
|                                  | Twice daily premixed insulin| 288    | 80.0           |
|                                  | Daily basal insulin         | 41     | 11.4           |
|                                  | Others                      | 11     | 3.1            |
| Concomitant use of Oral Hypoglycaemic drugs | Yes                    | 201    | 55.8           |
|                                  | No                          | 159    | 44.2           |
| About the Insulin Usage          | Can Stop at one point       | 87     | 24.2           |
|                                  | Life long                   | 273    | 75.8           |

**Table 3:** Insulin technique related practices among participants (n=360)
| Variable                           | Categories                  | No  | Percentage |
|-----------------------------------|-----------------------------|-----|------------|
| Do you clean the injection site   | yes                         | 293 | 81.4       |
|                                   | No                          | 67  | 18.6       |
| Do you rotate the sites           | Usually                     | 323 | 89.7       |
|                                   | Some times                  | 32  | 8.9        |
|                                   | No                          | 5   | 1.4        |
| Pinch the skin before injection   | Yes                         | 202 | 56.1       |
|                                   | No                          | 158 | 43.9       |
| Who injects the insulin           | By themself                 | 183 | 50.8       |
|                                   | By others                   | 177 | 49.2       |
| Angle of the injection            | 90 degree                   | 81  | 22.5       |
|                                   | Around 45 degree            | 259 | 71.9       |
|                                   | Parallel to skin            | 20  | 5.6        |
| Type of Insulin                   | Syringe                     | 329 | 91.4       |
|                                   | Pen                         | 31  | 8.6        |
| Do you reuse the needle           | No                          | 301 | 83.6       |
|                                   | Yes                         | 59  | 16.4       |
| Health Education regarding disposal | yes                       | 185 | 51.4       |
|                                   | No                          | 175 | 48.6       |
| Disposal of used needles          | Common household garbage bin| 126 | 35.0       |
|                                   | Sharp container             | 132 | 36.7       |
|                                   | Toilet pit                  | 6   | 1.7        |
Table 4: Injection site complications

| Variable                          | Categories | Number | Percentage          |
|----------------------------------|------------|--------|---------------------|
| Skin Changes                     | Yes        | 90     | 25.0 (95%CI:20.7-29.7) |
|                                  | No         | 270    | 75.0                |
| Persistent Swelling              | Yes        | 55     | 15.3 (95%CI:11.8-19.2) |
|                                  | No         | 97     | 26.9                |
|                                  | No reported| 208    | 57.8                |
| Wasting or Thinning of Skin      | Yes        | 28     | 7.8 (95%CI:5.3-10.9%) |
|                                  | No         | 124    | 34.4                |
|                                  | Not reported| 208  | 57.8                |

Table 5: Factors associated with skin changes
| Variable                      | Categories            | Skin Changes | Statistics       |
|-------------------------------|-----------------------|--------------|------------------|
|                               |                       | Present      | Absent           |
| Do you rotate the sites       | Usually               | 78 (24.1%)   | 245 (75.4%)      | Chi. Sq 3.558, P = 0.169 |
|                               | Sometimes             | 9 (28.1%)    | 23 (71.9%)       |                             |
|                               | No                    | 3 (60.0%)    | 2 (40%)          |                             |
| Angle of Injection            | 90 degree             | 26 (32.1%)   | 55 (67.9%)       | Chi-Sq-6.507, P-0.039***    |
|                               | Around 45 degree      | 63 (24.3%)   | 196 (75.7%)      |                             |
|                               | Parallel to skin      | 1 (5%)       | 9 (95%)          |                             |
| Do you clean the injection site| Yes                   | 79 (27.2%)   | 214 (72.8%)      | Chi.Sq-3.234, P-0.072       |
|                               | No                    | 11 (16.4%)   | 56 (83.6%)       |                             |
| Reuse needles                 | Yes                   | 79 (26.2%)   | 222 (73.8%)      | Chi.Sq-1.520, P-0.218       |
|                               | No                    | 11 (18.6%)   | 48 (81.4%)       |                             |
| Pinch the skin before injection| Yes                   | 48 (23.6%)   | 154 (76.2%)      | Chi.Sq-0.376, P-0.540       |
|                               | No                    | 42 (26.6%)   | 116 (73.4%)      |                             |
| Do you use Insulin            | Syringe               | 84 (25.5%)   | 245 (74.5%)      | Chi.Sq-0.577, P-0.448       |
|                               | Pen                   | 6 (19.4%)    | 25 (80.6%)       |                             |
| Who Inject Insulin            | By them self          | 45 (24.6%)   | 138 (75.4%)      | Chi Sq-0.033, P-0.855       |
|                               | By others             | 45 (25.4%)   | 132 (74.6%)      |                             |
| Insulin regime                | Basal Bolus regime    | 6 (30.0%)    | 14 (70.0%)       | Chi.Sq-29.798, P<0.0001***  |
|                               | Twice daily premixed  | 56 (19.4%)   | 232 (80.6%)      |                             |
|                               | Insulin               |              |                  |                             |
|                               | Daily Basal           | 21 (51.2%)   | 20 (48.8%)       |                             |
|                               | Others                | 7 (63.6%)    | 4 (36.4%)        |                             |
*** -statistically significant at 5% level

**Table 6:** Angle of injection of practice with socio demographic factors

| Socio demographic Factor | P value |
|--------------------------|---------|
| Sex                      | P-0.855 |
| Educational status       | P-0.068 |
| Family Income            | P-0.465 |
| Civil status             | P-0.082 |

**Table 7:** Storage of Insulin practices among participants (n=360)
| Variable                                      | Categories                      | Number | Percentage |
|-----------------------------------------------|---------------------------------|--------|------------|
| Where do you store Insulin                    | Natural containers              | 26     | 7.2        |
|                                               | Refrigerator                    | 328    | 91.1       |
|                                               | Room temperature                | 6      | 1.7        |
| Where in the refrigerator (Among who stored at Refrigerator) | Deep freezer                   | 12     | 3.7        |
|                                               | Door                            | 229    | 69.8       |
|                                               | Shelf                           | 87     | 26.5       |
| Insulin Vials while travelling                | Container with ice pack         | 109    | 30.2       |
|                                               | Hand bag                        | 136    | 37.8       |
|                                               | Plastic containers with cotton   | 31     | 8.6        |
|                                               | Other ways                      | 84     | 23.3       |

**Table 8:** Hypoglycaemia and related factors among participants
| Variable                                      | Categories                          | No  | Percentage     |
|-----------------------------------------------|-------------------------------------|-----|----------------|
| Experienced Hypoglycaemic symptoms            | Yes                                 | 247 | 68.6(63.7-73.2) |
|                                               | No                                  | 113 | 31.4           |
| Symptoms                                       | palpitation                         | 29  | 8.1            |
|                                               | Sweating                            | 44  | 12.2           |
|                                               | Loss of consciousness               | 8   | 2.2            |
|                                               | Headache                            | 6   | 1.7            |
|                                               | Confusion                           | 8   | 2.2            |
|                                               | Others                              | 27  | 7.5            |
|                                               | Palpitation, Sweating               | 103 | 28.6           |
|                                               | Palpitation, headache               | 19  | 5.3            |
|                                               | Palpitation, loss of consciousness  | 17  | 4.7            |
|                                               | All above mentioned symptom         | 10  | 2.8            |
|                                               | Missing values                      | 89  | 24.7           |
| Miss the meals after injection                | Yes                                 | 73  | 20.3           |
|                                               | No                                  | 287 | 79.7           |
| Gap between the meals and injection           | 5 minutes before meal              | 48  | 13.3           |
|                                               | 10 minutes before meal              | 29  | 8.1            |
|                                               | 15 minutes before meal              | 20  | 5.6            |
|                                               | 20 minutes before meal              | 25  | 6.9            |
|                                               | After meal                          | 232 | 64.4           |
|                                               | Not relevant to meal                | 6   | 1.7            |
| Adjust the dose of Insulin on their own       | Yes                                 | 71  | 19.7           |
|                                               | No                                  | 289 | 80.3           |
| Keep the glucose/Jelly Beans                  | Yes                                 | 157 | 43.6           |
|                                               | No                                  | 203 | 56.4           |
| Use the Glucometer |   |   |
|-------------------|---|---|
| Yes               | 248 | 68.9 |
| No                | 112 | 31.1 |

| When did you use the glucometer last? |   |   |
|--------------------------------------|---|---|
| less than one week                    | 183 | 73.8 |
| less than one month                   | 53  | 21.4 |
| Less than one year                    | 10  | 4.0  |
| More than one year                    | 2   | 0.8  |

Table 9: Factors associated with hypoglycaemia among participants
| Variable                                | Categories     | Hypoglycaemia | Statistics   |
|-----------------------------------------|----------------|---------------|--------------|
|                                         | Reported-No (%) | Not Reported-No (%) |              |
| Sex                                     | Male           | 88(68.2%)     | 41(31.8%)    | Chi Sq-0.014 |
|                                         | Female         | 159(68.8%)    | 72(31.2%)    | P-0.904      |
| Educational status                      | No school      | 10(83.3%)     | 2(16.7%)     | Chi Sq-5.085 |
|                                         | Primary        | 54(71.1%)     | 22(28.9%)    | P-0.166      |
|                                         | Secondary      | 175(68.6%)    | 80(31.4%)    |              |
|                                         | Tertiary       | 8(47.1%)      | 9(52.9%)     |              |
| Concomitant use of oral hypoglycaemic   | Yes            | 140(69.7%)    | 61(30.3%)    | Chi Sq-0.29  |
|                                         | No             | 107(67.3%)    | 52(32.7%)    | P-0.632      |
| Type of Insulin                         | Syringe        | 231(70.2%)    | 98(29.8%)    | Chi Sq-4.551 |
|                                         | Pen            | 16(51.6%)     | 15(48.4%)    |              |
|                                         |                | **OR-2.21 (95%CI:1.05-4.64)** |              |
| Adjusting the insulin dose by themself  | Yes            | 51(71.8%)     | 20(28.2%)    | Chi Sq-0.426 |
|                                         | No             | 196(67.8%)    | 93(32.2%)    | P-0.514      |
| Missing Meals                           | Yes            | 59(80.8%)     | 14(19.2%)    | Chi Sq-6.34  |
|                                         | No             | 188(65.5%)    | 99(34.5%)    | P-0.012***   |
|                                         |                | **OR-2.22 (95%CI:1.18-4.17)** |              |
| Using Glucometer                        | Yes            | 170(86.5%)    | 78(31.5%)    | Chi Sq-0.001 |
|                                         | No             | 77(68.7%)     | 35(31.3%)    | P-0.97       |

*** -Statistically significant at 5% level