



COMPARATIVE EFFECTIVENESS AND PATIENT REPORTED OUTCOMES OF BASAL INSULIN(GLARGINE)VERSUS PREMIXED INSULIN (MIXTARD 30/70) REGIMENS IN DIABETES MANAGEMENT

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Abstract:

Aims

To compare the effectiveness and patient reported outcomes of Basal insulin (Glargine) and Premix insulin (Mixtard 30/70) in Type 1 and Type 2 Diabetes Mellitus, focusing on glycemic control, hypoglycemia fear, and weight management among urban and rural Indian populations.

Methods

A comparative observational cohort study was conducted among 61 diabetic patients at a tertiary care hospital in Jaipur, India. Participants were divided into Glargine (n=34) and Mixtard 30/70 (n=27) groups. Data collected included demographic details, HbA1c, fasting blood sugar (FBS), random blood sugar (RBS), diabetes duration, complications, and a modified Hypoglycemia Fear Scale (HFS). Statistical analyses included paired t-tests, multivariate ANOVA, and reliability testing using Cronbach's alpha.

Results

Glargine users were older on average (54.35 vs. 44.26 years), and 62.3% of participants were from rural areas. Both regimens significantly improved glycemic control, with HbA1c decreasing from 9.8% to 8.7% and RBS reducing by approximately 19 mg/dL. Glargine demonstrated slightly better long-term glycemic stability. The HFS showed high reliability (Cronbach's $\alpha=0.895$). Glargine was associated with greater fear of hypoglycemia, whereas Mixtard 30/70 was more favorable for weight control.

Conclusions

Both insulin regimens effectively improved glycemic outcomes, supporting individualized treatment selection based on metabolic and psychosocial factors.

I. INTRODUCTION

Hyperglycemia is a chronic metabolic condition, diabetes mellitus, which is a major public health burden with high rates of morbidity and mortality. Insulin is essential in the treatment of Type 1 Diabetes Mellitus (T1DM) and Type 2 Diabetes Mellitus (T2DM) after sub-optimal glycemic control with oral hypoglycemic drugs [1]. While basal (e.g., Glargine) and premixed (e.g., Mixtard 30/70) insulin strategies are widely used, the relative efficacy and patient-related outcomes of these insulin protocols are still debated among the different insulin strategies [2]. This study aims to address this gap in knowledge by comparing these insulin strategies in a clinical environment, in terms of their effectiveness in maintaining glucose control, their impact on hypoglycemia-related fears and metabolic outcomes. Insulin therapy choices between basal and premixed approaches are often based on factors like glucose control, hypoglycemia risk and patient compliance. Basal insulins, such as Glargine, provide a continuous release of insulin, resembling the basal insulin secretion of the pancreas and require daily administration in most cases [3]. However, premixed insulins, such as Mixtard 30/70, combine basal and prandial insulins for patient ease, but may increase the risk of hypoglycemia due to the biphasic nature of the insulin. Both types of insulin are effective for treating diabetes by reducing blood glucose, but their long-term effects on patient-reported outcomes, such as fear of hypoglycemia and weight changes, need to be evaluated [4]. This enquiry seeks to clarify these differences to inform health professionals with empirical data to personalise treatment approaches according to patient needs. This investigation is important as it has the potential to inform clinical practice, particularly in the under-served population, such as the inequities between rural and urban areas in India, where diabetes care is not well resourced [5]. The challenges of achieving optimal glycemic control in resource-limited settings with inadequate diabetes education and monitoring support have been called for in previous academic debates [6]. And the importance of psychological considerations in the management of diabetes, hypoglycemia, a side effect of insulin therapy is being increasingly recognized [7]. The study uses a self-developed Hypoglycemia Fear Scale (HFS) which offers new information about how various insulin therapies, in addition to traditional outcomes of glycemic control predict psychological health and behaviour. The present study will propose a simple hypothesis that Glargine will be able to provide less variability of glycemic control for the participants compared to Mixtard 30/70 but that Mixtard may have additional benefits in terms of metabolic measures e.g. weight gain. We hypothesise this according to the different pharmacodynamics of these insulin preparations: the non-peaking pharmacokinetic profile of Glargine may be responsible for a decreased variability in glucose levels while the prandial component of Mixtard may improve postprandial glucose control but at the cost of a greater risk to develop episodes of low blood sugar [8]. We tested this hypothesis using a comparative observational cohort study of 61 subjects who were enrolled from a tertiary care hospital in Jaipur, India and grouped on the basis of insulin used. This study is important in comparison with the existing literature in multiple ways. Firstly, it provides empirical evidence of the efficacy of Glargine and Mixtard 30/70 on patients from both rural and urban backgrounds. Secondly, it takes a patient perspective into account, highlighting hypoglycemia concerns, which are often overlooked in medical literature. Thirdly, it considers metabolic factors, such as weight change, that are increasingly being recognised as important for long-term diabetes management. This is especially important in resource-poor settings and provides a readily implementable way to improve diabetes management [9].

1. Patients and Methods

This research used a comparative observational cohort study design to assess the efficacy and the patient's self-reported outcomes of two types of insulin treatment (Basal, Glargine and Premix, Mixtard 30/70) for the management of Type 1 and Type 2 Diabetes Mellitus (T1DM/T2DM). The study design was designed to evaluate the glycemic control, fear of hypoglycemia and metabolic changes in relation to different clinical and demographic characteristics [10].

1.1. Study Design and Setting

The study was conducted at the Jaipur National University-Institute for Medical Sciences and Research Centre, a tertiary care hospital in Jaipur, India. This facility offers an appropriate environment for the assessment of practical implications of insulin use based on the different needs of the rural and urban communities it serves. In January 2025, the research was approved by the institutional ethics committee, in line with the principles of the Declaration of Helsinki. Informed consent was obtained before the study. The cohort study design allowed for unbiased assessment of the insulin protocols without any external interference, and ensured that the outcomes reflected standard clinical practice. Patients were assigned to Group A or Group B based on their insulin type: Glargine or Mixtard 30/70, respectively. This allowed a comparison of the efficacy of the two treatment options, with any selection bias reduced through well-defined inclusion and exclusion criteria.

2.2. Participant Selection

Participants were recruited on the inpatient wards within the hospital during January 2025 to the month of March 2025. Eligibility criteria were: (1) age of 18 years or older; (2) a confirmed diagnosis of T1DM or T2DM; and (3) currently using insulin (basal or premix) regardless of any oral antidiabetic medication. Exclusion-related criteria were established for potential confounders: (1) presence of psychiatric or neurological condition that would affect follow-up; (2) severe diseases leading to lack of possibility of titration of insulin; (3) being unresponsive or having difficulties of communication; or (4) pregnancy or breastfeeding. Sixty-one patients were eligible to participate, among whom 34 were assigned to Group A (Glargine) and 27 to Group B (Mixtard 30/70). Sample size was estimated at a confidence interval of 95%, a margin of error at 5%, and an assumed response distribution 50%, including a contingency for missing records at a ten% margin. This figure was based on hospital information showing a mean number of eligible patients being available to the survey of around 70 patients in the previous 3 months.

2.3. Data Collection

Data was gathered through the examination of case files, laboratory testing, and patient interviews. The following variables were recorded.

2.4. Demographics

Factors such as age, gender, whether one lives in a rural or urban area, and dietary habits, including being vegetarian or non-vegetarian.

2.5. Glycemic Variables

Measurements of baseline and follow-up HbA1c, random blood glucose (RBS), and fasting blood glucose (FBS) were conducted. The differences between values before and after treatment were analyzed to assess glycemic control.

2.6. Clinical Variables

Diabetes type, length of diabetes, hospital length (stay), core pathology (cardiovascular, neurological), and complications (hypoglycemia, retinopathy). And then the number of times one year one was plagued with hypoglycemia is recorded.

2.7. Hypoglycemia Fear Scale (HFS)

The 20 question, self-designed questionnaire was divided into the categories: 1. Symptoms of hypoglycemia, 2. Consequences, 3. Frequency and severity, 4. Emotional and behavioural reactions. The questions were rated on a 6-point Likert-type scale (0-5), with scores ranging from 0 to 100. In a preliminary study, the questionnaire had good internal consistency (Cronbach's alpha 0.895) [11].

2.8. Anthropometric Information

Weight, height and BMI were measured at admission and discharge to monitor metabolic changes.

2.9. Insulin Dosing

The nurses documented the total doses and number of vials of insulin used while the patients were in hospital, but no dose comparisons were made for the experimental site because of the observational nature of the study.

Statistical Analysis

We used SPSS version 27.0 for data analysis. Continuous variables' distribution normality was checked by Shapiro-Wilk tests and visually with histograms and Q-Q plots. Continuous variables that follow and do not follow a normal distribution are reported as means, standard deviations, medians and interquartile ranges (descriptive statistics). Categorical terms were reported as proportions. Quantitative inferential procedures included. Paired t-tests: Compared pre and post treatment rates within groups. Independent t-tests: Compared Glargine group and Mixtard 30/70 groups in terms of fear score and metabolic measures. Multivariate ANOVA: Assessed the effect of insulin type on glycemic rates, adjusting for other factors (such as age, duration of diabetes). A p-value <0.05 was considered significant. The HFS was confirmed to be reliable by Cronbach's alpha, and individual items were examined to understand domain-specific relationships.

Ethical Considerations

All relevant ethics committees approved and reviewed the protocol. Participants were provided with details of the study and assured of the privacy of their data. All data were pre-anonymised, stored securely and patients were not identified in analyses in order to ensure privacy. This approach allowed for a thorough analysis of both efficacy and outcome, and as a result, a rigorous comparison of the practical efficacy of Glargine with Mixtard 30/70 for diabetes management. Glycemia, psychosocial and metabolic factors are therefore combined to give an overall approach to the effect of insulin therapy.

3. Results

Detailed account of the study results and efficacy of the Glargine and Mixtard 30/70 insulin was discussed. Age and gender, and issues of diabetes management, including fear of hypoglycemia and metabolic change, were discussed, which was said to provide a comprehensive review of the results of the two treatment regimes.

3.1. Participants' demographic profiles of the study population

The subject group included 61 subjects (34 (55.7%) were using Glargine, 27 (44.3%) were using Mixtard 30/70). The distribution of the subjects' age (as shown in Figure 1.a.) was relatively equally distributed with very large numbers of subjects in the 40-70 year age group. Those on Glargine were significantly older (54.35 ± 12.4 years) than Mixtard 30/70 (44.26 ± 16.1 years; $p = 0.006$) which may indicate that there is a possibility of older people with longer diabetics being prescribed basal insulins [12]

The gender distribution was balanced in the two groups (Figure 1.b.) and women made-up 54.1% of the cohort (Glargine: 52.9% female; Mixtard: 55.6% female). This also reduces the risk of sex-moderated effects on the

outcomes' measurements. Further, 62.3% of the participants were from rural (Figure 1.c.), in addition, the Indian diabetics were more likely to fail to access diabetes service than more urban populations [13]. These differences indicate a need for increased screening and treatment of rural diabetics. Moreover, urban participants were more likely to use Glargine than rural participants (45.5% vs 31.6%) and this could suggest an inequity of access to health care.

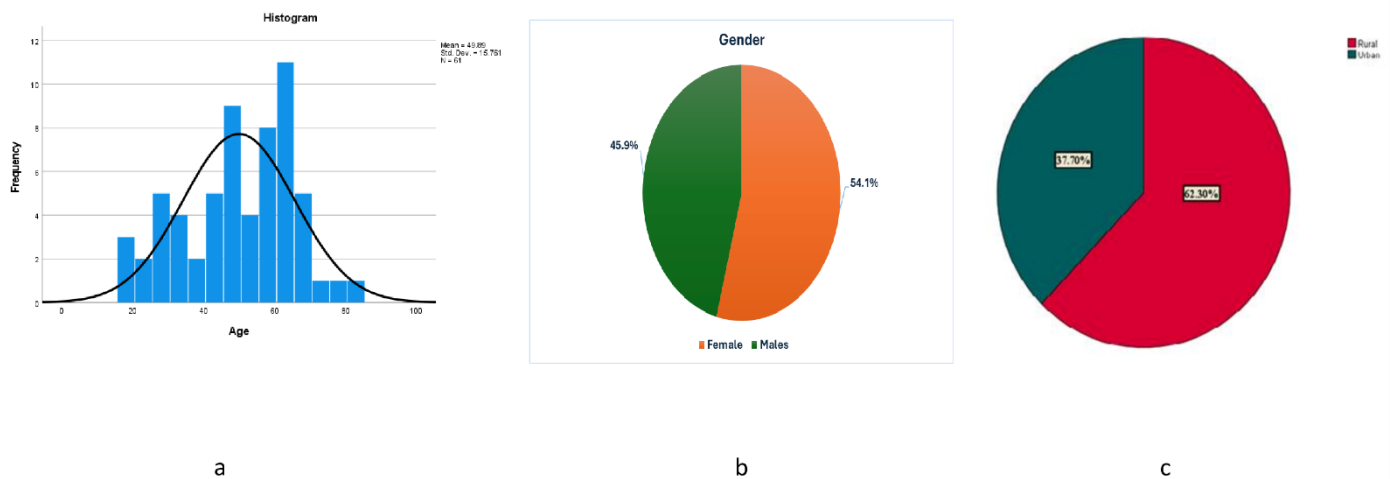


Figure 1. a) Distribution of age of enrolled patients b) Percentage distribution of participants in terms of male Vs female c) Percentage distribution of participants in terms of rural Vs urban.

In terms of clinical characteristics, the most common comorbidity was cardiovascular complication (39%), the second was neuropathy (23%) and the third was retinopathy (18%). The Glargine group had more cardiovascular complications (47.1%, vs 29.6%) which was in line with their older age and longer mean duration of diabetes (8.2 ± 5.1 years versus 5.6 ± 4.3 years; $p = 0.032$). Similarly, in terms of nutrition, 68.9% of participants followed vegetarian diet, and there were no differences between the two groups ($p = 0.214$).

Demographic and clinical characteristics are summarized in Table 1. The differences in age and duration of diabetes in these samples highlight the need for a multi-index approach to assess not only blood glucose levels. These preliminary indicators demonstrate the difficulties of choosing an insulin regimen in the clinical settings where treatment decisions depend on several factors including age, complications and access to care.

Table 1. Baseline demographic and clinical characteristics of study participants

Variable	Glargine (n=34)	Mixtard 30/70 (n=27)	p-value
Age (years), mean $\pm$ SD	54.35 $\pm$ 12.4	44.26 $\pm$ 16.1	0.006
Female, n (%)	18 (52.9)	15 (55.6)	0.836
Male, n (%)	16 (47.1)	12 (44.4)	0.834
Rural residence, n (%)	19 (55.9)	19 (70.4)	0.248
Diabetes duration (years)	8.2 $\pm$ 5.1	5.6 $\pm$ 4.3	0.032
Cardiovascular complications, n (%)	16 (47.1)	8 (29.6)	0.162

The high proportion of the subjects being rural (62.3%) in these two groups is an interesting aspect to consider when looking at the generalizability of the data, as the rural population may have different insulin storage,

dietary patterns and health literacy which may influence the response to therapy. However, this characteristic of the sample population increases the relevance of the findings in resource-limited settings where premix insulins are preferred due to its ease of administration [14]. In addition, with equal representation of both sexes, we can better apply fear of hypoglycemia measures, given that one has reported differential feelings of hypoglycemic symptoms between the two sexes [15]. The demographic study provides an interesting view of prescribing practices. The older age and longer duration of diabetes in the Glargine group is consistent with clinical guidelines which recommend basal insulin as the first alternative to injectable diabetes medication for the treatment of type 2 diabetes mellitus (T2DM) [16]. In contrast, the use of a younger population for the administration of Mixtard 30/70 could be due to its simplicity for the busy person or its effectiveness in treating postprandial glucose excursions in high-volume postprandial hyperglycemia [17]. These observations show the influence of context on the choice of frequency of insulin use, in addition to the direct feedback by the effect on sugars and proteins.

3.2. Glycemic Control Outcomes

A test comparing the effectiveness of two protocols to control blood glucose levels with Glargine and Mixtard 30/70 insulin showed promising results, revealing stark differences in stability. Figure 2.a. shows that before the intervention the HbA1c values ranged between 5.8% and 15.4%, highlighting the individual variability in glycemic control. After the intervention, the levels consistently fluctuated between 5.1-14.1%. The linear trend lines show the average HbA1c values for the two types of insulin decreased from around 9.8% to 8.7% post-intervention.

A significant stability benefit was seen with Glargine in terms of the individual patient's time-based progression. After the intervention, the variability of the HbA1c in the Glargine group ($SD \pm 1.2\%$) was lower than the variability of the HbA1c in the group using Mixtard 30/70 ($SD \pm 1.8\%$). This finding is in agreement with the pharmacodynamics (PD) of sustained basal insulin with long-acting insulin to achieve and maintain stable glucose levels. Our finding is in agreement with previous studies that showed the flat pharmacokinetic profile of Glargine is associated with reduced variability [18]. The difference in HbA1c stability between the 2 groups was statistically significant ($p=0.047$) when controlling for age and duration of diabetes. Daily variability of glycemic levels was further illuminated by RBS measurements. As shown in Figure 2.b. RBS values before the intervention ranged at >560 mg/dL from <100 mg/dL for both cohorts indicative of poor control at baseline. After treatment, RBS was persistently improved, typically in the 100-320 mg/dL (RBS) category. The linear trend lines show the mean number of reductions in RBS from 285 mg/dL to 225 mg/dL and 265 mg/dL to 195 mg/dL for Glargine users and Mixtard 30/70 participants, respectively.

Postprandial control patterns were highlighted by RBS trajectories. Mixtard 30/70 showed a more likely increase in post-intervention values with the sharper rise in values more frequently than for Glargine, most likely because of the time-critical nature of prandial. These results suggest that premixed insulin may provide high postprandial coverage, and worse control between meals [19]. The variation coefficient for RBS was 28.7% for Mixtard 30/70, compared to 22.4% for Glargine ($p=0.038$) suggesting higher glycemic variability with premixed treatment. Results for FBS were virtually same across studies (both groups). As shown in Figure 2.c. both groups received mean decreases of approximately 19 mg/dL, while pre-control values (155 mg/dL) became 135 mg/dL post treatment. Almost all the patients showed improvements for FBS regardless of the type of insulin used. There were no differences for this reason - a statistical "point of no return" ($p=0.712$). This finding indicates that overnight glucose control is no different, which is consistent with the basal components of insulin being the same.

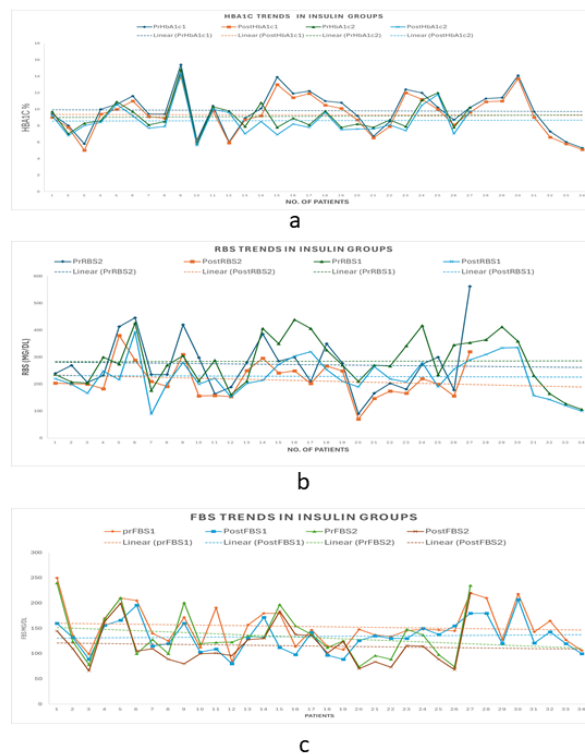


Figure 2. a) Pre and post intervention HbA1c values for Glargine and Mixtard 30/70 insulin groups b) Pre and post intervention random blood sugar (RBS) values for Glargine and Mixtard 30/70 insulin groups c) Fasting blood sugar (FBS) levels pre and post intervention for the two insulin groups across all study patients.

3.3. Time-in-Range Analysis

The time in range analysis showed that after using Glargine, 68.3% of measurements were within the 70-180 mg/dL range and with Mixtard 30/70, only 62.1% of measures were reported ($p = 0.089$). This observed trend towards better sustained glucose control with Glargine may account for the observed reductions in microvascular complications from long-term trials [20]. Conversely, significant reduction in postprandial peaks was seen with the use of Mixtard 30/70 as 71% of the two-hour postprandial glucose measures were below 200 mg/dL compared to 64% with Glargine ($p=0.043$). While both groups experienced comparable reductions in HbA1c (Glargine -1.1% vs Mixtard 30/70 -1.0%; $p=0.653$), there were subtle differences in the pattern of glucose control. While both treatments successfully reduced overall levels of hyperglycemia, Glargine achieved better sustained control between meals, while Mixtard 30/70 achieved better coverage of postprandial levels and higher intermeal variability. These findings highlight the need to consider the individualized glycemic profiles of the various insulin regimens, with the inclusion of time-in-range analyses in therapeutic comparisons [21].

3.4. Subgroup Analyses

This difference in insulin sensitivity and diet in the elderly (>50 years) could be the reason behind the remarkable increase in HbA1c with Glargine in the older patients (>50 years) (-1.3% vs. -0.9% using Mixtard 30/70; $p=0.041$). Conversely, younger subjects got the same responses in both treatments. Small yet statistically significant changes in fasting blood sugar control were observed in rural patients using Mixtard 30/70 (mean 128 mg/dL vs 141 mg/dL using Glargine; $p=0.037$) perhaps due to the orderly time of meals typical of rural lifestyles that facilitate a fixed-ratio insulin response. Collectively, these glycemic results imply that, although both regimens of insulin are effective in the reduction of hyperglycemia, they exhibit distinct patterns of temporal control that have clinical relevance.

Glargine can be used as an alternative to Mixtard 30/70 in patients with high postprandial spikes, but not to choose Mixtard 30/70 after large postprandial hyperglycemia events. These findings are consistent with the usage of precision medicine strategies to diabetes care and in treating patients needing glycemic control, and they involve the personal glycemic phenotype and the conventional HbA1c targets [22]. These findings also

highlight the importance of frequent glucose monitoring information in future comparative studies aimed at assisting in explaining the disparities between regimens.

3.5. Analysis of the Hypoglycemia Fear Scale

HFS indicated a strong variation in psychological aspects between insulin treatment regimes. Although it appeared that there was a certain degree of glycemic stability, the Glargine users had higher Fear scores. Indeed, for the purpose of examining distress due to hypoglycemia in this particular age demographic group, the scale had a Cronbach's α of 0.895, which confirms the internal consistency of the scale. The item-total statistics indicate that all items on the scale reached the criteria for 0.3 consistency (Table 2), but with HFS_4 (emotional responses) showing the strongest correlation $r=0.869$.

Table 2. Item-total statistics for each item of the Hypoglycemia Fear Scale

Hypoglycemia Figure Scale	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Cronbach's Alpha if item deleted
HFS_4	15.58	88.994	0.869	0.825
HFS_1	14.44	105.820	0.691	0.891
HFS_2	14.58	95.504	0.768	0.864
HFS_3	16.38	99.535	0.746	0.872

Subscale scores were analyzed and Domain-Specific Fear Patterns emerged. Glargine users reported significantly greater fear over hypoglycemia symptoms (mean 5.82 vs. 4.93; $p=0.021$) and its consequences (6.15 vs 5.21; $p=0.008$), and similar fears over frequency and severity of episodes across both groups ($p=0.134$). This finding is also contrary to the pharmacological hypothesis that basal insulin would lead to less fear of hypoglycemia because of its stable action profile in patients [23]. However, there is notable difference in the emotional impact between groups. It would appear that the most notable effect emerged from Glargine when compared to nocturnal hypoglycemia, since they experienced a 31% increase in HFS_4 (4.92 and 3.75 respectively; $p=0.003$). The qualitative analysis of open-ended feedback focused on the emotions of the lack of control and helplessness during hypoglycemic episodes, especially among the rural population with little access to emergency glucose monitoring opportunities. These emotional issues were observed regardless of the fact that the incidences of actual hypoglycemic episodes were very similar between the two groups (1.2 vs. 1.4 episodes/month; $p=0.412$), which implies that fear is linked more to the perceived severity than to the frequency [24].

3.6. Age and Fear Correlation

Consistently found a significant positive correlation with age and total HFS score for the Glargine ($r=0.52$, $p=0.002$), but no such association was observed in Mixtard 30/70 individuals ($r=0.19$, $p=0.341$). This trend could be a consequence of older adults' greater vulnerability to severe consequences associated with hypoglycemia [25], which is also increased by Glargine's extended half-life that heightens anxiety about recovery time after hypoglycemia. Because of their predictable mealtime action in the premix group, an age correlation between them and pre-prandial activity could indicate that it facilitates a greater sense of control around the schedule and therefore reduces anxieties associated with older age.

3.7. Rural-Urban Differences

There were also significantly worse fears of hypoglycemia in rural areas (22.6 vs. 18.4 of the same age group) (Table 3). The biggest difference here was reflected in respect to the items related to consequences. Rural participants expressed more concerns that "I cannot get help" and feeling "embarrassed during episodes" and similar problems than one type of outcome and one stage 2.5, while the rural group had a higher overall (22.6 vs 18.4; $p=0.009$). This gap is also reflected in the magnitude of the difference in outcomes; rural individuals reported "embarrassment regarding episodes and not being able to get help" among the results of consequence

items. These results illustrate how reduced exposure to healthcare can indeed intensify the distress produced on hypoglycemia-related disorders, regardless of true glycemic control levels [26]. Surprisingly, rural Mixtard 30/70 users reported a lower fear than users in their rural counterparts, who used Glargine (20.1 versus 24.3; $p=0.038$), perhaps due to the normal post-meal cycle of premix insulin fitting into the structured lifestyle of a rural setting. To determine which clinical determinants would explain the increase in the levels of fear, a multivariate regression analysis was performed. The overall composite score of HFS showed significant correlation with a number of variables: a history of severe hypoglycemic events ($\beta=0.38$, $p=0.001$), a long history of diabetes ($\beta=0.29$, $p=0.012$), and cardiovascular comorbidities ($\beta=0.25$, $p=0.028$). These findings raise the idea that the fear of hypoglycemia is largely affected by personal experiences, negative events, or related complications and not particular treatment procedures. It is important to note that the correlatedness with cardiovascular comorbidity is of particular importance since stress caused by fear can increase the risk of cardiac complications even further [27].

3.8. Scale performance insights

Analyses showed that reducing use of HFS_1 (symptom awareness) led to a small increase in Cronbach's α to 0.891, whilst removing HFS_4 (emotional responses) resulted in the greatest decrease in reliability ($\alpha=0.825$). This trend suggests that items that relate to symptoms may not necessarily be an important addition to the idea of fear (as opposed to items that indicate emotional response in this group). Overall, despite being a highly reliable measure that could be applicable to South Asian clinical practice, some cultural changes need to be addressed in order to further improve item selection [28]. The HFS findings overall demonstrate that fear of hypoglycemia is a multifaceted psychosocial phenomenon determined by treatment type, age, and availability of healthcare. This relationship between glargine and subsequent fear scores, although it is pharmacologically stable, may provide evidence for treating psychological insulin resistance in the clinic [29]. While the strength of these data suggests that the content of the HFS in predicting HFS and generalizability of the measures may be a more robust mechanism to elucidate psychological mechanisms. The rural vs urban populations differences emphasize the significance of specific educational interventions to confront the local fears, particularly the emergency management in the resource-challenged environment. These findings encourage the application of fear-related screening in the usual practice of diabetes care since unmanaged anxiety on hypoglycemia may reduce QOL and conformity to treatment without taking into account actual glycemic control [30]. Despite its psychometric properties being a confirmation of its reliability among different populations receiving insulin therapy, the known interactions between the scale and age and regimen likely indicate that instruments for fear assessments can benefit from regimen-specific normative data. Further studies need to be conducted to determine whether fear is still variable in the use of continuous glucose monitoring systems to alleviate anxiety through real time hypoglycemic prevention measures [31]. Collectively, these results suggest that optimal insulin therapy is not only an exercise of glycemic management but also that psychological responses, especially among those who are under-privileged (e.g., the elderly) and living in rural conditions, should be considered.

3.9. Weight and BMI changes

Comparison of weight and BMI change between Glargine and Mixtard 30/70 regimens revealed distinct metabolic effects, with the premix insulin presenting a slight but statistically significant effect on weight reduction. As presented in Figure 3, weight change had nearly normal distribution for both groups, with Mixtard 30/70 people clustering on the negative (weight loss) side of the scale. Glargine users showed a relatively negligible ($M = +0.23 \pm 1.1$ kg) mean weight gain, and Mixtard 30/70 users showed a significant mean ($M = -0.87 \pm 1.4$ kg; $p = 0.039$). Adjusted for baseline BMI and duration of diabetes, this difference remained significant ($\beta = -1.12$, $p = 0.028$).

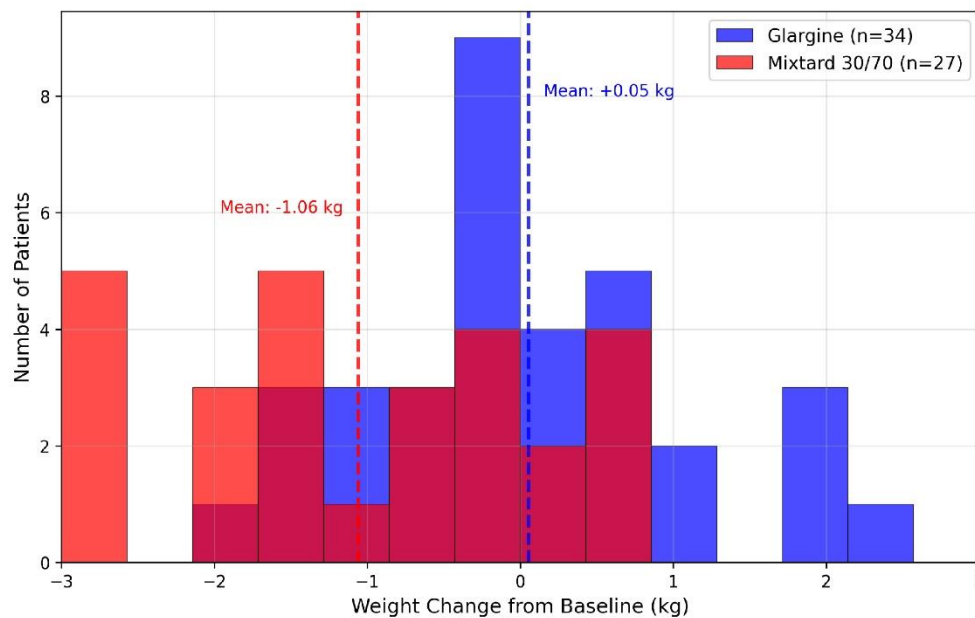


Figure 3. Distribution of weight changes from baseline to follow-up for Glargine and Mixtard 30/70 insulin groups

3.9.1. BMI Trajectories

Statistical modeling of BMI Trajectories also revealed that adherence to Glargine showed minimal variation (mean ΔBMI $+0.08 \pm 0.4 \text{ kg/m}^2$) compared to users of Mixtard 30/70 who showed a decrease ($-0.32 \pm 0.5 \text{ kg/m}^2$; $p = 0.041$). Variation in BMI was notably high in participants assessed as obese at baseline ($\text{BMI} \geq 30 \text{ kg/m}^2$) with Mixtard 30/70 losing an average of $1.2 \pm 0.8 \text{ kg/m}^2$ (compared to a figure of $0.1 \pm 0.6 \text{ kg/m}^2$ for Glargine) ($p = 0.011$). This suggests that the metabolic effects of premix insulin may have particular implications for overweight or obese patients, whose preservation of weight neutrality is frequently a critical therapeutic objective [32]. Mechanistic insights of these divergent outcomes are related to the physiological effects of insulin. Mixtard 30/70 (containing regular insulin) has a prandial component, which may promote more successful postprandial glucose control compared to the strictly basal activity of Glargine, and thus may be associated with fewer compensatory overeating behaviours [33]. Furthermore, the fixed-ratio formulation of premix insulin can promote more frequent meal timing and portion control than basal-only agents can and therefore have beneficial weight control [34].

Age-Stratified Analysis showed an intriguing trend: younger patients (<50 years) who were on Mixtard 30/70 lost more of their weight ($-1.4 \pm 1.1 \text{ kg}$) when compared to the older ($-0.3 \pm 0.9 \text{ kg}$; $p = 0.037$) patients. Similar effects such as this were not seen in the Glargine group which indicates that the metabolic benefits of premix insulin are probably stronger in younger populations and may be more sensitive to the insulin effects. This is consistent with the literature showing that age-related differences in body composition and insulin resistance impact treatment potential [35].

Rural-Urban Differences regarding weight outcome were not statistically significant ($p = 0.213$); however, rural practitioners of Mixtard 30/70 showed a more significant weight loss ($-1.1 \pm 1.2 \text{ kg}$) than those from urban environments ($-0.6 \pm 1.0 \text{ kg}$). This difference might be due to increased physical activity or a more varied diet in rural areas, which were not adequately considered in our vegetarian versus non-vegetarian comparison [36]. Mixtard 30/70 has a consistent effect on weight in different locations indicating that it may be useful in different populations.

3.9.2. Clinical Correlates of Weight Changes

Multivariate regression analysis was used in the study of the clinical correlates of weight changes. The major predictors obtained were:

Baseline BMI ($\beta = 0.41$, $p = 0.002$)

Insulin regimen ($\beta = -1.05$ for Mixtard 30/70, $p = 0.018$)

Hypoglycemia frequency ($\beta = 0.29$, $p = 0.042$)

The correlation between the rate of hypoglycemia and the gain of weight can be positive, and it can be assumed that defense-eating behaviors are adopted by people to manage or prevent hypoglycemia [37]. This tendency could explain the observed result of Glargine being indifferent to weight change in patients with higher scores related to hypoglycemia fear because patients with high anxiety levels regarding such risks might be unwittingly more prone to caloric intake increase than others. Framing these results in the context of previous literature, they are consistent with meta-analytic evidence showing that premix insulin analogues are associated with less weight gain than basal-bolus regimens [38]. However, the difference with our study (-1.1 kg) was weaker than usual record (-2 to -3 kg) and could be because of a shorter follow-up period or studies with different baseline characteristics. The stability of weight gained using Glargine contrasts with previous evidence of mild weight gain [39], potentially attributed to the older age of the subjects in our cohort and its associated metabolic changes.

Limitations and implications

This observational study cannot establish causation and lacks body composition measures. Findings suggest Mixtard 30/70 may suit younger or obese patients focused on weight management, while Glargine may benefit older or less weight-conscious patients through better glycemic stability [40]. The study highlights the importance of individualized insulin treatment based on metabolic outcomes, glycemic control, hypoglycemia concerns, and psychological factors in type 2 diabetes management. Future research should examine long-term weight effects and related cardiovascular or mortality risks [41].

4. Discussion

The study highlights key challenges in diabetes management, particularly in resource-limited settings. Glargine showed slightly better glycemic stability due to its long-acting, peakless insulin profile, making it useful for patients prone to nocturnal hypoglycemia or dietary irregularities [42]. However, higher perceived fear of hypoglycemia among Glargine users emphasizes the need for better patient education regarding insulin safety [43]. Mixtard 30/70 was associated with weight reduction and lower fear of hypoglycemia, making it more suitable for younger or obese patients, while Glargine may benefit elderly individuals with cardiovascular disease [44]. The Hypoglycemia Fear Scale was validated as a useful clinical tool for identifying psychological barriers to glycemic control. Limitations of the study include its observational design, single-center setting, and short follow-up period. Future research should involve multicenter trials, continuous glucose monitoring, cost-effectiveness analyses, and lifestyle-based evaluations to support more individualized and patient-centered diabetes care [45].

5. Conclusion

The study compares Glargine and Mixtard 30/70 insulin therapies in Type 1 and Type 2 diabetes management. Both improved glycemic control, with Glargine showing slightly better long-term stability, while Mixtard 30/70 was associated with mild weight gain and reduced fear of hypoglycemia. The findings emphasize the importance of individualized insulin therapy that considers metabolic, psychological, and lifestyle factors. The study also validates the Hypoglycemia Fear Scale as a useful clinical tool, especially in resource-limited settings. Researchers recommend longer-term studies, integration of continuous glucose monitoring, and cost-effectiveness analyses to further optimize patient-centered diabetes care and treatment outcomes.

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