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ASSESSMENT OF NUTRITIONAL STATUS OF ADOLESCENTS (13-17 YEARS) WITH TYPE 1 DIABETES – A CROSS-SECTIONAL STUDY

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Abstract: *Adolescents with Type 1 Diabetes Mellitus (T1DM) face multifaceted nutritional and psychosocial challenges that can impact disease management and long-term outcomes. This study aimed to assess their nutritional status and explore how socio-demographic, dietary, and clinical variables influence health indicators. A cross-sectional study was conducted among 50 adolescents (13–17 years) with T1DM in Mumbai. Data were collected using structured questionnaires, anthropometric measurements, 24-hour dietary recalls, and recent HbA1c levels. Socioeconomic status was assessed using the Modified Kuppuswamy Scale. Statistical analysis was done using SPSS v25, with significance set at $p < 0.05$. Boys were significantly taller and heavier than girls ($p=0.001$, $p=0.012$). Girls had significantly higher EAR for energy ($p=0.001$), EAR for protein ($p=0.020$), and RDA for protein ($p=0.020$). Participants from upper-middle SES had higher fiber intake ($p=0.001$) and better coping scores ($p=0.024$), while lower-middle SES adolescents reported more hypoglycemia due to skipped meals ($p=0.018$). Rapid-acting and long-acting insulin regimens were significantly more common in upper-middle SES ($p=0.002$). Fiber intake negatively correlated with BMI ($r = -0.312$, $p = 0.028$). Only 16% had good-to-fair glycemic control, while 64% had poor or very poor control. The study found that while most adolescents with T1DM had acceptable nutritional status, gender and socioeconomic differences influenced dietary intake and diabetes management. Boys consumed more carbohydrates; girls had better protein adherence and support. Higher fiber intake, more common in upper-middle SES, was linked to lower BMI and better insulin access.*

Key Words: *Adolescents, Type 1 Diabetes Mellitus (T1DM), Nutritional Status, Socioeconomic Status, Glycemic Control, Dietary Intake, Family Support, Fiber Intake, Carbohydrate Consumption, Insulin Regimens.*

1. INTRODUCTION

Type 1 Diabetes Mellitus (T1DM) is a chronic autoimmune disorder characterized by the destruction of insulin-producing beta cells in the pancreas, leading to absolute insulin deficiency and persistent hyperglycemia. The onset is most common in childhood and adolescence, necessitating lifelong insulin therapy and continuous medical monitoring[6]. Effective glycemic control is essential to prevent both acute complications like diabetic ketoacidosis (DKA) and long-term outcomes such as retinopathy, nephropathy, and cardiovascular disease[11, 15].

Adolescents with T1DM face unique challenges. Rapid physical growth, hormonal changes during puberty, and evolving food preferences increase the complexity of disease management[6]. Optimal nutrition during adolescence is essential not only for glycemic control but also for physical development, bone health, and mental well-being. Carbohydrate counting, balanced macronutrient intake, and regular monitoring are vital strategies in managing blood glucose fluctuations[10]. However, achieving dietary compliance in adolescents can be particularly difficult due to psychosocial stress, peer pressure, and increasing autonomy. Disordered eating behaviors, including emotional eating and carbohydrate restriction, may arise in response to the burdens of diabetes management and body image concerns[17]. Additionally, the increasing prevalence of obesity among youth with T1DM complicates insulin sensitivity and may increase cardiovascular risk[9, 11].

Socioeconomic disparities further influence nutritional access and diabetes management. Adolescents from lower socioeconomic backgrounds may face barriers such as limited access to nutritious food, diabetes education, or advanced treatment technologies like insulin pumps and continuous glucose monitoring[4]. In contrast, those from higher strata often benefit from better healthcare access and support systems. Family support is another crucial factor influencing dietary adherence and self-management skills. Research shows that adolescents with strong family involvement tend to have better glycemic outcomes and mental health[8, 12]. The relationship between exercise and diabetes is complex, and careful consideration must be given to factors such as exercise intensity, duration, and timing, as well as individual patient characteristics, to minimize the risk of adverse events, particularly hypoglycemia in T1D. Therefore, personalized exercise plans tailored to the specific needs and capabilities of each individual with diabetes are essential[22].

Despite the critical role of nutrition, few Indian studies have specifically assessed the nutritional status of adolescents with T1DM in relation to socio-demographic and clinical factors. This study aims to fill that gap by evaluating the nutritional status of adolescents aged 13–17 years with T1DM and identifying how factors like socioeconomic status, dietary patterns, family support, and glycemic control influence their overall health.

2. METHODOLOGY

This cross-sectional study was conducted among adolescents aged 13–17 years diagnosed with Type 1 Diabetes Mellitus (T1DM), attending diabetes clinics and outpatient departments in Mumbai, India. Ethical approval was obtained from the Inter System Biomedica Ethics Committee (ISBEC). Informed consent was obtained from parents, and verbal assent was taken from participants. A total of 50 adolescents (25 boys and 25 girls) were selected through purposive sampling, based on inclusion criteria such as age, diagnosis of T1DM for at least one year, and current insulin treatment.

Data were collected through face-to-face interviews using a structured questionnaire. Tools included demographic details, the Modified Kuppuswamy Socioeconomic Status Scale[5], anthropometric measurements (height, weight, BMI), recent HbA1c values (for glycemic control), and 24-hour dietary recall (3 non-consecutive days). Additional data included dietary habits, physical activity, family support, and access to healthcare. Nutritional status was assessed using IAP growth chart percentiles.

Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 25 for Windows (version 25, 2017, IBM Corporation, Armonk, New York, United State). Data presented as Mean±SD or frequency (percentage). Cross tabulations were computed for categorical data for gender or SES and compared using chi-square test. Anthropometry and dietary data were compared between gender or SES using the Independent Sample T test. Mann Whitney U test was used to compare ordinal data when classified according to gender or SES. Pearson's Correlation or Spearman's Correlation was used to assess correlations. $P<0.05$ was considered to be statistically significant.

3. RESULTS

The results of the study present the socio-demographic characteristics, anthropometric measurements, dietary intake, glycemic control, and behavioral patterns of adolescents aged 13–17 years with Type 1 Diabetes Mellitus (T1DM). The data were analyzed to explore differences by gender and socioeconomic status (SES), as well as correlations between nutritional intake, clinical indicators, and health outcomes. Key variables such as height, weight, BMI, insulin regimen, family involvement, and nutrient intake were compared across subgroups to identify significant associations and trends.

Table 1: Socio-Demographic Data of the study participants

Category	Variable	Frequency (n)	Percentage (%)
Age	13 years	12	24
	14 years	7	14
	15 years	7	14
	16 years	5	10

	17 years	19	38
Gender	Boy	25	50
	Girl	25	50
Duration of Type 1 Diabetes	1 year	3	6
	2 years	5	10
	3 years	8	16
	4 years	9	18
	5 years	5	10
	6 years	20	40
Medical History	None	50	100
Socioeconomic Scale	Upper middle class	15	30
	Lower middle class	35	70

As per table 1, The majority of participants were aged 17 years (38%), with an equal gender distribution. Most participants had been living with Type 1 Diabetes for over 3 years, and all reported no significant past medical history. A larger proportion (70%) belonged to the lower-middle socioeconomic stratum.

Table 2: Anthropometric Data of the Study Participants

Parameters	Boys (n=25)	Girls (n=25)	Total (n=50)	P value
Height (cm)	163.0±8.2	152.7±7.5	157.9±9.4	**0.001***
Weight (kg)	55.1±10.9	47.2±10.4	51.2 ±11.3	**0.012***
BMI (kg/m^2)	20.6±3.1	20.1±3.1	20.3±3.1	0.541
Parameters	UM SES (n=15)	LM SES (n = 35)	Total (n=50)	P value
Height (cm)	160.4±12.4	156.8±7.7	157.9±9.4	0.216
Weight (kg)	52.8±14.3	50.5±9.8	51.2 ±11.3	0.498
BMI (kg/m^2)	20.2±3.4	20.4±2.9	20.3±3.1	0.850

Note: UM SES – Upper middle socio-economic stratum; LM SES – Lower middle socio-economic stratum. Values are mean ± Standard Deviation. *p < 0.05 indicates statistical significance.

As per table 2, Boys were significantly taller and heavier than girls, with mean heights of 163.0 ± 8.2 cm and 152.7 ± 7.5 cm (p = 0.001), and mean weights of 55.1 ± 10.9 kg and 47.2 ± 10.4 kg (p = 0.012), respectively. However, no significant difference was observed in BMI between boys (20.6 ± 3.1 kg/m²) and girls (20.1 ± 3.1 kg/m², p = 0.541). When analyzed by socio-economic status, participants from upper middle (UM SES) and lower middle (LM SES) groups showed no significant differences in height, weight, or BMI.

Table 3: Comparison of Hypoglycemia Triggers, Insulin Regimens, and Dietary Approaches by Gender and SES

Category	Variable	Boys (n=25)		Girls (n=25)		Total (n=50)		P value
		N	%	N	%	N	%	
Hypoglycemia Triggers	Skipped meals	19	76	16	64	35	70	0.355
	Excessive physical activity	16	64	12	48	28	56	0.254
	Incorrect insulin dosage	14	56	11	44	25	50	0.396
	Illness or infection	3	12	5	20	8	16	0.440
	Stress or anxiety	2	8	2	8	4	8	1.000
	Changes in routine	2	80	1	4	3	6	0.552
Insulin Regimen	Rapid- acting & long acting	16	64	14	56	30	60	
	Short-acting & long acting	9	36	11	44	20	40	0.564
Dietary Approach	Tailored Diet or Carbohydrate counting	7	28	10	40	17	34	0.370
Category	Variable	UM SES (n=15)		LM SES (n=35)		Total (n=50)		P value
		N	%	N	%	N	%	

Hypoglycemia Triggers	Skipped meals	7	46.7	28	80	35	70	**0.018***
	Excessive physical activity	10	66.7	18	51.4	28	56	0.320
	Incorrect insulin dosage	6	40	19	54.3	25	50	0.355
	Illness or infection	2	13.3	6	17.1	8	16	0.736
	Stress or anxiety	1	6.7	3	8.6	4	8	0.820
	Changes in routine	2	13	1	2.9	3	6	0.153
Insulin Regimen	Rapid- acting & long acting	14	93.3	16	45.7	30	60	
	Short-acting & long acting	1	6.7	19	54.3	20	40	**0.002***
Dietary Approach	Tailored Diet or Carbohydrate counting	6	40	11	31.4	17	34	0.558

Note: UM SES – Upper middle socio-economic stratum; LM SES – Lower middle socio-economic stratum. *p < 0.05 indicates statistical significance

As per table 3, A significantly higher percentage of participants from Lower middle SES had hypoglycemia due to skipping meals as compared to those from Upper middle SES (p<0.05). A significantly higher percentage of participants from Upper middle SES followed an insulin regimen consisting of a combination of Rapid- acting & long acting (p<0.05). A significantly higher percentage of participants from Lower middle SES followed an insulin regimen consisting of a combination of Short-acting & long acting (p<0.05). No other significant differences were observed (p>0.05).

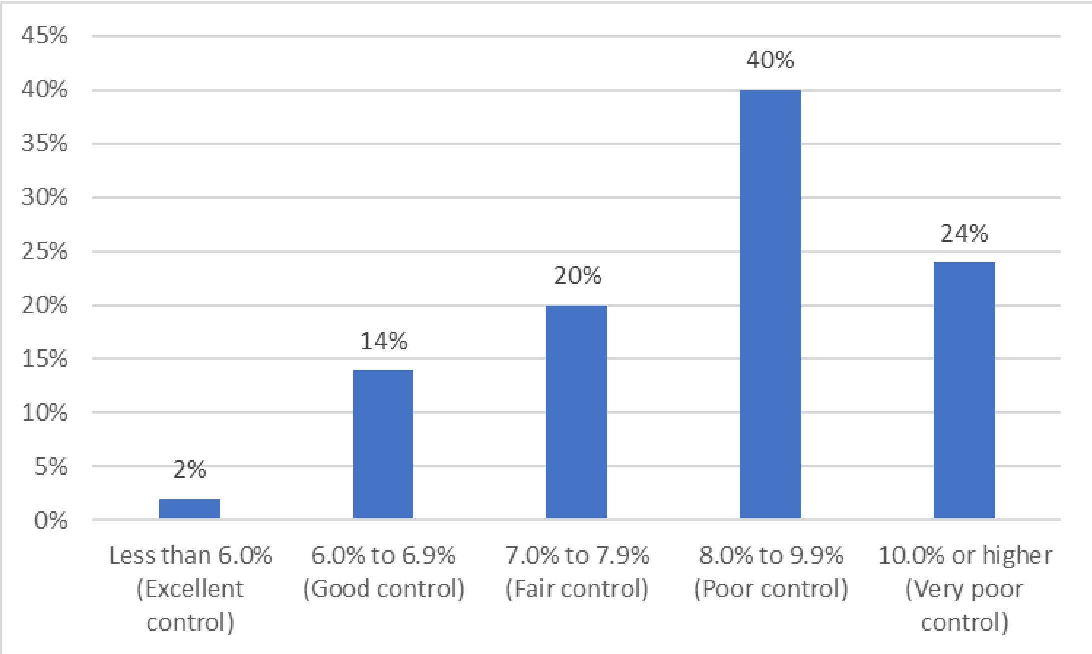

Figure 1: HbA1C levels of study participants

As per figure 1**,** Based on HbA1c levels, only 2% (n = 1) of study participants had excellent glycemic control (HbA1c less than 6.0%). Good control (HbA1c 6.0% to 6.9%) was observed in 14% (n = 7) of study participants. Fair control (HbA1c 7.0% to 7.9%) was seen in 20% (n = 10). A substantial proportion, 40% (n = 20), exhibited poor control (HbA1c 8.0% to 9.9%), while very poor control (HbA1c 10.0% or higher) was noted in 24% (n = 12) of study participants.

Table 4: Comparison of Family Involvement, Coping, Healthcare Access, and Satisfaction by Gender and SES

Category	Boys (n=25)	Girls (n=25)	P value
Family support	4.9±0.4	4.9±0.3	0.332
Family assistance in Insulin administration	2.6±1.1	3.2±1.4	**0.052***

Family encouragement in healthy eating	4.9±0.4	4.8±0.6	0.967
Family involvement in attending medical appointments	4.6±0.7	4.8±0.6	0.296
Family and participants coping with diabetes	3.4±1.0	3.0±1.0	0.164
Frequency of visiting doctor	3.4±1.1	4.3±0.7	**0.005***
Satisfaction score (quality of care)	4.6±0.5	4.7±0.6	0.203
Category	UM SES (n=15)	LM SES (n = 35)	P value
Family support	5.0±0.0	4.9±0.4	0.177
Family assistance in Insulin administration	2.5±1.1	3.1±1.3	0.127
Family encouragement in healthy eating	4.8±0.6	4.9±0.5	0.392
Family involvement in attending medical appointments	4.6±0.7	4.8±0.6	0.319
Family and participants coping with diabetes	3.7±1.2	2.9±0.8	**0.024***
Frequency of visiting doctor	3.3±1.2	4.1±0.9	**0.020***
Satisfaction score (quality of care)	4.8±0.4	4.6±0.6	0.284

Note: UM SES – Upper middle socio-economic stratum; LM SES – Lower middle socio-economic stratum. Values are mean ± Standard Deviation. *p < 0.05 indicates statistical significance

As per table 4, There was a statistically significant difference in family assistance in insulin administration between boys and girls, with girls receiving more assistance than boys (p<0.05). Boys visited the doctor significantly less frequently than girls (p<0.05). A significant difference was observed between the socio-economic strata, with participants from the Upper middle socio-economic stratum reporting better coping ratings compared to those from the LM SES (p<0.05). Participants from the Upper middle socio-economic stratum visited the doctor less frequently compared to those from the lower-middle socio-economic stratum (p<0.05). No other significant differences were observed (p>0.05).

Table 5: Comparison of Energy and Macronutrient Intake by Gender and SES

Category	Boys (n=25)	Girls (n=25)	Total (n=50)	P value
Energy (kcal)	1301.4±213.3	1245.7±155.3	1274± 187	0.297
Protein (g)	40.8±9.9	40.8±8.3	40.8 ± 9.1	1.000
Carbohydrates (g)	173.8±36.8	156.8±28.8	165.3 ± 33.8	0.075
Fats (g)	40.6±10.5	39.2±8.0	39.9 ± 9.2	0.587
Fiber (g)	21.4±6.4	20.3±6.7	20.8±6.5	0.579
EAR energy (%)	41.3±6.7	51.3±6.8	46.3 ± 8.3	**0.001***
EAR protein (%)	98.2±23.6	114.5±24.2	106.4 ± 25.1	**0.020***
RDA protein (%)	79.6±19.0	92.9±19.8	86.3 ± 20.3	**0.020***
RDA fiber (%)	45.6±14.1	55.7±18.8	103±50.6	0.037
Energy from protein (%)	12.4±1.4	13.1±1.7	12.7 ± 1.6	0.148
Energy from carbohydrates (%)	53.3±6.5	50.4±7.4	51.9 ± 7.0	0.151
Energy from fats (%)	28.3±6.1	28.5±5.2	28.4 ± 5.6	0.911
Category	UM SES (n=15)	LM SES (n = 35)	Total (n=50)	P value
Energy (kcal)	1311±145.3	1258±201.3	1274± 187	0.363
Protein (g)	40.9±7.2	40.7±9.9	40.8 ± 9.1	0.957
Carbohydrates (g)	176.8±30.6	160.4±34.4	165.3 ± 33.8	0.117
Fats (g)	41.3±12.6	39.3±7.5	39.9 ± 9.2	0.485
Fiber (g)	26.0±6.1	18.6±5.3	20.8±6.5	**0.001***
EAR energy (%)	45.2±8.2	46.8±8.5	46.3 ± 8.3	0.552
EAR protein (%)	103.7±21.3	107.5±26.8	106.4 ± 25.1	0.625
RDA protein (%)	84.1±17.0	87.2±21.8	86.3 ± 20.3	0.634
RDA fiber (%)	59.9±18.0	46.6±15.5	50.6±17.2	**0.011***
Energy from protein (%)	12.4±1.3	12.9±1.7	12.7 ± 1.6	0.374
Energy from carbohydrates (%)	53.9±6.8	51.0±7.0	51.9 ± 7.0	0.184

Energy from fats (%)	28.2±6.5	28.5±5.3	28.4±5.6	0.865

Note: UM SES – Upper middle socio-economic stratum; LM SES – Lower middle socio-economic stratum. Values are mean ± Standard Deviation. *p < 0.05 indicates statistical significance

As per table 5, Girls had significantly higher intake values than boys in terms of percentage of Estimated Average Requirement (EAR) for energy, EAR for protein, and Recommended Dietary Allowance (RDA) for protein (p <0.05). Fiber intake and percentage of RDA for fiber were significantly higher among participants from the Upper middle socio-economic stratum compared to those from the Lower Middle stratum (p <0.05). No other significant differences were observed (p>0.05).

Table 6: Correlation of Macronutrient Intake, Duration of Type 1 Diabetes, and HbA1c with Weight and BMI among Study Participants

Parameters	Weight		BMI	
	Pearson's R value	P value	Pearson's R value	P value
Energy	0.023	0.874	-0.057	0.694
Carbohydrates	0.171	0.235	0.065	0.665
Proteins	-0.012	0.934	-0.086	0.550
Fats	0.128	0.378	0.124	0.392
Fiber	-0.174	0.226	-0.312	**0.028***
Duration of T1D	0.072	0.620	0.072	0.583
HbA1c	-0.119	0.410	0.022	0.878

Note: BMI- Body Mass Index. R value ranges -1 to + 1. *p < 0.05 indicates statistical significance

As per table 6, Fiber intake showed a weak negative correlation with both weight and Body Mass Index (BMI), but only the correlation with BMI was statistically significant (r = -0.312, p<0.05), indicating that higher fiber intake was linked to lower BMI among the study participants. Correlation analysis showed no significant association (p > 0.05) between weight or BMI and energy, macronutrient intake, duration of T1D, or HbA1c. Energy and fat intake had weak positive correlations with weight and BMI, while protein showed weak negative correlations. Carbohydrates, duration of T1D, and HbA1c also showed only weak, non-significant associations with weight and BMI.

4. DISCUSSION

In the study, boys were significantly taller and weighted more than girls (p < 0.05). This aligns with established growth patterns during adolescence, where boys typically experience a later but more pronounced growth spurt compared to girls. Such differences are consistent with global growth standards and have been observed across various populations[13].

A significantly higher percentage of participants from the lower-middle socioeconomic stratum experienced hypoglycemia due to meal skipping, likely reflecting financial limitations that hinder consistent meal patterns. Individuals from lower socioeconomic backgrounds often encounter challenges such as food insecurity, reduced access to healthcare, and inadequate diabetes education, which collectively contribute to poor glycemic control. The findings emphasize the need for targeted nutritional support and structured diabetes care strategies for socioeconomically vulnerable groups[20].

A significant proportion of participants from Upper middle socioeconomic strata followed an insulin regimen combining rapid-acting and long-acting insulin, whereas those from the lower-middle stratum predominantly used a combination of short-acting and long-acting insulin (p < 0.05). The disparity is supported by a study examining socioeconomic disparities in access to intensive insulin regimens, which found that individuals from lower socioeconomic backgrounds faced barriers in accessing advanced insulin therapies. Factors such as limited health literacy and reduced access to structured education programs contributed to these disparities[14].

Girls received significantly more family assistance in insulin administration compared to boys (p < 0.05). This aligns with findings from research indicating gender differences in diabetes self-care, where females often receive greater family involvement in managing Type 1 Diabetes, particularly when it comes to insulin administration. Some studies indicate that younger girls tend to receive more assistance from family members compared to boys[7]. Participants from Upper middle socioeconomic strata reported better coping ratings compared to those from the lower-middle stratum ($p < 0.05$). This is supported by research highlighting the role of socioeconomic factors in coping with chronic illnesses. A study examining the impact of socioeconomic characteristics on metabolic control in children with type 1 diabetes found that higher socioeconomic status was associated with better coping strategies and glycemic control[1].

In the present study, boys visited doctors significantly less frequently than girls ($p < 0.05$). The gender disparity in healthcare utilization is supported by a study that analyzed UK general practice data and found that males, across a range of age groups, consistently consulted healthcare providers less frequently than females. The trend may stem from social norms around masculinity, reduced health-seeking behavior, or lower health awareness among males, including adolescents[21]. Additionally, participants from the Upper middle socioeconomic strata in this study were found to visit doctors less frequently than those from the lower-middle stratum ($p < 0.05$). Similar findings were noted in a study conducted in Malda District, India, where individuals from higher socioeconomic backgrounds utilized healthcare services less often for routine visits, likely due to better access to preventive resources, self-management capabilities, and overall health literacy[2]. These findings suggest that while lower SES groups may rely more on frequent doctor visits for diabetes management due to resource constraints, higher SES participants may benefit from improved self-care and reduced need for clinical interventions.

Girls had significantly higher intake values than boys in terms of percentage of Estimated Average Requirement (EAR) for energy ($p = 0.001$), EAR for protein ($p = 0.020$), and Recommended Dietary Allowance (RDA) for protein ($p = 0.020$). This aligns with findings from dietary studies indicating that adolescent girls often have better adherence to dietary recommendations compared to boys. A study on protein-rich foods for children emphasized the importance of balanced diets and noted that girls tend to have higher diet quality scores, reflecting better nutrient intake[3].

In the present study, boys had a higher carbohydrate intake (173.8 ± 36.8 g) compared to girls (156.8 ± 28.8 g). This aligns with findings from previous research indicating that boys, especially those with higher physical activity levels, tend to consume more energy and macronutrients, including carbohydrates, than girls[18]. Additionally, the percentage of energy derived from fats in both boys ($28.3 \pm 6.1\%$) and girls ($28.5 \pm 5.2\%$) exceeded the recommended dietary allowance of 25% total fat intake, which includes both visible and invisible fats. These findings highlight a trend toward higher fat consumption across genders, which may reflect dietary patterns that are energy-dense but not always nutritionally balanced[18].

In the present study, fiber intake and the percentage of Recommended Dietary Allowance (RDA) met for fiber were significantly higher among participants from the Upper middle socio-economic strata compared to those from the Lower-Middle stratum ($p < 0.05$). Individuals from higher socio-economic backgrounds are more likely to consume a varied and balanced diet that includes fiber-rich foods such as fruits, vegetables, legumes, and whole grains. This could be attributed to better access, affordability, and awareness regarding healthy dietary choices. In contrast, individuals from lower socio-economic groups may face financial constraints and limited access to such food items, leading to inadequate fiber intake. These findings highlight the persistent nutritional disparities linked to socio-economic status and underscore the need for public health strategies that promote dietary fiber intake across all income groups[16].

In the present study, fiber intake showed a weak negative correlation with both weight and Body Mass Index (BMI), although only the correlation with BMI was statistically significant. This suggests that higher dietary fiber intake may be modestly associated with lower BMI values among adolescents. Dietary fiber is known to enhance satiety, reduce total caloric intake, and positively influence gut microbiota—all of which can contribute to body weight regulation. The inverse relationship observed in this study is consistent with existing literature that links increased fiber consumption with a reduced risk of obesity and related metabolic disturbances. Mechanistic explanations suggest that fiber modulates appetite-regulating hormones, delays gastric emptying, and improves insulin sensitivity, which collectively may contribute to maintaining a healthier BMI[19].

The findings of the study underscore the complex interplay between gender, socioeconomic status, and various aspects of Type 1 Diabetes Mellitus management among adolescents. Notable differences were observed in dietary intake, healthcare utilization, and coping mechanisms, with boys and participants from higher socioeconomic strata generally exhibiting more favorable indicators in certain domains. However, disparities in access to advanced insulin regimens, glycemic control challenges among lower socioeconomic groups, and gender-based differences in support and behavior highlight the need for tailored, context-specific strategies. The insights contribute to the growing body of evidence emphasizing the importance of integrated, equitable, and multidisciplinary approaches in the nutritional and clinical management of adolescents with T1DM.

5. CONCLUSION

The study assessed the nutritional status of adolescents with Type 1 Diabetes Mellitus (T1DM) and examined the impact of socio-demographic, dietary, and clinical factors on their health outcomes. The study confirms that many adolescents with T1D maintain an acceptable nutritional status. While gender and socioeconomic differences influenced dietary behaviors and diabetes management, notable trends emerged. Boys reported higher carbohydrate intake, whereas girls had better protein intake adherence and more family support in insulin administration. Adolescents from Upper middle socioeconomic strata demonstrated healthier dietary practices and greater access to advanced insulin therapies. In contrast, those from lower-middle strata experienced more hypoglycemic episodes, largely due to skipped meals, reflecting economic and educational barriers. Additionally, fiber intake was higher among adolescents from Upper middle socioeconomic strata, and higher fiber intake was associated with lower BMI. The findings underscore the need for individualized, family-inclusive nutrition counseling and equitable healthcare access to improve self-management and long-term outcomes in adolescents with T1DM.

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