ORIGINAL RESEARCH

Adherence to Diabetes Self-Management and Its Associated Factors Among Adolescents Living with Type 1 Diabetes at Public Hospitals in Addis Ababa, Ethiopia: A Cross-Sectional Study

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Objective: The purpose of this study was to determine the level of adherence to diabetes self-management and associated factors among adolescents living with type 1 diabetes at Public Hospitals in Addis Ababa, Ethiopia.

Methods: An institutional-based cross-sectional study was carried out among 422 adolescents with type 1 diabetes attending outpatient diabetic clinics at public hospitals in Addis Ababa. The adolescents were interviewed using pretested questionnaires to give information on adherence to diabetes self-management. A variable that has a P-value of <0.2 in bi-variable logistic regression analysis was subjected to multivariable logistic regression analysis to control the confounding factors. The level of significance was pronounced at P-value <0.05.

Results: In this study, a total of 414 adolescents living with type 1 diabetes were interviewed making a 98.1% response rate. About 218 participants (52.7%) had poor adherence to overall diabetes self-management. Self-efficacy (AOR=8.7, 95% CI:1.9–14.1, P=0.005), social support (AOR=4.6, 95% CI:1.5–13.5, P=0.006), age (AOR=0.2, 95% CI:0.1–0.4, P=0.001), good knowledge of the disease (AOR=9.046, 95% CI:3.83–13.5, P=0.000), moderate knowledge (AOR=6.763, 95% CI:2.18–12.921, P=0.001), and time since diagnosis of type 1 diabetes (AOR=0.1, 95% CI:0.02–0.2, P=0.005) were significantly associated with adherence to diabetes self-management.

Conclusions and Recommendations: More than half of this population had poor adherence to diabetes self-management. The finding suggested that implementing a comprehensive guideline of adherence and expanding the recurrence of follow-up visits could be important for this population.

Keywords: adherence, diabetes, self-management, adolescents, ADSM

Introduction

Adherence to diabetes self-management (ADSM) is a fundamental process of learning to interact with the complex nature of the disease. It involves collaboration with the health care providers to control the interactions of health-related behaviours to chronic conditions of the disease. This adherence mandates socially touchy and developmentally suitable diabetes self-management instructions. Studies showed that destitute ADSM among adolescents with T1D were associated with shorter time since diagnosis, comorbidities, depression, lack of self-efficacy, lack of social support, lack of knowledge about the disease, poor patient-provider relationships and less frequent follow up visits.[1–4]

Few studies were conducted to assess ADSM in adolescents by incorporating adherence to insulin administration, dietary management, management of hypoglycemia, blood glucose testing, and regulation of exercise. Hence, they

reported that poor ADSM were higher in middle and low-income countries than in high-income countries. Overall poor ADSM was 20% in America whereas, poor adherence to glucose testing, dietary management, exercise, and insulin administration in Palestine was 66%, 89%, 79%, and 21% respectively. Overall poor ADSM in Uganda and Cameroon were 63% and 67% respectively.[5–12]

Poor ADSM may impose different impacts on the health care system of adolescents. Hence, most adolescents complain of diabetes ketoacidosis (DKA), anorexia nervosa, poor quality of life, prolonged hospital admissions, micro and macrovascular disease. In low-income countries, access to insulin and self-management tools is scarce. This may lead to severe disability and early death as a result of ketones building up in the body. Thus, proper ADSM is the only option to improve the health status of adolescents with T1D.[13–18]

Though the issue of ADSM requires strong devotion and considerable attention, few studies were conducted to show the gap and magnitude of the problem in Africa. To the extent of the investigator's knowledge, there has been no published study that determines ADSM and associated factors among adolescents with T1D in Ethiopia. Therefore, this study aimed to assess ADSM of adolescents with T1D and associated factors in the study area. This helps to reveal the level of poor adherence and would be essential for the care delivery services of the adolescents to fill the gaps to resolve the problems.

Methods and Materials
Study Area and Period
The study was conducted in Addis Ababa city, Ethiopia, from March 10 to April 25, 2021. Addis Ababa city was conveniently selected as a study area based on the goals of the study, feasibility, and the availability of diabetic clinics at all levels of the public health care system in the study area.

Study Design
An institutional-based descriptive cross-sectional study design was used.

Source Population and Study Population
All adolescents with T1D who visited the outpatient Department at public hospitals in Addis Ababa were the source populations.

Inclusion and Exclusion Criteria
All adolescents with T1D who visited the outpatient Department at selected public hospitals in Addis Ababa and those on insulin treatment at least for 1 year period before commencement of the study were included in the study. Adolescents who were unable to speak, those who had a major hearing problem, those who have serious physical and mental retardation were excluded from the study.

Sample Size Determination
The sample size was determined by using single population proportion formula. Using standard normal value corresponding to a 95% confidence interval (CI), taking a margin of error as 5% and Prevalence (P) of 50% (prevalence of ADSM of T1D for adolescents in Ethiopia was not known). Then by taking a 10% non-response rate the final sample size was 422.

Sampling Techniques
From the ten public hospitals in Addis Ababa city that give chronic follow-up care services for adolescents with T1D, four public hospitals were selected by using a simple random sampling technique. The number of participants for each hospital was proportionally allocated based on the number of adolescents coming per month for follow up.

Based on documented information from each hospital the number of adolescents coming for follow up per month was 340, 160, 320, and 60 for Black lion Specialized hospital, Zewuditu Memorial hospital, Yekatit 12 Medical College hospital and Menilik II Referral hospital respectively. Then by using the proportional allocation formula the number of

participants was calculated. The number of participants = Ni*n/N; Where; "Ni" represents the number of adolescents coming for follow up per month at each hospital, "n" indicates sample size = 422, and "N" is the sum of the total number of adolescents coming for follow up per month at each hospital.

Based on the above formula the number of participants from Black lion Specialized hospital, Zewditu Memorial hospital, Yekatit 12 Medical College hospital, and Menilik II Referral hospital was 163, 76, 154, and 29 respectively. Finally, to get the specific study subject consecutive adolescents coming for follow up were included in the study until the allocated proportion was fulfilled.

Operational Definitions
Adolescents
Adolescents are the population of human beings conventionally understood as the age between 10 and 18 years old.[19]

Adherence
Adherence is the extent to which a person's behaviour corresponds with the advice from health care providers.[1]

Adherence to Diabetes Self-Management (ADSM)
ADSM in this study refers to behaviours such as following adherence to the management of insulin administration, dietary management, management of hypoglycemia, blood glucose testing, and regulation of exercise to control T1D on their own. The percentage was calculated and categorized as good ADSM if "diabetes self-management profile self-report questionnaire" scores greater than 50% and poor ADSM for scores less than or equal to 50%.[8,20]

Knowledge About Type 1 Diabetes
Respondents with a score greater than or equal to 80%, 60%-79%, less than or equal to 59% of the total diabetes knowledge test (DKT) evaluation of lifestyles and management scale were taken as having good knowledge, moderate knowledge, and poor knowledge about type 1 diabetes respectively.[6,21]

Self-Efficacy
Is the belief in one's capabilities to organize and execute the courses of action required to produce given attainment. In this study, respondents who scored greater than 50% of the questionnaires on the "self-efficacy in adolescents, girls and boys with insulin-dependent diabetes mellitus" scale were considered as having good self-efficacy to cope up and manage their disease. Similarly, respondents who scored less than or equal to 50% were considered as having poor self-efficacy.[22]

Social Support
This is the support gained from family and non-family members. In this study, respondents whose scores were greater than fifty per cent on the diabetes social support questionnaire-family version and friend version will be taken as having social support. Also, respondents who were scored less than or equal to 50% were considered as having no social support.[23,24]

Study Variables
Dependent Variables
Adherence to diabetes self-management (ADSM).

Independent Variables
Socio-demographic Factors: Age, Sex, Educational status
    Medical characteristics of adolescents with T1D: Co-morbidities, duration of the disease
    Behavioural Factors: Self-efficacy and knowledge about the disease
    Social Factors: Support from family and non-family members

Data Collection Method

Data Collection Instrument

Standardized and structured questionnaires were adapted from different works of literatures. Then an interview technique was implemented for data collection. Only 30 minutes were required to answer the questionnaires. All of the questions were first prepared in English then translated to Amharic by experts and back-translated to English for consistency. The questionnaire contains six parts.

Part I: Participant's socio-demographic characteristics: Gender, age, educational level, and Address.[25]

Part II: Medical factors: Age at diagnosis, duration of taking insulin medications, number of years of follow up and comorbidities.[26]

Part III: Adherence to diabetes self-management: Data about self-management activities was collected using the tool called "Validation of a self-report version of the diabetes self-management profile" which was cross-culturally adapted in Hindi in 2020. Its reported internal consistency reliability was α=0.835.[8,27]

This Diabetes Self-Management Profile Self-Report (DSMP-SR) has 24 item instrument that quantifies five areas of diabetes self-management which were insulin administration (4 items), dietary management (6 items), hypoglycemia management (4 items), blood glucose testing (7 items), and exercise (3 items). Then 5-point Likert scale with the anchors 1=never, anchors 2=Almost never, anchors 3=Sometimes, anchors 4=Almost always, anchors 5=always was used. Therefore, those with scores greater than 50% are categorized as having good adherence and those with scores less than or equal to 50% are categorized as having poor adherence.[8,20]

Part IV: Knowledge about Type 1 diabetes: The diabetes knowledge test (DKT) was utilized to assess the general understanding of adolescents about their disease and treatment recommendations. DKT was developed and tested for reliability and validity by the University of Michigan researchers, which was adapted for this study. DKT consists of 23 questions that have been shown to adequately estimate a general patient's knowledge of diabetes, related to the 5 domains of adherence to diabetes self-management.[21]

The score for each participant was determined by dividing the number of correct answers by the total number of questions then multiplied by 100 to give a 0 to 100 score. To assess the level of knowledge about diabetes, patients' level of knowledge was recorded into three groups based on their DKT scores as good, moderate, and poor knowledge if they score greater than or equal to 80%, 60–79%, and less than or equal to 59% respectively.[28]

Part V: Self-efficacy: "Self-efficacy in adolescent girls and boys with T1D scale" was adapted to measure self-efficacy of adolescents living with T1D.[22] The reported internal consistency reliability was 0.91. The questionnaires have 35-items instruments and are modified into a 5-point scale ranging from "totally unconfident" to "totally confident". Totally unconfident was scored 1, unconfident scored 2, not sure scored 3, confident was scored 4, totally confident was scored 5. Therefore, respondents who scored greater than 50% of the questionnaires were considered as having good self-efficacy to cope up, and manage their disease.[29]

Part VI: Social support: The diabetes social support questionnaires family version and friend version which contains 52 total items was used to assess support gained from family, friends and/or significant others. Responses were coded as follows: No=1, Yes=2. The support score was calculated by summing the 52 responses in the questionnaires and the resulting total was divided by 52 and multiplied by 100 to give a 0 to 100 score. Respondents whose score was above 50% on the questionnaires were taken as having social support and those with a score less than or equal to 50% were considered as having no social support.[23,24]

Data Collectors

Four trained BSc nurse professionals and two trained BSc nurse professionals were assigned as data collectors and supervisors respectively. Two days of training was given on the overall objective of the study, questionnaire clarification, sampling strategy, ethical considerations, how to facilitate and supervise the data collection process.

Data Collection Procedures

Face-to-face interview using a structured questionnaire was used for the data collection. A consent form, assent form, and an information sheet with details of the study were given to the participants and their families to obtain informed consent. Participants were assured of their confidentiality through anonymity by using code numbers on their questionnaires.

Subsequently, those who were willing to participate in the study were asked the questionnaire after taking informed, voluntary, and signed consent and assent. The data collectors guided and facilitated the data collection process by giving directions, clarifications, and checking for completeness of the data. The supervisors and the investigators also have followed the overall activities daily.

Data Quality Assurance

To assure the quality of data the following measures were undertaken. First, the questionnaire was designed properly and translated to Amharic language and back-translated into English by another person to check for consistency and similarity. Then, two weeks before the actual data collection the questionnaire was pretested in St. Paul's Millennium Medical College hospital and Tirunesh Beijing hospital using 5% of the sample size.

Moreover, the questionnaire was assessed for completeness, consistency, applicability, and important modifications were made before the actual data collection. Furthermore, the study procedures protected the patient's privacy by allowing anonymous and voluntary participation. Data was also kept in the form of a file in a secure place where no one can access it except the investigators. Finally, during analysis data were cleaned carefully; missing values were handled not to be included in the analysis by checking repeatedly through data exploration. A frequency check was also done for controlling errors during data analysis and the Cronbach alpha reliability test was calculated using SPSS and it was 0.72.

Data Processing and Analysis

The data was collected by using Kobo collect software version 1.30.1 from adolescents with T1D who fulfilled the inclusion criteria and those who visited outpatient Departments during the study period at selected public hospitals. Then the data was checked and cleaned in excel software for exporting to SPSS version 25 software for analysis. Incomplete and inconsistent data were excluded from the analysis. The results of the descriptive statistics were expressed as percentages and frequencies.

Associations between independent and dependent variables were analyzed first using bivariable analysis to identify factors that were associated with the outcome variable. Those variables which were found to have an association with the outcome variable at $P<0.2$ and which fitted for binary logistic regression model were entered to multivariable logistic regression analysis to control the confounding factors. Then the fitness of the model was checked using Hosmer and Lemeshow goodness of fit. The magnitude of the association between the different variables with the dependent variable was measured using an adjusted odds ratio (AOR) and 95% CI and $P<0.05$ were considered to be statistically significant.

Results

Sociodemographic Characteristics of Adolescents with Type 1 Diabetes

A total of 422 adolescents living with type 1 diabetes were selected to participate in this study, among these, 414 participated making a 98.1% response rate. The data was collected from Black lion Specialized hospital, Yekatit 12 Medical College hospital, Zewditu Memorial hospital, and Menilik II Referral hospital. The majority of the participants (56.5%) were female. The age of the respondents ranged from 10 to 18 years with a mean age of 13.64 years. About 51% were found within the age group of 15 to 18 years. Of the total respondents, about 63.3% had primary level (1–8 grade) of education (Table 1).

Medical Characteristics of Adolescents with Type 1 Diabetes

Out of the total 414 respondents, 227 (54.8%) of the total participants were living with diabetes for at least 6 years and 247 (59.7%) of the total participants were receiving insulin injections for a duration of at most 5 years. All of the

Table 1 Distribution of Socio-Demographic Characteristics of Adolescents with Type 1 Diabetes in Selected Public Hospitals in Addis Ababa, March to April 2021 (n=414)

Characteristics	Categories	Frequency(n=414)	Percentage (%)
Age Category	10 to 14 years	203	49.0
	15 to 18 years	211	51.0
Sex	Male	180	43.5
	Female	234	56.5
Educational status	Unable to read and write	42	10.1
	Primary level (1–8 grade)	262	63.3
	Secondary level (9–12 grade)	101	24.4

Abbreviation: n, the total number of participants.

participants were on insulin injection with the mean duration of receiving insulin medication 4.86 years. The mean time since diagnosis with the disease was 5.7 years and 79.7% of the total participants were diagnosed with diabetes after the age of 6. The majority of the participants (99%) had no comorbidities and Hypertension was found to be the only comorbidity that was reported in this study (Table 2).

Level of Adherence to Diabetes Self-Management

The overall prevalence of good adherence to diabetes self-management for the participants was 47.3% (196 participants) and the prevalence of total poor adherence to diabetes self-management was 52.7% (218 participants) CI:95% (0.47, 0.57). The prevalence of poor adherence to insulin administration, dietary management, management of hypoglycemia, blood glucose testing, and regulation of exercise was 56.8% (235 participants), 68.4% (283 participants), 42% (174 participants), 54.8% (227 participants) and 50.5% (209 participants) respectively.

Factors Associated with Adherence to Diabetes Self-Management

Both bi-variable and multivariable logistic regression analyses were implemented to determine the factors that were associated with diabetes self-management. Ten variables were entered into bi-variable logistic regression. Then nine variables were transferred to multivariable logistic regression based on a p-value of >0.2. After controlling possible confounding effects of other covariates, Adolescents' knowledge about type 1 diabetes, age, time since diagnosis of the

Table 2 Distribution of Medical Characteristics of Adolescents with T1D in Selected Public Hospitals in Addis Ababa, March to April 2021 (n=414)

Characteristics	Categories	Frequency(n=414)	Percentage (%)
Time since diagnosis of T1D	1 to 5 years	187	45.2
	6years and above	227	54.8
Age at diagnosis with T1D	1 to 5 years	84	20.3
	6 years and above	330	79.7
Duration of taking insulin medications	1 to 5 years	247	59.7
	6 years and above	167	40.3
Comorbidities	Yes	2	0.5
	No	412	99.5

Abbreviations: n, the total number of participants; T1D, type 1 diabetes.

disease, self-efficacy, and social support were found to be significantly associated with adherence to overall diabetes self-management.

Adolescents who had social support were more adherent to overall diabetes self-management than those who had no social support (AOR=4.6, 95% CI: 1.5–13.5, P=0.006). Similarly, the participants with good self-efficacy were more adherent to overall diabetes self-management than those who had poor self-efficacy (AOR=8.7, 95% CI: 1.9–14.1, P=0.005).

Moreover, the adolescents with a shorter duration of time since diagnosis of T1D had more adherent to overall diabetes self-management than those who had a longer duration of time since diagnosis (AOR=0.1, 95% CI:0.02–0.2, P=0.001). Likewise, participants with age below 14years were more adherent to overall diabetes self-management than those with age above 15years (AOR=0.14, 95% CI:0.1–0.4, P=0.001).

Furthermore, the adolescents with good knowledge about type 1 diabetes were more adherent to overall diabetes self-management than those with poor knowledge (AOR=9.046, 95% CI: 3.83–13.5, P=0.000). Likewise, adolescents with moderate knowledge about type 1 diabetes were more adherent to overall diabetes self-management than those with poor knowledge (AOR=6.763, 95% CI: 2.186–12.921, P=0.001) (Figure 1).

Whereas, the adolescent's educational status, level of education, duration of taking insulin, gender, and age of diagnosis were not associated with adherence to overall diabetes self-management (Table 3).

Discussion
Adherence to Diabetes Self-Management
Overall ADSM in adolescents with T1D is the process of developing understanding by learning to live with the complex nature of the disease in the social context. This study aimed to determine the level of ADSM and associated factors among adolescents with T1D in four diabetic clinics in Addis Ababa, Ethiopia. Few studies had been performed to measure adherence to diabetes self-management, especially relating to the five domains of ADSM (adherence to insulin administration, dietary management, management of hypoglycemia, blood glucose testing, and exercise) in adolescents.[6,9,12,30]

This study reported overall ADSM among adolescents with T1D was poor in 52.7% of the participants. This level of poor ADSM was higher than what has been reported in Iraq.[30] This difference in the level of adherence could be due to the difference in tools that were used in the study. However, when compared to what has been reported in Palestine and Cameroon[9,12] the finding from this study was a better report. This discrepancy could be explained by methodological factors where there was a difference in study design, sample size, and tool that was used to collect data.
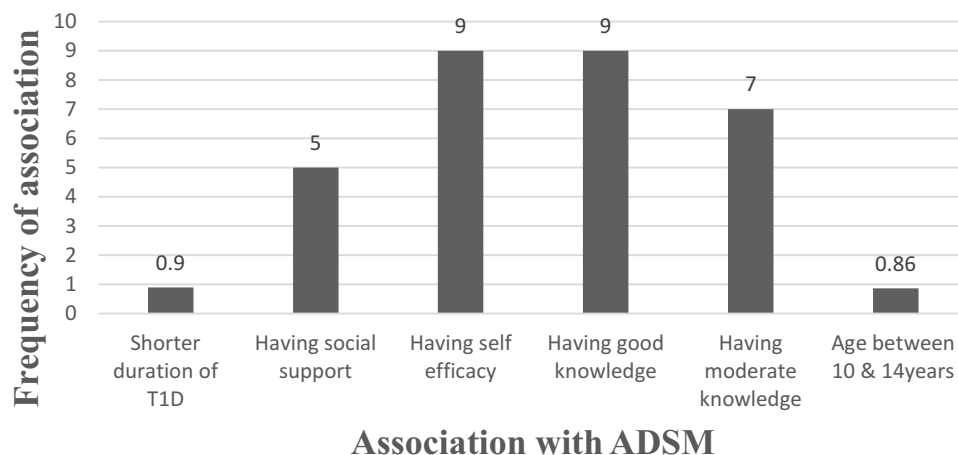

Figure 1 Frequency of factors associated with overall adherence to diabetes self-management in multivariable analysis model among adolescents with type 1 diabetes in Addis Ababa Public hospitals, March to April 2021(n=414).
Abbreviations: ADSM, Adherence to diabetes self-management; T1D, Type 1 diabetes.

Table 3 Factors Associated with Overall Adherence to Diabetes Self-Management in Multivariable Analysis Model Among Adolescents with Type 1 Diabetes in Addis Ababa Public Hospitals, March to April 2021 (n=414)

Variables	Poor Adherence	Good Adherence	COR (95% CI)	P-value	AOR (95% CI)	P-value
Time since diagnosis of T1D						
1 to 5 years	24	163	1		1	
6years and above	194	33	0.03 (0.02, 0.04)	0.000	0.1 (0.02, 0.2)*	0.001
Participant's age						
10–14 years	60	143	1		1	
15–18 years	158	53	0.14 (0.09, 0.2)	0.000	0.2 (0.1, 0.4)*	0.001
Social Support						
No	131	24	1		1	
Yes	87	172	10.8 (6.5, 17.9)	0.000	4.6 (1.5, 13.5)*	0.006
Self-efficacy						
Poor	111	10	1		1	
Good	107	186	19.3 (9.7, 38.4)	0.000	8.7 (1.9, 14.1)*	0.005
Knowledge about T1D						
Poor knowledge	170	39	1		1	
Moderate knowledge	39	95	9.5 (5.7, 15.9)	0.030	6.76 (2.19, 12.92)*	0.001
Good knowledge	9	62	34.9 (16, 75.7)	0.000	9.05 (3.83, 13.5)*	0.000

Note: *P-value is significant at P<0.05.
Abbreviations: n, the total number of participants. T1D, type 1 diabetes; CI, confidence interval; COR, crude odds ratio; AOR, adjusted odds ratio; 1=Reference.

Factors Associated with Adherence to Diabetes Self-Management

ADSM was significantly associated with age, time since diagnosis, knowledge about T1D, self-efficacy, and social support. The report from this study concluded that participants with age between 10 and 14 were 80% more adherent to diabetes self-management than those with age between 15 and 18. This finding was consistent with the study conducted by Oxford University and Tanzania.[25,31] The reason why adherence decreases as age increases could be due to the fall in social support as the age of the participant increases. Thus, education on ADSM should be provided for all adolescents with T1D, especially for those between 15 and 18 years.

Similarly, the adolescents with a shorter time since diagnosis of T1D had better adherence to diabetes self-management than adolescents with a longer time since diagnosis. This report was the same finding as to the studies from Tanzania and America[25,32] but contradicted with the study from Cameroon and Britain.[12,26] The reasons for poor adherence in a patient with a longer time since diagnosis of T1D could be as the time since diagnosis increases the patients get bored with the diseases process which in turn decreases adherence.

Moreover, adolescents with good knowledge about T1D had better ADSM than adolescents with poor knowledge. Likewise, adolescents with moderate knowledge about T1D were better at ADSM than adolescents with poor knowledge. Previous studies also showed that greater adolescents' knowledge predicts better ADSM.[33] This could be due to the adolescents with poor knowledge about the disease are less complaint to their self-management; which will cause poor ADSM.

Furthermore, respondents who had good self-efficacy were better at ADSM than patients who had poor self-efficacy, since they have higher self-esteem to control their disease. Several studies also reported that self-efficacy is the significant determinant factor for successful ADSM.[34–36]

Finally, respondents who had social support (both family and friends support) manifest more adherent than those with no social support. The reason may be respondents who had good social support would share their concerns and burdens. Reports from different countries also found that lack of social support was significantly associated with low quality of life and poor ADSM.[6,37]

Although studies from different parts of the world revealed that the presence of co-morbidities has a significant association with poor ADSM[38,39] the findings from this study do not indicate any association. Likewise, the finding from this study report showed that there was no significant association between ADSM and educational status. This report contradicts a study from Cameroon which revealed that adolescents with the educational status of tertiary level (College/University) were 30% more adherent than those who cannot read and write.[12] Similarly, there was no significant association between the duration of taking insulin medication and ADSM.

Moreover, there is no significant relationship between the gender of the participants and the level of ADSM among adolescents with T1D; which was the same finding with a study conducted in Australia.[40] Whereas this finding contradicted the report from Britain, which revealed that females showed 1.05 times good ADSM than males.[26]

Strengths and Limitations
Strengths
This study considered five domains of ADSM; adherence to the regulation of exercise, insulin administration, dietary management, blood glucose testing, and management of hypoglycemia, which were mostly studied separately in other studies. The study also included important influencing factors like adolescents' knowledge about T1D, self-efficacy, and social support. Furthermore, the data was collected by kobo collect software, which saves time and enhances the quality of the data. Finally, the findings of this study could be generalized to adolescents who were attending diabetes follow up at public health hospitals in Addis Ababa.

Limitations
This study did not include adolescents living with diabetes who were attending follow up in private health facilities. Next, the data on diabetes self-management was also collected through self-reporting methods which may cause recall and social desirability biases and hence, may lead to overestimation of the results. The cross-sectional nature of the data also made it impossible to reach the causal relationship between the different independent variables and ADSM. Finally, the absence of national guidelines on ADSM among adolescents, limits this study to focus on foreign countries' guidelines.

Conclusions and Recommendations
Conclusions
This study assessed ADSM and associated factors among adolescents living with T1D. Around 52.7% of adolescents who participated in this study had poor ADSM. In particular, the management of the hypoglycemia domain of ADSM was very poor and relatively there was a good dietary management domain of ADSM. Good knowledge about T1D, moderate knowledge about T1D, Age between 10 and 14, shorter time since diagnosis of T1D, having self-efficacy and having social support was significantly and positively associated with ADSM.

Recommendations
This study revealed that there was a need to improve ADSM in adolescents with T1D. We wish to recommend Addis Ababa health bureaus and health institutions prepare a waiting area at which information on self-management will be given to adolescents with T1D. And also, to prepare advertisements on ADSM using mass media like television, radio, Facebook, and the like. We wish to recommend the ministry of health prepare a comprehensive guideline of ADSM.

The health care providers should provide age-specific education both separately and with the family of the adolescents on ADSM. They should also, prepare care plans that can increase adolescents' knowledge about ADSM.

It is also recommended to increase the frequency of follow-up visits in diabetic clinics to have good adherence and to minimize the complication of the disease.

The researchers should do further study by including private health institutions to increase the representativeness of the study with emphasis on the impact of interventions targeting those subgroups noted to be at higher risk of poor ADSM.

Abbreviations

ADSM, Adherence to diabetes self-management; AOR, Adjusted Odd Ratio; COR, Crude Odd Ratio, DKA, Diabetic Ketoacidosis; DKT, Diabetic Knowledge test; DSMP-SR, Diabetes Self-Management Profile Self report; T1D, Type 1 Diabetes.

Data Sharing Statement

All related data have been presented within the manuscript. The data set supporting the conclusion of this article is available from the corresponding author upon reasonable request.

Ethical Consideration

To get ethical approval for this study, a letter was written by Addis Ababa University, College of Medicine and Health Sciences to the Addis Ababa Public Health Research and Emergency Management Directorate. Then Ethical approval was obtained from the Addis Ababa Public Health Research and Emergency Management Directorate (Ref.No: A/A/H/ 7534/227). Finally, a formal letter was written to the respective health offices and study facilities before going for data collection.

Written assent along with parental written consent was obtained from all subjects before the study. Participants and their parents were briefed about the objectives and aims of the study in detail. Participants were informed that their participation is purely voluntary and assured of the confidentiality of all information. Confidentiality of the data was assured throughout the study. Moreover, there are no invasive procedures in this study and it was conducted following the declaration of Helsinki.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agreed to be accountable for all aspects of the work.

Disclosure

The authors declare that they have no conflicts of interest for this work.

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