



ADDIS ABABA UNIVERSITY

COLLEGE OF HEALTH SCIENCES

SCHOOL OF PUBLIC HEALTH

**ARTS-BASED APPROACH TO IMPROVE CHILDREN'S KNOWLEDGE
OF HYPERTENSION AND DIABETES IN ADDIS ABABA, ETHIOPIA**

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Arts-Based Approach to Improve Children's Knowledge of Hypertension and
Diabetes in Addis Ababa, Ethiopia

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Acronyms/Abbreviations

AAU - Addis Ababa University

DM - Diabetes

CVD – Cardiovascular disease

FGDs - Focus group discussions

GATS - Global Adult Tobacco Survey

HIC - High-income countries

HTN - Hypertension

LMIC - Low and middle income countries

NCDs - Non-communicable diseases

SDGs - Sustainable Development Goals

SPSS - Statistical Package for Social Science

SRH – Sexual and Reproductive Health

THET - Tropical Health and Education Trust

WHO - World Health Organization

Abstract

Background: Non-communicable diseases (NCDs) are a global public health challenge. In Ethiopia, NCDs accounted for 46% of total deaths in 2023. Despite this burden, inadequate knowledge about NCDs contributes to late diagnosis and poor treatment outcomes. Although effective health education intervention is believed to improve early diagnosis and treatment of NCDs, there is limitation in reaching to the public with appropriate information and channel. This study aims to bridge this gap by evaluating the effectiveness of storybooks as a health education tool to improve knowledge about hypertension and diabetes among school children, while also exploring areas of improvement of the storybooks.

Methods: This study employed a sequential mixed method design. The study was conducted from January 2025 to March 2025 in two primary schools in Nifas Silk Lafto sub-city, Addis Ababa. For quantitative part, pre-post study design was conducted with 449 randomly selected students aged 12-19 years. Self-administered structured questionnaire was adapted from previously published research and used to measure the knowledge of children regarding hypertension and diabetes before and after disseminating the storybooks. The data were entered in to Epi-Data version 3.1 and analyzed using SPSS version 26. Paired t-test was used to compare the mean knowledge score of children before and after the intervention. A p-value less 0.05 considered statistically significant. For qualitative part, eight focus group discussions were conducted to explore areas of storybook improvement. The data were transcribed verbatim, translated in to English and coded, then thematic analysis was done, which was facilitated by MAXQDA-24.

Result: The overall mean knowledge score increased from 10.41 ± 5.50 to 14.48 ± 5.24 for hypertension and 12.02 ± 5.19 to 14.32 ± 4.84 for diabetes at end-line ($P < 0.001$). Knowledge gain was varied significantly by grade level ($P = 0.025$). The key areas for improvement of the storybooks that children suggested include simplifying the vocabulary, enhancing visual quality with brighter images, larger fonts, and increased line spacing as well as including more detailed health information.

Conclusion: Storybooks are an effective tool for improving children's knowledge of hypertension and diabetes. Health messages should be presented in simple, easily understandable and visually

attractive way. Future interventions should focus on refining these storybooks and expanding their distribution to improve health outcomes.

Key words: Arts-based approaches, School children, Knowledge, Hypertension, Diabetes

1. Introduction

1.1 Background

Non-communicable diseases (NCDs) are chronic diseases that have longer duration, not transmittable from person to person. These include cardiovascular diseases (CVDs), cancers, chronic respiratory diseases, diabetes, chronic kidney disease, mental illness and neurological conditions (1). In 2021, NCDs attributed to 75% of all deaths globally and 82% of premature deaths (before reaching the age of 70 years) in low-and-middle income countries (2).

Among NCDs, hypertension and diabetes are the two most prevalent chronic diseases globally. According to global statistical reports, 1.4 billion people had hypertension and 422 million individuals were living with diabetes at the end of 2016 (3). A systematic review and meta-analysis studies showed that in Ethiopia, the overall prevalence of hypertension and diabetes was 21.81% and 3.3% in 2021, respectively (4, 5). Nearly 3/4th of the premature deaths occurring in adulthood are the result of unhealthy behaviors initiated during childhood or adolescence (6). Even if there is lack of evidence in prevalence of hypertension among children since it is diagnosed later in adulthood, the estimated prevalence of diabetes among children aged 0–19 years old is 2.4 per 100,000 per year (7).

Hypertension and diabetes share common risk factors such as being overweight or obese, having a sedentary lifestyle, unhealthy diet, chronic stress, poor sleep habits, smoking and excessive alcohol consumption (8). They also shared common comorbidities and complications, such as stroke, cardiovascular disease, chronic kidney disease, and retinopathy (9-11).

Sustainable Development Goal (SDG) 3.4 targeted to reduce by one third premature mortality from NCDs through prevention and treatment by 2030 (12). As a result, the Ethiopia Ministry of Health (MOH) developed the National Strategic Plan for prevention and control of NCDs to reduce the burden of NCDs by promoting healthy lifestyles and reducing common risk factors (13). In light of this, the Ethiopia National Health Promotion Strategic Plan (2021/2–2025/6) emphasized that without increased public knowledge and behavior change health improvements in the country would not be achievable (14). A lack of knowledge about NCDs and their risk factors creates significant barriers to effective prevention and may increase the prevalence of these diseases; hence, raising children's knowledge of NCDs is crucial to finding a solution to this problem.

1.2 Statement of the problem

Since most NCDs are asymptomatic in early stages, people do not seek care (15). Only some people were checked for common NCDs in 2020 as Ethiopian health sector transformation plan yearly performance report described (16). The pooled prevalence of undiagnosed hypertension and diabetes in Ethiopia was 21% and 5.68%, respectively in 2023 (17, 18).

A study showed that there is poor treatment adherence and frequent loss to follow-up among NCD patients (19). About 42% of hypertensive patients defaulted from clinic attendance during the 30 month follow-up period and 47.5% of individuals were lost after being diagnosed with diabetes (20, 21). Regarding treatment adherence, studies showed that the level of non-adherence to anti-hypertensive drugs was between ranges between 24.9% and 38.2% (22, 23) and it is 31.41% for anti-diabetic medications (24). The reasons for those poor treatment adherence and follow-up is preference for traditional treatments, lack of knowledge, lack of health information, distance from the health facility, associated costs and misunderstanding of NCD management (19).

Currently, hypertension and diabetes are becoming common among adolescents due to unhealthy lifestyle choices (25, 26). Even though they are mostly diagnosed at later age, the disease progress starts much earlier than its time of diagnosis which is at young age. Therefore, there is a need to take preventive measures, such as awareness raising and early screening at young age (27).

Well-designed community-based educational initiatives positively influence knowledge, attitudes, behaviors, and health outcomes related to NCDs; however, cultural barriers, participant retention and engagement difficulties influenced program acceptance and adherence (28). Thus, art-based approaches can help to understand how local knowledge and attitudes towards NCDs affect health behaviors (29). Art is a bridge between culture and health that can improve everyone's life (30). Arts encompass a wide variety of forms including theatre, song, story-telling, dancing, and circus. Thus, arts can be integrated into health systems to supplement NCD prevention and treatment (30). However, in Sub-Saharan Africa, arts-based approaches to health promotion have yet to be widely applied by researchers outside of HIV/AIDS (31). Having this insight, this study aimed at using one of the arts-based approach which is storybook to improve children's knowledge of hypertension and diabetes.

1.3 Significance of the study

Storybooks are one of the art-based approaches that can communicate health messages in to a form which can be easily understood, accepted and put into action by the intended audience. Storybooks can motivate and encourage children in adopting a healthy lifestyle. They are also practical methods to reach parents through their children. Therefore, using storybooks is an ideal strategy to improve children knowledge on risk factors, early diagnosis, and treatment adherence of hypertension and diabetes. Since art-based approaches haven't been widely applied in the area of NCDs in Ethiopia, this study will be used as a baseline for other researches. Furthermore, it will provide a potential for planners, programmers, policy makers and researchers to use similar approaches to improve knowledge on major public health issues.

2. Literature review

2.1 Burden of Hypertension

Globally, the burden of hypertension is increasing exponentially. In 2010, an estimated 1.39 billion adults, equivalent to a prevalence of 31.1% had hypertension worldwide (32). It is projected likely to exceed 1.6 billion by 2025 (3). The number is increasing in low- and middle-income countries (LMIC) (1.04 billion) due to low economic growth, dietary change, and an aging population, while remaining stable or decreasing in high-income countries (HIC) (349 million people) (32).

Hypertension is among the leading causes of CVD such as stroke and heart disease (33). Out of 17.9 million total deaths due to CVDs in 2019, more than half (10.8 million) were from hypertension complications (34). However, according to WHO about 46% of adults with hypertension are do not know that they have hypertension, less than half of adults with hypertension (42%) are aware and on treatment and 21% of people with hypertension have their condition under control (33).

There is regional variation in hypertension prevalence in Ethiopia. The highest prevalence of hypertension observed in Addis Ababa (30.6%) and the lowest prevalence is in Afar (9.2%) (8). The prevalence was higher among males (23.21%) than females (19.62%) (4). The variation also showed among different age groups, which is 18-24 (7.1%), 25-39 (19.8%) and 40-54 (46.5%) (35). Despite this increased prevalence, the proportion of undiagnosed hypertension remained high ranging from 12.3 % to 28.8% (36, 37). There is also high prevalence of uncontrolled hypertension, which is 51% in 2023 (38).

2.2 Burden of Diabetes

The global prevalence of diabetes doubled from 7% to 14 % within 32 years from 1990 to 2024 (39). About 59% of diabetic adults did not seek or get treatment in the year of 2022, thus factoring into the increase in the people that are left untreated and 90% of those within the group of people that do not seek treatment or get treated for diabetes reside in low-and-middle-income countries (39). Among the two types of diabetes, Type 2 diabetes is the most common form of diabetes among people that are diabetic with a 90% prevalence among diabetic people (40).

A systematic review showed pooled prevalence of diabetes in Ethiopia ranged from 2% to 6.5% (41) while a meta-analysis from 2021, showed specifically the pooled prevalence of type-2 DM to be 6.5% in Ethiopia with values ranging from 2% (Tigray) to 14% (Dire Dawa) (42). Similarly, on other study in Addis Ababa, prevalence of diabetes mellitus was higher, 14.8% with sex difference in of prevalence of 18.35% in males and 16.62% in females (43).

The age-adjusted prevalence of diabetes showed a rise from 3.4% in 2011 to 4.4% in 2024 and is expected to be around 5.3% by 2050 (44). According to International Diabetes Federation (IDF) 2021 report, the estimated prevalence of diabetes among children aged 0–19 years old is 2.4 per 100,000 per year (7). However, in spite of the rising prevalence, studies carried out in different regions of Ethiopia showed that the rate of undiagnosed diabetes is even higher, ranging from 2.3 % to 14.7 % (45).

2.3 Factors associated with knowledge of hypertension and diabetes

As studies done in Iraq and Venezuela among hypertensive patients showed knowledge of hypertension was significantly associated with age, educational status, previous diagnosis of hypertension, duration since diagnosis and family history of hypertension with the group under 30 years, those of shorter diagnostic duration and lower education showed a lower level of knowledge while patients with a prior diagnosis of hypertension and those who had family history of hypertension showed a higher level of knowledge about the disease (46, 47). On the other hand, studies done in Thailand and Senegal indicated that having finished secondary school education or higher, being employed, having family history of diabetes, and getting awareness by healthcare staff were related to good diabetes knowledge (48, 49).

Studies done in Ethiopia showed poor knowledge about hypertension was observed among younger age <40 years, unmarried, illiterate and rural dwellers whereas females, respondents with family history of hypertension and those who were getting information from healthcare providers was found to be more knowledgeable than their counterparts (50-52). While knowledge of diabetes was positively associated with having primary education and above, urban residence, attending diabetes educational sessions and family history diabetes, but there are controversial findings

regarding gender with some studies showed higher knowledge among females and others among males (53, 54).

A study done regarding factors associated with knowledge of hypertension among adolescents revealed that children from urban areas, those with the higher school grades, who had had their blood pressure previously examined and those who had family history of hypertension showed good knowledge about hypertension (55). However, the research did not show any significant differences in knowledge about hypertension when taking age and sex into consideration (55). On the other hand, knowledge about diabetes among adolescents was higher among girls, those who heard about diabetes before, having family history of diabetes and among urban and semi-urban residents (56, 57).

2.4 The role of Health Communication in NCD prevention and control

Health education and communication plays an essential role in health promotion through raising awareness, altering perceptions, promoting motivation and ultimately bringing behavioral change (58, 59). Even if communication is a tool to bring behavior change, it is affected by different factors including the individual perceptions and belief, the social support system, the community norms and other structural factors (economical, political condition of a country) (60). Therefore, different communication approaches should be used that are tailored to targeted audiences.

In clinical settings and public health, behavior change communication (BCC) is essential for the prevention of both communicable and non-communicable diseases (61). Research indicate that effective health communication can promote positive behavior change and help to prevent chronic diseases, respiratory illnesses, HIV/AIDS, COVID-19 as well as zoonotic diseases (60, 62, 63). Despite this, a study done in Bahir Dar showed there are poor health communication practices in preventing and controlling NCDs (64).

2.5 Art-based approaches to raise community knowledge

Nowadays art-based methods are largely employed within health research (65). They consist of visual arts (like photography, video animations, digital media, drawing, paintings, sculpture), performing arts (theater, storytelling through audio dramas) and written narratives (66, 67). Among

such narratives are an effective means of health message delivery and appealing for audiences (68).

The research findings showed arts humanize, simplify and empower health communication. Target audiences can be drawn in and engaged by the arts, which can also lessen hierarchical divisions and tensions that can hinder communication between community members and health professionals. Moreover, the arts can communicate at an emotional and culturally relevant way that allows concepts to be embodied and made actionable (69).

A study carried out on exploring arts-based interventions for prevention of substance use among youth reported that they can empower young people in prevention of drug use by engaging them (70). Another study indicated that arts-based health education programs able to effectively involve young people in prevention of sexually transmitted disease (STD), HIV/AIDS and hepatitis (71).

A scoping review done in Sub-Saharan Africa showed arts-based approaches have been widely used in communicable disease research, particularly HIV/AIDS, Ebola and Malaria, but are still underutilized in NCD research (31). The arts-based participatory workshops conducted in Tanzania and Malawi indicated art-based approaches as a novel method to inform development of culturally appropriate NCD prevention strategies (29).

2.6 Children's health literacy

Health literacy among children is an understudied area in Ethiopia. There aren't many studies done on health literacy especially on younger age groups but the ones done showed limited health literacy among young students and adolescents although general literacy rate has shown an increment over the past years (72, 73). For instance, a study done among students in southwest Ethiopia showed 65% of them had limited health literacy levels for which parent's occupational status, age and grade level were major predictors (74).

Other studies done in different parts of Ethiopia showed a prevalence of 30% (Southern Ethiopia, 2023) and 25% (Oromia region, 2023) of adequate sexual and reproductive health (SRH) literacy while another study showed prevalence of 18% (Oromia region, 2021) of literacy regarding reproductive health among students (75, 76). Being female, school type, mother's and father's

occupation, family income, attending SRH topic, and SRH service use were found to be significantly associated with sexual and reproductive health literacy with many relying on internet for seeking information (75-77). Similarly, a study that assessed mental health literacy among students found that female students were more literate on mental health than males (78). However, there's limited study assessing health literacy on NCDs especially among students in Ethiopia making it even more difficult to understand level of knowledge on NCDs among students and develop appropriate and tailored interventions.

2.7 Children's storybooks to improve health

Arts-based approaches are a powerful in promoting behavior and attitude change among children (79). Lifestyle changes are effective when began at the earliest years of childhood (80). To best promote healthy behavior and adopt a healthy lifestyle in adulthood, children have to learn about risk factors, prevention and treatment of NCDs. School based interventions can reach all the children regardless of their social and cultural background (81).

Educating children also influences parents' healthy behavior through sharing the information they gained (82). A study on a school-based cardiovascular prevention program showed that children teach parents and demand changes in lifestyle of the whole family based on their beliefs taught at school (83). Parents also indicated their values, preferences, attitudes, and personal behaviors are influenced by their children (84, 85). Therefore, children are agents to bring behavior change.

Since stories play an important role in children's imagination and perception of the world, it is crucial to take this into account when working on them (86). Storybooks are suggested as a powerful educational tool to spread health information and promote wellbeing among school children, which might be an instrument to foster collective health (87).

Conceptual framework

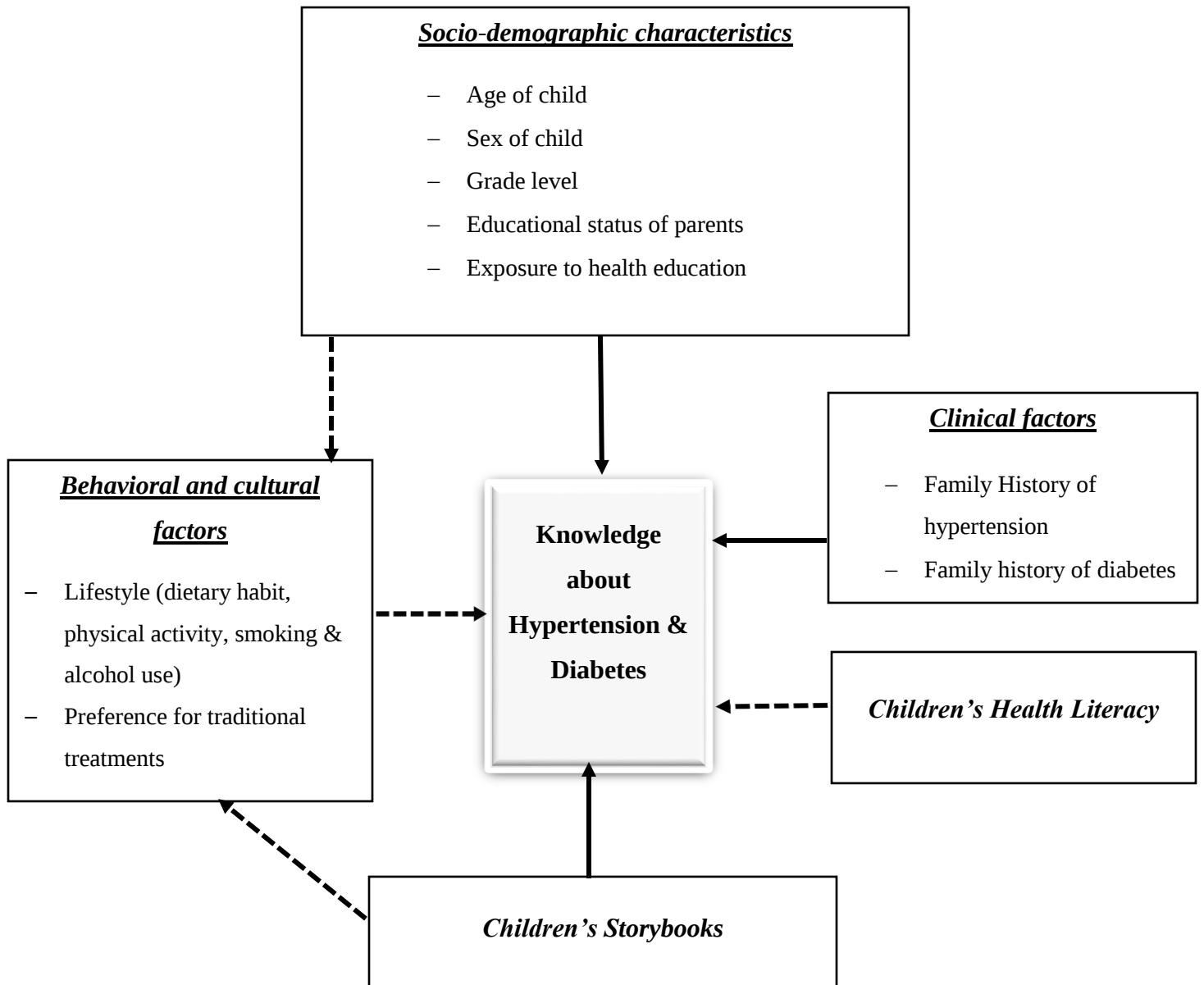


Figure 1: Conceptual framework for a study on arts-based approach to improve children knowledge of hypertension and diabetes in Addis Ababa, Ethiopia developed by reviewing different literature (87-90)

3. Objective

3.1 General objective

To evaluate the effectiveness of storybooks in improving knowledge about hypertension and diabetes among school children and to explore areas of improvement of the storybooks

3.2 Specific objectives

1. To evaluate the effectiveness of storybooks in improving knowledge about hypertension among school children
2. To evaluate the effectiveness of storybooks in improving knowledge about diabetes among school children
3. To explore areas of improvements of the storybook for improving knowledge about hypertension among school children
4. To explore areas of improvements of the storybook for improving knowledge about diabetes among school children

4. Methods

4.1 Study area and period

The study was conducted from January 2025 to March 2025 in Addis Ababa, the capital city of Ethiopia. It is sub-divided into 11 sub-cities. Nifas Silk Lafto Sub-city is one of the 11 sub-cities in Addis Ababa city administration. It covers an area of 5876.02 hectares. It is situated in the South Western part of Addis Ababa, bounded from the South by Oromia Special Zone, from the North West by Kolfe Keranio, from the East by Bole and Akaki Kality and from North by Lideta and Kirkos. At present, the sub-city is divided into 12 woredas (91). Based on the census report 2007, Nifas Silk Lafto has a total population of 316, 283 from which, 148, 984 are males and 167, 299 females (92). There are 22 primary government schools (grade 1-8) in Sub-City of Nifas Silk Lafto. Among those, 2 schools were targeted by the project. The selected schools to distribute the storybooks were Atse Zerayakob and Hawaryaw Petros primary schools.

4.2 Study design

This study employed sequential mixed method study design. The quantitative part used one group pre-post study design to compare the level of knowledge about hypertension and diabetes among school children before and after the intervention. For the qualitative part, descriptive study approach was employed to explore potential areas of improvement in the storybooks (93).

Description of the intervention/ the storybooks

Author Daniel Worku, and Artist Gebreyesus Asmare had produced two Amharic short storybooks for school children aimed at creating knowledge regarding hypertension and diabetes. The content of the storybooks was reviewed by medical doctors and public health experts during the design phase, and their comments were incorporated. Those books were based on a narrative featuring the two NCDs. Each book contains general description of the diseases, the causes and common symptoms of the diseases, treatment options and medication adherence, the complications and commonly held beliefs and myths. The two storybooks titled as follows: “Tinshua doctor”, which is about hypertension and “Zihonochun filega”, which about diabetes. The first book, “Tinshua doctor”, is divided into 6 chapters and contains 16 pages, while the second book, “Zihonochun

filega”, is also divided into 6 chapters and contains 23 pages. Each page includes colored pictures illustrating the actions of the characters described in the text below. The text is in font size 14, while the titles for each chapter are in font size 21. Each book was distributed in series. The reading time given to the children was one month for each storybook.

4.3 Study participants

Source population: The source population of this study was all school children who are grade 7 and 8 (age 12 to 19 years) living in Addis Ababa.

Study population: The study population were children who were learning in selected schools and given the storybooks.

4.4 Inclusion and exclusion criteria

Inclusion criteria: All children who had given the storybooks were included in the study.

Exclusion criteria: There was no specific exclusion criteria.

4.5 Sample size determination

For quantitative:

The sample size was determined according to double population proportion formula, using Epi Info version 7.2.6.0. Since there were no estimates available related to children’s knowledge about hypertension and diabetes, sample size was calculated assuming 50% baseline knowledge of hypertension and diabetes and a conservative increase in knowledge of 10% after the intervention. This 10% change in knowledge from baseline to end-line was used for sample size calculation. Thus, the sample size of 449 was calculated at 1.96 critical value of 95% confidence interval (CI) and 0.84 critical value at 80% power (Z_{β}),

$$n = \frac{Z_{\alpha/2} + Z_{\beta}}{(P1-P2)^2} * (P1(1-P1) + P2(1-P2))$$

$n = 408 + 10\% \text{ non-response} = 449$ (sample size before and after the intervention)

For qualitative:

For each storybook four Focus Group Discussion (FGD) sessions were conducted with each FGD contain 7 to 11 participants. Number of FGDs were adjusted until saturation reached, where there was a redundancy of information.

4.6 Sampling technique

Quantitative: The two schools in which the intervention was done, were selected conveniently since the project targeted on them. Systematic random sampling technique was applied based on students' attendance list to select the study participants.

$K = N/n$ where K = Sample interval, N = Population size, n = Sample size

$K = \frac{\text{Total number of students}}{\text{Calculated sample size}}$

$$K = \frac{672}{449} = 1.5$$

Therefore, the first person was selected randomly, then every 2nd person was selected until the desired sample size was reached.

Qualitative: Maximum variation sampling technique was employed to select respondents for Focus Group Discussions (FGDs). Students from different grades (sections) and with different age groups from both sex were included in the FGDs.

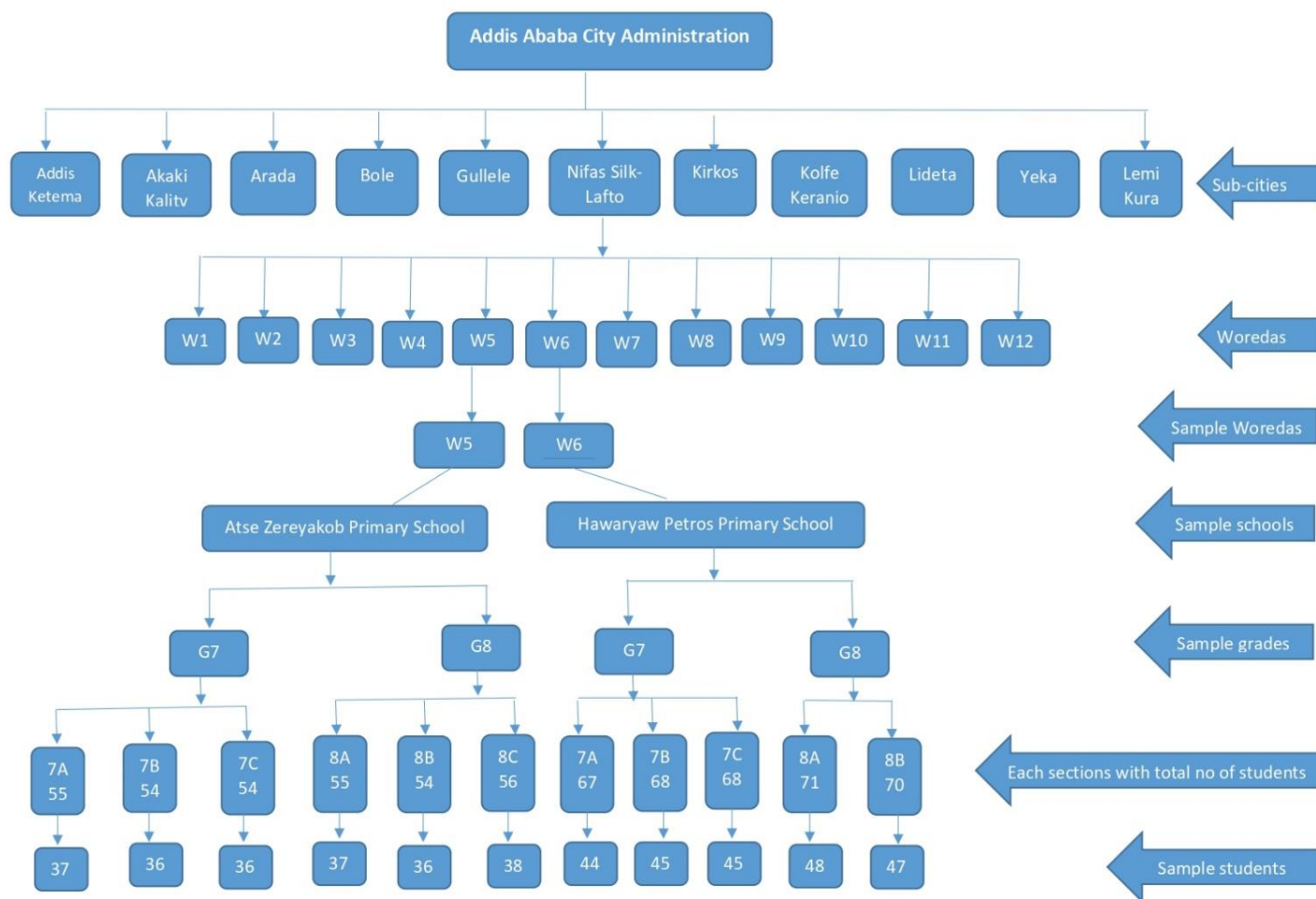


Figure 2: Schematic presentation of sampling procedure for a study on arts-based approach to improve children knowledge of hypertension and diabetes in Addis Ababa, Ethiopia

4.7 Data collection tools and procedures

Quantitative: Data were collected using questionnaire adapted from previous studies (88-90, 94, 95) and modified based on the study objectives by the investigator. The questionnaire was developed in English and translated to Amharic for data collection. Data were collected by recruited data collectors through self-administered questionnaire and it was supervised by principal investigator. The students generally assumed to have the cognitive skills to understand and respond to questions independently. Data were collected from the same students and same questionnaire

was used before and after the intervention. Each student were get special identification number during the baseline assessment and was evaluated after the intervention.

Qualitative: Data collection was conducted after each book get distributed. The data were collected through Focus Group Discussions (FGDs). Students who got the storybooks were included in the discussions. The discussion guide was prepared in English and translated to Amharic. The guide was prepared by the principal investigator based on the research objective and generally consisted of four sections. The first section was an introductory part that focused on the characters; favorites, friends or those perceived as scary characters to explore how the children engaged with the story. The second section explored how the children understood and applied the knowledge gained from the storybooks as well as the clarity of the information presented. The third section was focused on children's reaction to the storybooks. This section gathered feedback from children towards the storybooks regarding the content, writing style, illustrations and any difficulties encountered with vocabulary, missed ideas and other areas of improvements of the storybooks. The last section explored the knowledge sharing behavior of children and gathered suggestions for future distribution sites of the storybooks.

The FGDs were conducted in quiet places such as school libraries and halls. Before starting each sessions, participants were assigned codes (participant 1, participant 2, etc.) according to their seating arrangement and their socio-demographic information was collected based on these numbers. The moderator approached the participants in a friendly manner and created a comfortable environment, began the discussion with self-introduction and encouraged participants to feel free and talk openly. The discussion lasted an average of 1 hour and 9 minutes (ranging from 41min to 1:31hr) and it was flexible enough to accommodate participants' responses to questions, without limiting or interrupting them. The FGDs were moderated by the principal investigator and all the information was tape-recorded. Throughout the discussion, in addition to audio recording, moderator also took note about participants' facial expressions and other nonverbal cues. After all the questions were addressed, the moderator was asked the participants if there was anything additional they want to discuss or mention. Finally, the participants were acknowledged for their time and cooperation.

4.8 Measurement and variables

4.8.1 Measurement

The first part of each questionnaire focused on socio-demographic information that includes age, sex, grade, and religion, family history of NCDs and educational status of parents. Knowledge was the outcome variable. There were two outcome variables (knowledge about hypertension and knowledge about diabetes), which was measured independently. For each question the correct answer was coded as '1' while the wrong answer was marked as '0'.

Knowledge about hypertension was assessed by 26 items (6 items about general understanding, 4 items about symptoms, 7 items about risk factors, 4 items about treatment and 5 items about complications). Knowledge about diabetes was assessed by 26 items (3 items for definition, 5 items for risk factors, 6 items for sign and symptoms, 8 items for management and 4 items for complications). The sum of knowledge score for each disease was range between 0 and 26.

4.8.2 Study variables

Table 1: Variables associated with knowledge of hypertension and diabetes

Outcome variables	Independent variables
Knowledge about Hypertension	➤ Sociodemographic characteristics (Age, Sex, Grade, Religion and Living with parents) ➤ Family history of hypertension ➤ Educational status of parents (Educational status of mother and Educational status of father)
Knowledge about Diabetes	➤ Sociodemographic characteristics (Age, Sex, Grade, Religion) ➤ Family history of diabetes ➤ Exposure to health education regarding diabetes

4.9 Operational definitions

Knowledge: It is the level of understanding about the causes, risk factors, sign and symptoms, treatment and complications of NCDs.

Effectiveness: The storybook will be considered effective if it demonstrates a statistically significant increase in mean knowledge scores.

Evaluation: It is the process of assessing the impact of storybooks on participants' knowledge regarding hypertension and diabetes. It involves measuring participants' knowledge before and after the intervention through questionnaires.

School children: are groups belongs to adolescents whose age is between 10 and 19 (96).

Sociodemographic characteristics: such as age, sex, grade, and religion.

Family history of hypertension: A participant is considered to have a family history of hypertension if at least one of the parent or sibling has been diagnosed with hypertension (blood pressure $\geq 140/90$ mmHg) or is currently receiving treatment for hypertension (97).

Family history of diabetes: A participant is considered to have a family history of diabetes if they have a parent, brother, or sister with diagnosed with diabetes mellitus (Type 1 or Type 2), as confirmed by a healthcare provider (98).

Exposure to health education regarding diabetes: If the participant has participated in at least one organized educational session (class, seminar, or workshop) on diabetes prevention, management, or general awareness.

Storybooks: They are booklets, typically designed to transmit a health message about hypertension and diabetes.

4.10 Data quality assurance

Quantitative: Questionnaire was prepared in English and then translated to Amharic and translated back to English to observe its consistency. The questionnaire was pretested in 5% of

sample size before actual data collection. The pre-test was conducted at Netsanet Chora primary school and appropriate modification was made based on the findings. The overall Cronbach's alpha for knowledge-related questions was 0.71 and 0.77 for hypertension and diabetes respectively, suggesting acceptable consistency of the questionnaires. There was one day training to data collectors regarding the purpose of study, questionnaire, ensuring confidentiality of participants and the data collection procedure. During data collection, close supervision was made and the collected data was checked for completeness by the principal investigator.

Qualitative: To maintain trustworthiness (rigor) of the findings the following procedures were taken. In order to ensure credibility, the investigator took adequate time with study participants to build rapport. There was also triangulation of data using multiple sources. Maintaining thick description of the context and participants allowed other researchers to get deeper understanding and transferability of the study in other settings. Documenting all the study process including written informed consent, data collection methods, audio records and transcripts were kept for doing audit trial by colleagues and peers to see the objectivity and neutrality. To assure dependability, the codes and extracted categories will be presented to audit the process of data extraction and categorization. Confirmability will also be established by audit trial and the words of study participants (quotations).

4.11 Data analysis procedures

Quantitative: The data were checked for completeness, coded and entered into the computer using Epi-data Version 3.1 and after cleaning it was exported to SPSS version 26 for statistical analysis. Items that were negatively specified were inverted prior to analysis. Descriptive statistics such as frequencies and proportions were calculated at baseline and used to summarize the data.

A paired t-test was used to compare the significant differences in mean knowledge scores before and after the intervention. A p-value of <0.05 was considered to be statistically significant. Repeated measures ANOVA was conducted to compare the baseline and end-line mean knowledge scores among different socio-demographic variables i.e. age, sex, grade, religion, educational status of parents, exposure to health education and family history of hypertension and diabetes. The post hoc tests with Bonferroni correction were used for multiple comparisons. The assumption

of sphericity was checked using Mauchly's Test of Sphericity. If Mauchly's Test was significant ($p < 0.05$), indicating a violation of sphericity, the degrees of freedom were corrected using the Greenhouse-Geisser or Huynh-Feldt correction.

Qualitative: After completed the discussions, the information stored on an audio recorder was transcribed verbatim and translated into English. After the transcription, the researcher was read the transcripts repeatedly and codes were emerged inductively. The coded data was categorized based on similarities of the meanings of code. Then, theme and sub-themes were developed from categories and thematic analysis was done. Data analysis was facilitated by MAXQDA 24.

To enhance the validity and reliability of the findings, this study employed a triangulation techniques, specifically method triangulation that compare and contrast the quantitative findings with the qualitative insights. For instance, if the quantitative data showed a significant increase in knowledge scores, the qualitative data could help to understand why the storybooks were effective particularly the specific aspects of the storybooks that were engaging or informative. But, the knowledge gain might differ for each items. The FGD further explored areas of improvement in terms of the content, the design and so on. Therefore, any similarities and discrepancies between the qualitative and quantitative findings explored further more to provide a comprehensive understanding of the effectiveness of the intervention.

4.12 Ethical consideration

Ethical clearance was obtained from the Research Review Committee of School of Public Health of Addis Ababa University. All study activities was abided by basic ethical principles; respect for person's autonomy, beneficence, non-maleficence and justice. A Participant's Information Sheet and consent form were annexed and translated into the local language. The objective and importance of the study was also explained & informed consent was obtained from each participant. However, since the study participants are children, the consent was obtained from their parents or guardians. Participants who were unwilling to participate in the study & those who wanted to quit from the study at any point was informed to do so without any restriction.

4.13 Dissemination of the results

The result of this study presented to Addis Ababa University, School of Public Health as part of masters' thesis and made available to the project funder and other potentially interested organizations. Efforts will be made to publish in peer review journal and present in various seminars and workshops.

5. Results

5.1 Quantitative findings

5.1.1 Socio-demographic characteristics

A total of 449 participants were recruited for this study; among them, 414 completed the end-line assessment for hypertension, resulting in a response rate of 92.2%, while 421 completed the end-line assessment for diabetes, with a response rate of 93.7%.

The participants' mean age was 14.18 ± 1.22 years (Range 12-19); more than half of the participants were female 257 (59.1%). About half of the participants were grade 7 students 224 (51.5%). Regarding educational status of parents, about 85 (9.8%) of parents were unable to read and write. Only 82 (18.9%) of participants had a family history of hypertension and 63 (14.5%) had family history of diabetes.

Table 2: Socio-demographic characteristics of study participants at baseline (n=435)

Variable	Category	Frequency	Percent (%)
Age (in years)	12-14	299	68.7
	15-17	128	29.4
	Above 17	8	1.8
Sex	Male	178	40.9
	Female	257	59.1
Grade	Grade 7	224	51.5
	Grade 8	211	48.5
Religion	Orthodox	284	65.3
	Muslim	88	20.2

	Protestant	60	13.8
	Other	3	0.7
Living with parents	Yes	414	95.2
	No	21	4.8
Educational status of mother	Unable to read and write	62	14.3
	Primary education	161	37.0
	Secondary and preparatory	108	24.8
	Higher education	82	18.9
Educational status of father	Unable to read and write	23	5.3
	Primary education	110	25.3
	Secondary and preparatory	130	29.9
	Higher education	144	33.1
Exposure to health education regarding diabetes	Yes	64	14.7
	No	371	85.3
Family history of hypertension	Yes	82	18.9
	No	353	81.1
Family history of diabetes	Yes	63	14.5
	No	372	85.5

5.1.2 Hypertension and diabetes knowledge scores at baseline and end-line

The baseline and end-line survey findings showed a generally positive trend in the knowledge change regarding hypertension and diabetes among participants. The overall mean knowledge scores for hypertension and diabetes increased from 10.41 to 14.48 and 12.02 to 14.32, respectively. Each items showed different levels of improvement as described in Table 3 and Table 4 below.

Table 3: Comparison between baseline and end-line knowledge scores regarding hypertension

S/N	Items	Number of items	Baseline		End-line	
			Mean $\pm$ SD	Min, Max values	Mean $\pm$ SD	Min, Max values
1	General understanding	6	2.43 $\pm$ 1.51	(0, 6)	3.01 $\pm$ 1.45	(0, 6)
2	Sign and symptoms	4	1.67 $\pm$ 1.33	(0, 4)	2.40 $\pm$ 1.26	(0, 4)
3	Risk factors	7	2.22 $\pm$ 1.95	(0, 7)	3.43 $\pm$ 2.14	(0, 7)
4	Treatment	4	2.43 $\pm$ 1.30	(0,4)	3.10 $\pm$ 0.99	(0,4)
5	Complications	5	1.66 $\pm$ 1.41	(0,5)	2.53 $\pm$ 1.63	(0,5)
6	Overall knowledge	26	10.41 $\pm$ 5.50	(0,23)	14.48 $\pm$ 5.24	(4,25)

Table 4: Comparison between baseline and end-line knowledge score regarding diabetes

S/N	Items	Number of items	Baseline		End-line	
			Mean $\pm$ SD	Min, Max values	Mean $\pm$ SD	Min, Max values
1	General understanding	3	1.29 $\pm$ 0.87	(0, 3)	1.50 $\pm$ 0.87	(0, 3)
2	Sign and symptoms	6	2.18 $\pm$ 1.83	(0, 6)	2.75 $\pm$ 1.79	(0, 6)
3	Risk factors	5	2.27 $\pm$ 1.57	(0, 5)	2.70 $\pm$ 1.43	(0, 5)
4	Management and control	4	3.47 $\pm$ 0.99	(0,4)	3.57 $\pm$ 0.85	(0,4)
5	Complications	4	1.08 $\pm$ 1.14	(0,4)	1.60 $\pm$ 1.29	(0,4)
6	Hypoglycemia and its management	4	1.74 $\pm$ 1.26	(0,4)	2.19 $\pm$ 1.24	(0,4)
7	Overall knowledge	26	12.02 $\pm$ 5.19	(0,25)	14.32 $\pm$ 4.84	(3,26)

5.1.3 The effect of using storybooks in improving knowledge regarding hypertension and diabetes

The statistical paired t-value for overall knowledge score was found as 16.209 (P-value <0.0001, d = 0.79) and 9.404 (P-value <0.0001, d = 0.42) for hypertension and diabetes respectively. This emphasizes that the difference between end-line and baseline and knowledge score was found to be statistically significant. The effect size (d) indicates moderate to large impact of a storybook intervention in improving knowledge.

Table 5: Effect of storybooks in improving knowledge regarding hypertension and diabetes

	Knowledge score	Mean $\pm$ SD	Paired Differences		t-value	Effect size (d)	P-value
			Mean difference (95% CI)	SD			
Hypertension	Baseline	10.41 $\pm$ 5.504	4.070 (3.576, 4.564)	5.109	16.209	0.79	<0.0001
	End-line	14.48 $\pm$ 5.244					
Diabetes	Baseline	12.02 $\pm$ 5.19	2.299 (1.819, 2.780)	5.017	9.404	0.42	<0.0001
	End-line	14.32 $\pm$ 4.84					

5.1.4 Effect of storybooks in improving knowledge regarding hypertension according to socio-demographic characteristics of participants

A repeated measures ANOVA showed a significant association between knowledge scores of hypertension and grade (P = 0.025). A mean difference of grade 8 children (M=4.66, SD=5.22) was higher than those of grade 7 children (M=3.53, SD=4.96). However, there was no significant association between mean knowledge scores and other socio-demographic variables as shown in the table 6 below.

Table 6: Repeated measures ANOVA results for knowledge scores of hypertension across various socio-demographic characteristics (n= 414)

Variables	Baseline	End-line	N	Within subjects effect
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					P-value**	P-value***
Grade	Grade 7	10.31 ± 5.17	13.84 ± 5.23	217	<0.0001	0.025
	Grade 8	10.52 ± 5.86	15.18 ± 5.17	197		
Age	12-14	10.33 ± 5.46	14.10 ± 5.29	289	<0.0001	0.158
	15-17	10.89 ± 5.59	15.73 ± 4.80	117		
	Above 17	6.38 ± 4.37	10.00 ± 5.68	8		
Sex	Male	9.84 ± 5.89	14.42 ± 5.66	165	<0.0001	0.093
	Female	10.79 ± 5.21	14.52 ± 4.95	249		
Religion	Orthodox	10.40 ± 5.46	14.67 ± 5.19	271	<0.0001	0.703
	Muslim	10.42 ± 5.24	14.12 ± 5.23	83		
	Protestant	10.33 ± 6.22	14.09 ± 5.62	57		
	Other	12.33 ± 3.51	14.67 ± 3.78	3		
Educational Status of Mother	Unable to read and write	10.02 ± 5.81	14.25 ± 5.81	80	<0.0001	0.460
	Primary Education	9.94 ± 5.17	14.40 ± 5.07	156		
	Secondary and preparatory	11.21 ± 5.60	15.07 ± 4.96	100		
	Higher Education	10.73 ± 5.64	14.12 ± 5.35	78		
Educational Status of Father	Unable to read and write	10.16 ± 5.47	13.16 ± 5.26	50	<0.0001	0.272

	Primary Education	10.17 ± 5.00	14.83 ± 5.30	105		
	Secondary and preparatory	10.88 ± 5.82	15.11 ± 5.18	123		
	Higher Education	10.26 ± 5.61	14.13 ± 5.18	136		
Family history of hypertension	Yes	10.79 ± 5.35	15.62 ± 5.52	81	<0.0001	0.137
	No	10.32 ± 5.54	14.20 ± 5.14	333		

* Reported as Mean ± SD, ** Significant value < 0.05 for change between baseline and end-line knowledge scores only, *** Significant value < 0.05 for change in mean knowledge scores among socio-demographic variables

5.1.5 Effect of storybooks in improving knowledge regarding diabetes according to socio-demographic characteristics of participants

A repeated measures ANOVA showed a significant association between knowledge scores of diabetes and religion ($P = 0.012$). Since the association between knowledge score and religion was significant, post-hoc tests were conducted to determine which specific groups differed significantly from each other. All p-values are 1.000, indicating that there are no significant differences between the categories. There was no significant association between mean knowledge scores and other socio-demographic variables as indicated in table 7.

Table 7: Repeated measures ANOVA results for knowledge scores of diabetes across various socio-demographic characteristics (n=421)

Variables	Baseline	End-line	n	Within subjects effect	
				P-value**	P-value***

Age	12-14	12.01 ± 5.24	14.23 ± 4.97	283	<0.0001	0.881
	15-17	12.08 ± 5.15	14.52 ± 4.64	132		
	Above 17	11.50 ± 4.72	14.33 ± 3.26	6		
Sex	Male	10.90 ± 5.29	13.50 ± 4.82	170	<0.0001	0.312
	Female	12.78 ± 5.00	14.88 ± 4.78	251		
Grade	Grade 7	11.72 ± 5.11	14.00 ± 4.84	218	<0.0001	0.934
	Grade 8	12.34 ± 5.28	14.66 ± 4.83	203		
Religion	Orthodox	12.04 ± 5.18	14.36 ± 4.71	278	0.141	0.012
	Muslim	11.62 ± 5.23	14.92 ± 4.46	84		
	Protestant	12.31 ± 5.18	13.35 ± 5.75	55		
	Other	15.00 ± 6.68	12.25 ± 7.18	4		
Exposure to health education regarding diabetes	Yes	13.30 ± 4.98	15.02 ± 4.59	63	<0.0001	0.316
	No	11.80 ± 5.21	14.20 ± 4.88	358		
Family history of diabetes	Yes	13.63 ± 5.05	15.81 ± 5.05	62	<0.0001	0.836
	No	11.74 ± 5.18	14.06 ± 4.77	359		

* Reported as Mean ± SD, ** Significant value < 0.05 for change between baseline and end-line knowledge scores only, *** Significant value < 0.05 for change in mean knowledge scores among socio-demographic variables

5.2 Qualitative findings

5.2.1 Socio-demographic characteristics

A total of Eight Focus Group Discussions were conducted (4 FGDs for each storybook). Each FGD group composed of 7-11 participants. About half of the participants were grade 7 students (52.6%) and more than half were female students (63.2%). The mean age of the participants was 14.5 years (SD = 1.87; range = 12-17 years). One major theme (feedback towards the storybooks) and 7 sub-themes were emerged from the analysis of the FGD data.

5.2.2 Feedback towards the storybooks

5.2.2.1 Clarity and Comprehensibility

Most of the participants expressed positive feedback about the storybook. They appreciated that the health messages about hypertension and diabetes were simple and easy to understand. The narrative style was also engaging and facilitated learning.

“The message conveyed in the Little Doctor book was very simple and easy to understand. And it was written in a way that we could learn from it easily.” (FGD 2 HTN: A 14yr female, grade 8)

*“It was clear to understand. As I read one page, I was imagining what the next page would be.”
(FGD 3 DM: 14yr male, grade 7)*

However, several participants struggled with understanding certain texts due to the presence of difficult/unfamiliar words and complex vocabularies, particularly in the first storybook.

“...but in some sections, it is written in local words and it may be difficult for a person who does not understand local words to understand it. And if this is written in common Amharic words, it may be more understandable or interesting.” (FGD 2 HTN: A 14yr female, grade 8)

They suggested practical solutions to improve comprehension, such as simplifying the language, using more common terms, and providing a glossary or footnotes to explain those difficult words.

“There were difficult words. It would be good if they were numbered and explained at the bottom like a footnote. (FGD 4 HTN: 13yr male, grade 7)

5.2.2.2 Emotional Connection

Participants showed emotional connection to characters of the storybooks that supported them in understanding the health message. Participants showed favorable feeling towards characters that support their families in management and control of hypertension and diabetes as well as creating awareness among the community. While others expressed their empathy and concern for those characters who were facing health problems. This demonstrates a deeper engagement with the narratives.

“I like two characters; the little Doctor and Martha. Because Martha give care for her father and aware of the disease. The little Doctor also made efforts to protect the community from disease.” (FGD 2 DM: 14yr female, grade 8)

“I was afraid of Aster's mother; I was afraid of her...because she was really sick, she would die or because the people did not understand Aster, she would have gone and died without getting the treatment.” (FGD 1 HTN: 13yr female, grade 7)

Furthermore, participants noted that the stories were similar to what happens around them and accurately reflect a real challenges faced by the community.

5.2.2.3 Appearance

Most of the participants were told that the pictures included in the storybook were interesting and descriptive. The cover design was also perceived as attractive and inviting to read the books. Generally, they highlighted the importance of illustrations in making the complex health information easier to understand for the reader. Moreover regarding the text, participants appreciated the writing style and presentation of the story section by section.

“If people get this book, even if they are not that active readers, they will understand it by looking at the pictures. The pictures explain the essence of the story. So they can understand the idea from the pictures.” (FGD 3 HTN: A 13yr female, grade 8)

“It is interesting. It is interesting the way it is written part by part. It is short, but it is interesting.” (FGD 2 HTN: 14yr male, grade 8)

While the participants appreciated the illustration and the text layout, they were also provide constructive feedbacks to improve the quality of the storybooks. One of the suggestion was on improving the image quality and the other was on increasing the spacing between lines and using larger font sizes to enhance readability.

“It's cool if the image is a little bright. It's also a bit blurry, and it would be good if it were edited.” (FGD 4 HTN: 15yr female, grade 8)

“The texts are very closely together and if written a little further apart, I mean there should be a gap in between.” (FGD 1 HTN: 15yr female, grade 7)

5.2.2.4 The content

Participants highlighted that the storybooks were comprehensive and described the diseases through character's experience. They appreciated the in-depth explanations of the diseases. The storybooks not only inform the readers, but also empowered them to make healthy lifestyle choices and to support others too.

“Compared to other books, this one is written in detail; the others are just superficial. For example, about blood pressure, we are given detailed information about how Aster's mother(one of the character) got sick, the symptoms, what medicine she took, and what she did when she went to the doctor. There is another textbook that is not well-explained, so it only describes the routes and nature of the disease, but does not describe it in terms of characters.” (FGD 3 HTN: 14yr female, grade 8)

“From this book, I learned how to save a person with diabetes and not only help a person with diabetes, but also how to protect myself from diabetes, adjust my diet and do various sports to prevent diabetes; if someone in our family has diabetes, I learned to take the medicine correctly and do various things from this book.” (FGD 1 DM: 14yr male, grade 7)

Despite the positive feedback, participants were mentioned some of the gaps in the content of the storybooks. They have compared the content of these storybooks with the books that they read previously. They expressed a need for more detailed information on the normal blood pressure and blood sugar levels, how the diseases are caused and the risk factors and also the fact that such health conditions are chronic. They suggested that including these factors would enhance the comprehensiveness of the book.

“There are a couple of things missed that are more important here; if it is complete, it will be closer. When I compare, I forget the number (the normal range of blood pressure) right now; but in that book (a book that a participant read before) it says that when the number rises, it reaches a dangerous level. Here, too, the number is not mentioned...And also such things are described like coffee and fatty foods as a risk factor there, it would be better if they were mentioned here.”

(FGD 2 HTN: 14yr female, grade 8)

“The question of whether blood pressure is a disease that can be cured with proper medication has not been answered.” (FGD 3 HTN: A 14yr female, grade 8)

“This book does not explain how blood pressure occurs and how we can reduce its consequences after it occurs.” (FGD 2 HTN: A 16yr female, grade 8)

5.2.2.5 Preference

More than half of the participants expressed strong preference for reading a storybook rather than listening the audio recordings of the narrative. They believe that it helps in developing their reading habit and enhancing understanding of the message. Additionally, they recognized that the need for audio recordings particularly for those people with visual impairments, people lacking reading habit and those who can't read and write. Some others prefer to watch it in a movie.

“I think it would be good if it was recorded and broadcast. Because it would be difficult for blind people to read, so it would be good if it was recorded and broadcast.” (FGD 3 DM: 13yr male, grade 7)

“I prefer the narrative. Even if many people can read, they won't have the desire to read it. There are also many uneducated people in the country, so I think it would be good if it was broadcast on the radio so that they could gain awareness.” (FGD 3 DM: 14yr female, grade 8)

5.2.2.6 Knowledge sharing

Some of the participants have shared what they learned from the storybooks with their family, which creates a meaningful discussion regarding the diseases among the children and their family members. The participants not only gained the knowledge but also enabled them to play active roles in helping others within their communities.

“I read the book at home as soon as it was given to me. I told to my family when they came home from work... I told them up to the page I had read. Then they told me to finish the whole story and tell them the whole story. Then I finished the story and told them everything about diabetes. So that in the future, if our relative suddenly comes to our house and has this problem, I will reach him first; because I know the prevention method and what the symptoms are. They (her family) also told me what they know about diabetes.” (FGD 1 DM: 14yr female, grade 7)

However, the level of engagement varied among families. While some families were receptive and showed interest in discussing more about diseases, but some others were less involved and less responsive to these discussions.

“I told my family about the nature of diabetes, what to do if they find someone who is unconscious due to low blood sugar, and to check their blood sugar as soon as possible. Then, they said, "You're a child, why are you worried about this?" (FGD 2 DM: 14yr female, grade 8)

Additionally, most of the participants mentioned that they faced challenges in communicating the health messages to their families due to the busy work schedule of their parents. This time constraint hindered interaction and effective communication of health information.

“The reason I haven't told my family is because they're busy with work and don't pay much attention to it.” (FGD 3 DM: 14yr female, grade 8)

Some others were influence their family members in managing hypertension and diabetes effectively. They provided advice on lifestyle modification, encouraged adherence to medication and medical care seeking. Interestingly, the ripple effect of knowledge sharing extended beyond immediate family. Children were also creating awareness among their neighbors and guided them on healthier lifestyle practices.

“...my mother is hypertensive patient. I always tell her not to use things that increase blood pressure, such as salt, coffee, and various other things. And I help her to go to her appointments...” (FGD 2 HTN: A 14yr female, grade 8)

“I told our neighbor. My neighbor's sister was sick and I told her about hypertension and she went to the doctor...when she first went to the doctor, she said she wouldn't take the medicine, but now she has started taking it.” (FGD 3 HTN: A 14yr male, grade 8)

5.2.2.7 Suggestions for distribution

The participants emphasized the importance of making the storybook accessible to all readers, regardless of age. They supported that early exposure to health information can promote healthy behavior in adulthood. They were also highlighted importance of targeting rural areas for disseminating such storybooks since they have limited access to healthcare and counseling services.

“It (the storybook) should be available to everyone who can read, because...if those who can read are used to this kind of thing in their childhood, they will not have any difficulty in doing anything in high school or campus. If they can know such problems and their solutions from a young age, their ability to help people will increase greatly. And it would be good if we didn't limit the age, so that even if we made it available to adults who can read, they would learn from it, because even older people are more vulnerable than children...” (FGD 1 HTN: A 15yr female, grade 7)

“I think it should be distributed in the rural parts of Ethiopia; because they do not have much access to such counseling services, so I would like it to be distributed in the rural areas; Second place is in schools.” (FGD 1 DM: 13yr female, grade 7)

They also pointed the need for translating the storybook in to different languages to reach diverse communities. Additionally, they suggested utilization of various platforms including Social Medias like Facebook and telegram to make the health information accessible for broader audiences.

“It would be good if it were translated into Afaan Oromo, Tigrigna, Afar, and other languages for other regions and given to people in rural areas.” (FGD 2 DM: 15yr male, grade 8)

6. Discussion

This study aimed to use an arts-based approach to improve children knowledge of hypertension and diabetes. The findings from this study suggested that a statistically significant improvement in knowledge scores for both hypertension and diabetes following the storybook intervention. The mean knowledge scores for hypertension and diabetes increased from 10.41 to 14.48 and 12.02 to 14.32, respectively. These findings align with the existing literature supporting the use of storybooks as effective tools for conveying health message and improving health literacy, particularly to children (87, 99-101).

From the paired sample t-tests value, the effect size (d) for hypertension and diabetes was 0.79 and 0.42 (P-value <0.0001), respectively, indicates a moderate to large impact of a storybook intervention in improving knowledge. The qualitative findings further support this, showing that participants not only understood the health messages but also connected emotionally with the characters and narratives presented in the storybooks. This may enhance knowledge retention.

However, there was a difference in knowledge change among the two outcome variables. At baseline, there was higher mean knowledge score regarding diabetes than hypertension, whereas the increase in knowledge score was higher for hypertension at end-line. There was also observed differences among each items. High mean scores were observed among sign and symptoms, risk factors and complication. While low mean scores were observed among general understanding items. This suggested that the storybooks need more in-depth discussions and broader conceptual frameworks. The qualitative finding further support this. Children were mentioned the storybooks lack information related with the chronic nature of the diseases, the normal range and the types. In line with this, the study done in Ethiopia on promotion of non-communicable disease screening suggested that health communication materials should pass through evaluation process including the concept based evaluation, stakeholders' review and field testing to maintain its good quality (102).

The repeated measures ANOVA showed that improvement in knowledge scores regarding hypertension was significantly influenced by grade, with grade 8 students showing higher scores than grade 7 students. A study done in Pakistan also showed the mean scores of grade five children

were higher than those of grade four in the baseline and end-line from the use of pictorial storybooks in the generation of road safety knowledge (103). This suggests that as adolescents mature, their capacity to understand and retain health information improves.

In contrast to other researches, there is lack of significant differences across other sociodemographic variables (101, 103). This may be due to homogenous sample that all study participants were from public schools and shared some common characteristics. On the other hand, this finding suggested that the storybook intervention had broader applicability in addressing the knowledge gaps across these groups.

The qualitative findings from the focus group discussions provided rich insights towards the areas of improvements of the storybooks. Almost all participants found the storybook as an educational resource with useful information that improved their understanding of hypertension and diabetes. The effectiveness of the storybooks utilized in the present study may have resulted from the clarity of the health messages and the attractive drawings included in the storybooks. When storybooks designed the characters should be more relatable to the reader, the language should be simple, the pictures and the texts should maintain high quality (color, size, font...). Other similar studies also supported that educational materials should be more engaging, simple and understandable (104, 105).

The messages in the storybooks should create emotional attachment to effectively promote the desired behavior change. The findings from this study also showed that characters can serve as a role model and inspiration for children. They can also effectively communicate seriousness of the diseases, prompting children to consider the implications of untreated conditions. A study done on characteristics of narrative interventions and health effects showed that expression of emotions in the narrative by emotional adjectives and descriptions increased persuasive effects of the storybook (106).

Moreover, the FGDs revealed knowledge sharing behavior of the participants. This demonstrates the potential for educational interventions to extend beyond the individual level and promote community understanding of health issues. Other studies also emphasized the role of children in disseminating the health information and influencing behavior change among their peers and

families (83, 85, 107). However, challenges in communicating health messages to family members due to busy work schedules were also noted.

Participants highlighted how crucial it is to make the storybooks accessible to all community members. This aligns with community-based health education programs that are essential for promoting health equity, reducing disparities, and creating sustainable health improvements (108). Additionally, they were pointed out that many people who are uneducated and people with visual impairments can be reached through audio recordings of the storybooks. Another study also suggested that audiovisual materials had the highest reach as compared with printed materials since it can effectively engage both literate and non-literate audiences also individuals with visual impairments (102).

7. Strengths and limitations of the study

7.1 Strengths

- This is a first kind of study conducted on evaluating effectiveness arts-based in improving children knowledge of hypertension and diabetes in Ethiopia. Since the prevalence of NCDs becoming high, it is very essential to use such a novel approaches in health promotion activities.
- In this study both quantitative and qualitative methods were used. Using qualitative method has helped in exploring areas of improvement of the storybooks

7.2 Limitations

- This study did not include the control group due to limited resource and time. This makes it difficult to determine the extent to which the storybook intervention was responsible for the observed improvements in mean knowledge scores.
- This study did not assess the impact of the intervention on actual health behaviors and outcomes, such as blood pressure control and diabetes management.

8. Conclusion

In conclusion, storybooks are effective in improving children knowledge of hypertension and diabetes. They may enable people to communicate health messages in a more engaging manner and can help promote healthy behavior. Future interventions should focus on refining those educational materials based on the feedback gathered from the participants and expanding distribution to ensure better health outcomes.

9. Recommendations

- While this study showed that the storybook intervention resulted in significant change in knowledge about hypertension and diabetes among school children, a large-scale trial is required to assess effectiveness of the intervention in more diverse settings. This may be through randomized control trials.
- Future studies could benefit from a longitudinal study design to assess whether knowledge gains translate into actual behavior changes.
- Future research should focus on the best way to integrate such health education materials to the school curriculum.
- Furthermore, the Ministry of Health and Ministry of Education, as well as other related sectors, may use the findings of this study to support policy and planning to improve knowledge of hypertension and diabetes among school children.

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ANNEXES

Annex I: Information sheet English version

Study Title: Using an arts-based approach to improve children knowledge of hypertension and diabetes

Hello! My name is Mliete Tsega, Master of Public Health student at Addis Ababa University. Currently, I am collecting data for a research project intended to evaluate the effectiveness of storybooks in improving knowledge about hypertension and diabetes among school children.

Study procedures: There are storybooks produced in Amharic about non-communicable diseases. We will give your children one or more books (which they can keep), ask them to read it and afterwards ask them some questions about the book. Also, there will be group discussions after your children read the books.

Confidentiality: The information collected from your children will be kept confidential and stored in a file, without indicating their name by assigning a code number to it. They will not be personally identified in any presentation or publication of the data.

Benefits and risks: If your children participate in this study, their understanding of non-communicable diseases will increase. There is no direct risk associated with your children's participation in this study. But, it will take about 15 minutes to finish the questionnaires and up to 90 minutes for the group discussions.

Voluntary participation: Participation in this study is entirely voluntary, and your children have the right to withdraw at any time without giving a reason. There will not be any consequence or loss of benefit if they withdraw from the study.

Contact address:

If you have any questions or complaints regarding this study, you can contact using the following contact addresses.

Investigator name - Mliete Tsega

Phone - +251920819733

Email - mlietetsega123@gmail.com

If you have any questions regarding this study and your rights as a research participant or if you wish to report any problems you have experienced related to the study, please contact:

1. Prof. Mirgissa Kaba

Email: mirgissa.kaba@aau.edu.et

2. Dr. Bezawit Ketema

Email: bezawitketema@gmail.com

3. Dr. Yoseph Mamo

Email: Yoseph.Mamo@thet.org

Annex II: Consent form English version

I hereby declare that: I have been given a description of the study along with its purpose in the language I speak and understand. I understand that all information that my children provided will be kept confidential. I also understand that participation is volunteer and that they can withdraw at any time without giving any reason.

I understand all the information given above and confirm my willingness for my children to participate in this study through my signature below.

Parent/ guardian signature: _____

Date: _____

Consent provider name: _____

Date: _____

Annex III: Questionnaire English Version

1. Knowledge assessing questions for hypertension			
Section I: Socio-demographic characteristics			
S.no	Question	Option	Skip
101	Student ID	_____	
102	Age (in completed years)	_____	
103	Sex	1. Female 2. Male	
104	Grade	1. Grade 7 2. Grade 8	
105	Religion	1. Orthodox 2. Muslim 3. Protestant 4. Other	
106	Do you live with your parents?	1. Yes  2. No	Go to Q. 107
107	Educational status of mother	1. Unable to read and write 2. Primary education 3. Secondary and preparatory	

		4. Higher education	
108	Educational status of father	1. Unable to read and write 2. Primary education 3. Secondary and preparatory 4. Higher education	
109	Do you have a family history of hypertension?	1. Yes 2. No 3. I don't know	
Section II: Knowledge questions about hypertension			
General understanding and symptoms			
110	Hypertension is a chronic condition.	1.Yes 2.No 3. I don't know	
111	Blood pressure is high when it's at or over 140/90 mmHg.	1.Yes 2.No 3. I don't know	
112	Hypertension may not show symptoms.	1.Yes 2.No	

		3. I don't know	
113	A patient may develop complications without showing any symptoms.	1.Yes 2.No 3. I don't know	
114	Which are signs and symptoms of raised blood pressure? (Multiple response is possible)	1. Headache 2. Dizziness 3. Blurred vision 4. Fatigue 5. I don't know	
115	Hypertension can only be diagnosed after the blood pressure gets measured.	1.Yes 2.No 3. I don't know	
116	Hypertension is curable.	1.Yes 2.No 3. I don't know	
Risk factors			
117	What are risk factors of hypertension? (Multiple response is possible)	1. Genetic or family history of hypertension 2. Older age 3. Being	

		overweight/ obesity 4. Not doing regular exercise 5. Overconsumption of salt 6. Overconsumption of fatty food 7. Increased alcohol intake 8. I don't know	
Treatment			
118	Drugs for hypertension must be taken regularly.	1.Yes 2.No 3. I don't know	
119	Individuals with hypertension must take their medication only when they feel ill.	1.Yes 2.No 3. I don't know	
120	Holy water can be taken alongside medication to manage hypertension.	1.Yes 2.No 3. I don't know	
121	Individuals with hypertension should go for follow-up regularly.	1.Yes	

		2.No 3. I don't know	
Complications			
122	Hypertension can cause premature death if left untreated.	1.Yes 2.No 3. I don't know	
123	What will happen if hypertension left untreated. (Multiple response is possible)	1. Heart diseases 2. Stroke 3. Renal failure 4. Blindness 5. I don't know	
2. Knowledge assessing questions for diabetes mellitus			
Section I: Socio-demographic characteristics			
201	Student ID	_____	
202	Age (in completed years)	_____	
203	Sex	1. Female 2. Male	
204	Grade	1. Grade 7 2. Grade 8	
205	Religion	1. Orthodox 2. Muslim	

		3. Protestant 4. Other	
206	Have you received health education about diabetes?	1. Yes 2. No	
207	Do you have a family history of diabetes?	1. Yes 2. No 3. I don't know	
Section II: Knowledge questions about diabetes mellitus			
General understanding			
208	Diabetes is a condition of high level of sugar in the blood.	1. Yes 2. No 3. I don't know	
209	Diabetes is curable.	1. Yes 2. No 3. I don't know	
210	There are two main types of diabetes.	1. Yes 2. No 3. I don't know	
Risk factors and symptoms			
211	What are risk factors of diabetes? (Multiple	1. Older age	

	response is possible)	2. Genetic or family history of diabetes 3. Being overweight/ obesity 4. Poor dietary habits 5. Not doing enough exercise 6. I don't know	
212	What are sign and symptoms of diabetes? (Multiple response is possible)	1. Frequent urination 2. Excessive thirst 3. Excessive hunger 4. Blurred vision 5. Feeling of weakness 6. Slow healing of cuts and wounds 7. I don't know	
Control and management of diabetes			
213	Medications are important to control diabetes.	1.Yes 2.No 3. I don't know	

214	Diabetic medications should be taken regularly.	1.Yes 2.No 3. I don't know	
215	Regular exercise helps to control diabetes.	1.Yes 2.No 3. I don't know	
216	Healthy diet helps to control diabetes.	1.Yes 2.No 3. I don't know	
Complications			
217	What will happen if diabetes left untreated? (Multiple response is possible)	1. Blindness 2. Heart diseases 3. Kidney diseases 4. Amputation of leg 5. I don't know	
Hypoglycemia and its management			
218	Medication overdose can result low blood glucose.	1.Yes 2.No 3. I don't know	

219	Low blood glucose can result loss of consciousness.	1.Yes 2.No 3. I don't know	
220	Low blood glucose can cause death if left untreated.	1.Yes 2.No 3. I don't know	
221	Taking sweets helps to manage low blood glucose.	1.Yes 2.No 3. I don't know	

Annex IV: Discussion guide English Version

The Little Doctor ‘Book 1’

❖ Introduction

1. Who are the key characters in the book? Probing: Did the characters feel real? Are the characters likeable? Which character do you like the most? Could you relate/compare yourself with the key characters?
2. If you are asked to choose a friend from characters in the book, whom will you choose?
3. Is there a character you were afraid of in the book? Who is he/she? Explain what you are afraid of.

❖ Assessment of how much the children understood the story

4. What is the book about? Probing: What do you understand about hypertension? How would you summarize the main messages of the book regarding hypertension? What is described in the book as a way to control high blood pressure?
5. How well did the book address common misconceptions about hypertension? What are those misconceptions?
6. How clear and understandable was the information presented in the book?
7. What lessons did you learn from reading this book? Do you think the book shows a real problem in the society?
8. Did the book provide practical advice that you found useful? Probing: Can you give examples of how you might apply what you learned from the book in your daily life?

❖ Assessment of children's reactions to the Storybook

9. What did you like about the book? Do you think your friends would also like to read the book?

10. What did you dislike about the book? What would you like to see in the book?
11. Were there any contents that are difficult to understand? What are they? How can it be improved?
12. Were there topics did you feel missed or could have been explored more in depth? What do you think should be included in the book?
13. Have you read other similar books? How do you compare this book with other similar books you have read?
14. How did you find the writing style? How do you see the tone of the book?
15. What did you think about pictures included in the book? Did they enhance your understanding of the content?
16. Do you prefer to read this book on your own or prefer to hear the audio recording?

❖ Recommendation

17. Have you shared what you learned from this book with your family?

Probing: In what ways have you shared the knowledge you've gained from this book with your family? Can you provide specific examples of how you shared this knowledge? What insights or knowledge from this book have you shared with your family? How did your family respond to the knowledge you shared?

18. Would you recommend others to read this book? Why?
19. Who do you think would like to read this book? Would you like to share this book with anyone?
20. Where do you think this book should be disseminated? Probing: community, school, youth centers.
21. To what grade and age level is this book appropriate?
22. Do you have any additional ideas/comments/questions?

Searching for the Elephants ‘Book 2’

❖ Introduction

1. Who are the key characters in the book? Probing: Did the characters feel real? Are the characters likeable? Which character did you find most compelling? Could you relate to the key characters?
2. Who did you like the most in the story? Why?
3. Is there a character in the story that you are afraid of? If so, who is it?

❖ Assessment of how much the children understood the story

4. What is the book about? Probing: What do you understand about diabetes? What are the signs and symptoms of diabetes? How many types of diabetes are there?
5. Do you think it is possible to control diabetes? How? What are the complications of lack of control of diabetes?
6. How did the people of the little doctor's village use threads to control diabetes? Probing: What is the meaning of the different the colors of the threads to the residents of the village?
7. Why do the villagers listen carefully to what the children tell them?
8. How clear and understandable was the information about diabetes presented in the story?
9. What do you do if you find a person who loses consciousness due to low blood sugar level?
10. Did the book provide practical advice that you found useful? Probing: Can you give examples of how you might apply what you learned from the book in your daily life?

❖ Assessment of children's reactions to the Storybook

11. What did you like about the book? Which part of the story did you enjoy reading? Do you think your friends would also like to read the book?
12. Were there any parts that you found confusing or difficult to understand?

13. Is there anything you didn't like about the story? If so, why didn't you like it?
14. How did you like the ending of the story? Why?
15. Have you read other similar books? How do you compare this book with other similar books you have read?
16. How did you find the writing style? How do you see the tone of the book?
17. What did you think about pictures included in the book? Did they enhance your understanding of the content?
18. Do you prefer to read this book on your own or prefer to hear the audio recording?

❖ Recommendations

19. Have you shared what you learned from this book with your family?

Probing: In what ways have you shared the knowledge you've gained from this book with your family? Can you provide specific examples of how you shared this knowledge? What insights or knowledge from this book have you shared with your family? How did your family respond to the knowledge you shared?

20. Would you recommend this book to others? Why?
21. Who do you think would like this book? Would you like to share this book with anyone?
22. Where do you think this book should be disseminated? Probing: community, school, youth centers.
23. Who do you think would benefit most from reading it?

Annex V: Information sheet Amharic version

የመረጃ ወረቀት

የጥናት ርዕስ፡ ስለ ከፍተኛ የደም ግፊት እና የስኳር በሽታ የልጆችን እውቀት ለማሻሻል ኪነጥበባዊ አቀረራረብን መጠቀም።

ሰላም! ስሜ ምልአተ ጸጋ እባላለሁ፤ በአዲስ አበባ ዩኒቨርሲቲ የህብረተሰብ ጤና ትምህርት ክፍል ተማሪ ነኝ። በአሁን ሰአት ስለ ከፍተኛ የደም ግፊት እና የስኳር በሽታ ተማሪዎች ያላቸውን እውቀት ለማሻሻል የታሪክ መፅሃፍትን መጠቀም ያለውን ውጤታማነት መገምገም ዓላማው ያደረገ የምርምር ፕሮጀክት ላይ መረጃ እየሰበሰብኩ ነው።

የጥናቱ ሂደቶች፡ ተላላፊ ያልሆኑ በሽታዎችን በተመለከተ በአማርኛ የተዘጋጁ የተረት መጽሃፎች አሉ። ለልጆችም አንድ ወይም ከዚያ በላይ መጽሃፎችን እንሰጣቸዋለን (የሚመለሱ አይደሉም)፤ እንዲያነቡት እንጠይቃቸዋለን፤ ከዚያ በኋላ ስለ መጽሐፉ አንዳንድ ጥያቄዎችን እንጠይቃቸዋለን። እንዲሁም ልጆችዎ መጽሃፎቹን ካነበቡ በኋላ የቡድን ውይይቶች ይኖራሉ።

ሚስጥራዊነት፡ ከልጆችዎ የሚሰበሰበው መረጃ በሚስጥር ይጠበቃል እና በፋይል ውስጥ ይቀመጣሉ። በመልሶቻቸው ላይ ስማቸው አይጠቀስም፤ በቁጥር ብቻ ኮድ ይደረጋሉ። ታትሞ በሚወጣውም ጥናት ላይ የተሳታፊ ማንነት ተለይቶ አይታወቅም።

ጥቅሞች እና ጉዳዮች፡ ልጆችዎ በዚህ ጥናት ውስጥ ቢሳተፉ ተላላፊ ያልሆኑ በሽታዎችን ላይ ያላቸው ግንዛቤ ይጨምራል። በዚህ ጥናት ውስጥ መሳተፍ በልጆችዎ ላይ ምንም ዓይነት ቀጥተኛ ጉዳት አያመጣም። ነገር ግን መጠይቆችን ለመሙላት 15 ደቂቃ ያህል እና ለቡድን ውይይቶች ደግሞ እስከ 90 ደቂቃዎች ሊወስድ ይችላል።

የፈቃደኝነት ተሳትፎ፡ በዚህ ጥናት ውስጥ መሳተፍ ሙሉ በሙሉ በፈቃደኝነት ላይ የተመሰረተ ነው፤ እና ልጆችዎ በማንኛውም ጊዜ ምንም ምክንያት ሳይሰጡ ከጥናቱ የመውጣት መብት አላቸው። ጥናቱን በማቋረጣቸው ምንም አይነት ችግር ወይም ጥቅም ማጣት አያጋጥማቸውም።

ለበለጠ መረጃ፡

ይህንን ጥናት በተመለከተ ማንኛቸውም ጥያቄዎች ወይም ቅሬታዎች ካሉዎት የሚከተሉትን አድራሻዎች በመጠቀም ማነጋገር ይችላሉ።

የተመራማሪ ስም፡ ምልአተ ጸጋ

ኢሜል፡ mlietetsega123@gmail.com

ስልክ ቁጥር፡ +251920819733

በዚህ ጥናት ላይ እንደ የጥናት ተሳታፊ ያለዎትን መብቶች ወይም ከጥናቱ ጋር በተያያዘ ያጋጠመዎትን ማንኛውንም ችግር ሪፖርት ለማድረግ ከፈለጉ እባክዎን ከታች ያሉትን አድራሻዎች ይጠቀሙ፡-

1. ፕሮፌሰር ሚርጊሳ ካባ

ኢሜል፡ mirgissa.kaba@aau.edu.et

2. ዶ/ር ቤዛዊት ከተማ

ኢሜል፡ bezawitketema@gmail.com

3. ዶ/ር ዮሴፍ ማሞ

ኢሜል፡ Yoseph.Mamo@thet.org

Annex VI: Consent form Amharic version

የፈቃደኝነት ማረጋገጫ ቅጽ

የጥናቱን ዓላማ በምናገረው እና በምረዳው ቋንቋ ማብራሪያ ተሰጥቶኛል። ልጆቼ የሚሰጡት መረጃ ሁሉ በሚስጥር እንደሚጠበቅ ተረድቻለሁ። በተጨማሪም የጥናቱ ተሳትፎ በበጎ ፈቃደኝነት እንደሆነ እና ልጆቼ ምንም ምክንያት ሳይሰጡ በማንኛውም ጊዜ ከጥናቱ መውጣት እንደሚችሉ ተረድቻለሁ።

ከዚህ በላይ የተሰጠውን መረጃ ሁሉ ተረድቻለሁ እና ልጆቼ በዚህ ጥናት እንዲሳተፉ ያለኝን ፍላጎት ከዚህ በታች ባለው ፊርማ አረጋግጣለሁ።

የወላጅ/አሳዳጊ ፊርማ: _____

ቀን:- _____

የፈቃድ አቅራቢ ስም: _____

ቀን:- _____

Annex VII: Questionnaire Amharic Version

1. ስለከፍተኛ የደም ግፊት የተዘጋጀ መጠይቅ			
ክፍል I: የሶሺዮሊዊ ሞግራፊ ጥያቄዎች			
ተ.ቁ	ጥያቄ	ምርጫ	የሚዘለል
101	መለያ ቁጥር	_____	
102	ዕድሜ	_____	
103	ጾታ	1. ሴት 2. ወንድ	
104	ክፍል	1. 7ኛ ክፍል 2. 8ኛ ክፍል	
105	ሃይማኖት	1. ኦርቶዶክስ 2. ሙስሊም 3. ፕሮቴስታንት 4. ሌላ	
106	የምትኖረው/ረው ከወላጆችህ/ሽ ጋር ነው?	1.  አዎ 2. አይ	ወደጥያቄ 107 ይሂዱ
107	የእናት የትምህርት ደረጃ	1. ማንበብና መጻፍ አትችልም 2. አንደኛ ደረጃ ትምህርት 3. ሁለተኛ ደረጃ እና መሰናዶ 4. ከፍተኛ ደረጃ	

		ትምህርት	
108	የአባት የትምህርት ደረጃ	1. ማንበብና መጻፍ አይችልም 2. አንደኛ ደረጃ ትምህርት 3. ሁለተኛ ደረጃ እና መሰናዶ 4. ከፍተኛ ደረጃ ትምህርት	
109	በቤተሰብ የደም ግፊት ያለበት ሰው አለ?	1. አለ 2. የለም 3. አላውቅም	
ክፍል II: ስለ የደም ግፊት እውቀትን መለኪያ ጥያቄዎች			
አጠቃላይ ግንዛቤ እና ምልክቶች			
110	የደም ግፊት ረጅም ጊዜ የሚቆይ በሽታ ነው።	1. አዎ 2. አይ 3. አላውቅም	
111	የደም ግፊት ከ140/90 በላይ ሲሆን ከፍተኛ ነው ይባላል።	1. አዎ 2. አይ 3. አላውቅም	
112	ከፍተኛ የደም ግፊት ምንም ምልክቶች ሊያሳይ ይችላል።	1. አዎ 2. አይ 3. አላውቅም	
113	አንድ ታካሚ ምንም የከፍተኛ ደም ግፊት ምልክት ሳያሳይ ውስብስብ ችግሮች ሊያጋጥሙት	1. አዎ 2. አይ	

	ይችላል።	3. አላውቅም	
114	የደም ግፊት መጨመር ምልክቶች የትኞቹ ናቸው? (ከአንድ በላይ መልስ መምረጥ ይቻላል)	1. ራስ ምታት 2. ራስ ማዞር 3. የአይን ብዥታ 4. ድካም 5. አላውቅም	
115	አንድ ሰው ከፍተኛ የደም ግፊት እንዳለበት ማወቅ የሚቻለው የደም ግፊቱ ከተለካ በኋላ ብቻ ነው።	1. አዎ 2. አይ 3. አላውቅም	
116	ከፍተኛ የደም ግፊት መዳን ይችላል።	1. አዎ 2. አይ 3. አላውቅም	
አጋላጭ ምክንያቶች			
117	ለደም ግፊት በሽታ የሚያጋለጡ ምክንያቶች ምንድን ናቸው? (ከአንድ በላይ መልስ መምረጥ ይቻላል)	1. በቤተሰብ የደም ግፊት በሽታ ያለበት ሰው መኖር 2. እድሜ መግፋት 3. ከመጠን በላይ ውፍረት/መወፈር 4. አዘውትሮ የአካል ብቃት እንቅስቃሴ አለማድረግ 5. ጨው ከመጠን በላይ መጠቀም 6. ቅባታማ ምግቦችን ከመጠን በላይ	

		መውሰድ 7. የአልኮል መጠጦችን አብዝቶ መውሰድ 8. አላውቅም	
እክምና			
118	ለከፍተኛ ደም ግፊት የሚወሰዱ መድሃኒቶች በየቀኑ መውሰድ አለባቸው።	1. አዎ 2. አይ 3. አላውቅም	
119	ከፍተኛ የደም ግፊት ያለባቸው ሰዎች መድሃኒታቸውን መውሰድ ያለባቸው ህመም ሲሰማቸው ብቻ ነው።	1. አዎ 2. አይ 3. አላውቅም	
120	የደም ግፊትን ለመቆጣጠር መድሃኒቶችን እና ጸበልን ጎን ለጎን መውሰድ ይቻላል።	1. አዎ 2. አይ 3. አላውቅም	
121	ከፍተኛ የደም ግፊት ያለባቸው ሰዎች በየጊዜው ክትትል ማድረግ አለባቸው።	1. አዎ 2. አይ 3. አላውቅም	
ውስብስብ ችግሮች			
122	ከፍተኛ የደም ግፊት ህክምና ካልተደረገለት ያለጊዜው ለሞት ሊዳርግ ይችላል።	1. አዎ 2. አይ 3. አላውቅም	
123	ከፍተኛ የደም ግፊት ካልታከመ ምን ሊያስከትል ይችላል? (ከአንድ በላይ መልስ መምረጥ ይቻላል)	1. የልብ ህመም 2. ስትሮክ 3. የኩላሊት ስራ	

		ማቆም 4. ዓይነት ስውርነት 5. አላውቅም	
2. ስለስኳር በሽታ የተዘጋጀ መጠይቅ			
ክፍል I፡ የሶሻሎዊ ሞግራፊ ጥያቄዎች			
201	መለያ ቁጥር	_____	
202	ዕድሜ	_____	
203	ጾታ	1. ሴት 2. ወንድ	
204	ክፍል	1. 7ኛ ክፍል 2. 8ኛ ክፍል	
205	ሃይማኖት	1. ኦርቶዶክስ 2. ሙስሊም 3. ፕሮቴስታንት 4. ሌላ	
206	ስለስኳር በሽታ የጤና ትምህርት አግኝተህ/ሽ ታውቃለህ/ሽ?	1. አዎ 2. አይ	
207	በቤተሰብ የስኳር በሽታ ያለበት ሰው አለ?	1. አዎ 2. አይ 3. አላውቅም	
ክፍል II፡ ስለ ስኳር በሽታ እውቀትን መለኪያ ጥያቄዎች			
አጠቃላይ ግንዛቤ			

208	የስኳር በሽታ የሚባለው በደም ውስጥ ያለው የስኳር መጠን ከፍ ሲል ነው።	1. አዎ 2. አይ 3. አላውቅም	
209	የስኳር በሽታ መዳን ይቻላል።	1. አዎ 2. አይ 3. አላውቅም	
210	ሁለት ዓይነት የስኳር በሽታዎች አሉ።	1. አዎ 2. አይ 3. አላውቅም	
መንስኤዎች እና ምልክቶች			
211	ለስኳር በሽታ የሚያጋለጡ ምክንያቶች ምንድን ናቸው? (ከአንድ በላይ መልስ መምረጥ ይቻላል)	1. እድሜ መግፋት 2. በቤተሰብ የስኳር በሽታ ያለበት ሰው መኖር 3. ከመጠን በላይ ውፍረት/መወፈር 4. ጤናማ ያልሆነ አመጋገብ 5. በቂ የአካል ብቃት እንቅስቃሴ አለማድረግ 6. አላውቅም	
212	የስኳር በሽታ ምልክቶች የትኞቹ ናቸው? (ከአንድ በላይ መልስ መምረጥ ይቻላል)	1. ቶሎ ቶሎ ሽንት መሸናት 2. ቶሎ ቶሎ ውሃ መጠማት	

		3. ቶሎ ቶሎ መራብ/የረሃብ ስሜት መኖር 4. ብዥ ያለ እይታ 5. የድካም ስሜት 6. የቁስሎች ቶሎ አለመዳን 7. አላውቅም	
የስኳር በሽታን መቆጣጠር			
213	የስኳር በሽታን ለመቆጣጠር መድሃኒቶች አስፈላጊ ናቸው።	1. አዎ 2. አይ 3. አላውቅም	
214	የስኳር በሽታ ያለባቸው ሰዎች መድሃኒታቸውን በአግባቡ መወሰድ አለባቸው።	1. አዎ 2. አይ 3. አላውቅም	
215	አዘውትሮ የአካል ብቃት እንቅስቃሴ ማድረግ የስኳር በሽታን ለመቆጣጠር ይረዳል።	1. አዎ 2. አይ 3. አላውቅም	
216	ጤናማ አመጋገብ የስኳር በሽታን ለመቆጣጠር ይረዳል።	1. አዎ 2. አይ 3. አላውቅም	
ውስብስብ ችግሮች			
217	የስኳር በሽታ ሕክምና ካልተደረገለት ምን ሊያስከትል ይችላል? (ከአንድ በላይ መልስ መምረጥ ይቻላል)	1. ዓይነ ስውርነት 2. የልብ ህመም 3. የኩላሊት በሽታ 4. እግር መቆረጥ	

		5. አላውቅም	
በደም ውስጥ ያለው የስኳር መጠን መቀነስ እና ህክምናዎች			
218	የስኳር በሽታ መድሃኒት በሃኪም ከታዘዘው በላይ መውሰድ በደም ውስጥ ያለውን የስኳር መጠን በጣም ሊቀንሰው ይችላል።	1. አዎ 2. አይ 3. አላውቅም	
219	በደም ውስጥ ያለው የስኳር መጠን በጣም ሲቀንስ ራስን መሳት ሊያስከትል ይችላል።	1. አዎ 2. አይ 3. አላውቅም	
220	በደም ውስጥ ያለው የስኳር መጠን መቀነስ ካልታዘመ ለሞት ሊዳርግ ይችላል።	1. አዎ 2. አይ 3. አላውቅም	
221	ጣፋጭ ነገሮችን መውሰድ ዝቅተኛ የደም ስኳርን ለማስተካከል ይረዳል።	1. አዎ 2. አይ 3. አላውቅም	

Annex VIII: Discussion guide Amharic version

ትንሿ ዶክተር

መግቢያ

1. በመጽሐፉ ውስጥ የተጠቀሱት ዋና ዋና ገጸ-ባህሪያት እነማን ናቸው?

ጥቆማ: ገጸ ባሕርያቱ እውነተኛ እንደሆኑ ያህል ተሰምቷቸዋል? ገጸ ባሕርያቱን ወዳችኋቸዋል? የትኛውን ገጸ ባሕርይ በጣም ወደዳችሁት? ራሳችሁን ከዋና ዋና ገጸ ባሕርያቱ ጋር ማመሳሰል ትችላላችሁ?

2. በመጽሐፉ ውስጥ ካሉ ገፁ-ባሕርያት መካከል ዳደኛ እንድትመርጡ ብትጠየቁ ማንን ትመርጣላችሁ? አብራችሁ ምን ታደርጋላችሁ?

3. በመጽሐፉ ውስጥ የፈራሹት ገፁ ባህሪ ነበር? ካለ ማነው/ናት?

ልጆቹ ታሪኩን ምን ያህል እንደተረዱት ግምገማ

4. መጽሐፉ በአጠቃላይ ስለምንድን ነው የሚያወራው?

ጥቆማ : ስለ ደም ግፊት ምን ተረዳችሁ? የደም ግፊትን በተመለከተ የመጽሐፉን ዋና መልዕክት ጠቅለል አድርጋችሁ እንዴት ትገልጹታላችሁ? በመጽሐፉ ውስጥ በተገለጸው መሰረት ከፍተኛ የደም ግፊትን እንዴት መቆጣጠር ይቻላል?

5. መጽሐፉ የደም ግፊትን በተመለከተ የሚነሱ የተለመዱ የተሳሳቱ አመለካከቶችን ምን ያህል ገልጿል?

6. መልእክቱ ምን ያህል ግልጽ እና ለመረዳት የማይከብድ ነበር?

7. ይህን መጽሐፍ በማንበባችሁ ምን ትምህርት አግኝታችኋል? መጽሐፉ በማህበረሰቡ ውስጥ ያለውን ትክክለኛ ችግር ያሳያል ብላችሁ ታስባላችሁ?

8. መጽሐፉ ጠቃሚ የሆነ ምክር ሰጥቷል?

ጥቆማ: ከመጽሐፉ የተማራችሁትን በዕለት ተዕለት ሕይወታችሁ እንዴት ተግባራዊ ማድረግ እንደምትችሉ ምሳሌዎችን መስጠት ትችላላችሁ?

ልጆቹ ስለ ታሪክ መጽሐፉ ያላቸውን ስሜት መገምገም

9. ከመጽሐፉ ምኑን ወደዳችሁት? ዳደኞቻችሁ መጽሐፉን ቢያነቡ ይወዱታል ብላችሁ ታስባላችሁ?

10. ከመጽሐፉ ምኑን አልወደዳችሁትም? በመጽሐፉ ውስጥ ምን ቢካተት ደስ ይላችኋል?

11. ለመረዳት አስቸጋሪ የሆኑ ይዘቶች ነበሩ? ምንድን ናቸው? እንዴትስ ሊሻሻል ይችላል?

12. የጎደሉ ወይም በጥልቀት ሊዳሰሱ የሚችሉ ጉዳዮች ነበሩ? ምን መካተት አለበት ብላችሁ ታስባላችሁ?

13. ሌሎች ተመሳሳይ መጽሃፎችን አንብባችኋል? ይህን መጽሐፍ ካነበባችዋቸው ሌሎች ተመሳሳይ መጻሕፍት ጋር እንዴት ታወዳድራላች?

14. የአጻጻፍ ስልቱን እንዴት አገኛችሁ? የመጽሐፉን ቃና/ውበት እንዴት ታዩታላችሁ?

15. በመጽሐፉ ውስጥ ስለተካተቱት ሥዕሎች ምን ትላላች? መልእክቱን አጉልተው ያሳዩ ነበር?

16. ይህን መጽሐፍ በራሳችሁ ማንበብ ትመርጣላችሁ ወይስ በድምፅ ተቀድቶ ሲነበብ ማዳመጥ ትመርጣላችሁ?

ምክር

17. ከዚህ መጽሐፍ የተማራችሁትን ለቤተሰቦቻችሁ አካፍላችኋል?

ጥቆማ: ከዚህ መጽሐፍ ያገኛችሁትን እውቀት ለቤተሰቦቻችሁ በምን ዓይነት መንገዶች አካፍላችሁ? ይህን እውቀት እንዴት እንዳካፈላች የተወሰኑ ምሳሌዎችን ማቅረብ ትችላላችሁ? ከዚህ መጽሐፍ ምን አይነት ግንዛቤዎችን ወይም እውቀቶችን ለቤተሰቦቻችሁ አጋርታችኋል? ላካፍላችሁት እውቀት ቤተሰቦቻችሁ ምን ምላሽ ሰጡ?

18. ሌሎች ይህን መጽሐፍ እንዲያነቡት ትመክራላች? ለምን?

19. ይህን መጽሐፍ ምን ዓይነት አንባቢ ሊወደው ይችላል? ይህን መጽሐፍ ለማን ማጋራት ትፈልጋላች?

20. ይህ መጽሐፍ መሰራጨት ያለበት የት ነው ብላችሁ ታስባላችሁ?

ጥቆማ: በማህበረሰቡ ውስጥ፣ በትምህርት ቤቶች፣ በወጣት ማዕከላት

21. ይህ መፅሃፍ በየትኛው ክፍል እና ዕድሜ ደረጃ ላይ ነው ተገቢ የሚሆነው?

22. ተጨማሪ ሃሳብ፣ አስተያየት ወይም ጥያቄ አላችሁ?

ዝሆኖቹን ፍለጋ

መግቢያ

1. በመጽሐፉ ውስጥ የተጠቀሱት ዋና ዋና ገጸ-ባህሪያት እነማን ናቸው?

ጥቆማ: ገጸ ባሕርያቱ እውነተኛ እንደሆኑ ያህል ተሰምቷችኋል? ገጸ ባሕርያቱን ወዳችኋቸዋል? የትኛውን ገጸ ባሕርይ በጣም ወደዳችሁት? ራሳችሁን ከዋና ዋና ገጸ ባሕርያቱ ጋር ማመሳሰል ትችላላችሁ?

2. በታሪኩ ውስጥ በጣም የወደዳችሁት ማንን ነው? ለምን?

3. በታሪኩ ውስጥ የፈራቹት ገፁ ባህሪ ነበረ? ከሆነ ማን ነው?

ልጆቹ ታሪኩን ምን ያህል እንደተረዱት ግምገማ

4. መጽሐፉ የሚያወራው ስለ ምንድን ነው?

ጥቆማ: ስለ ስኬት በሽታ ምን ተረዳቹ? የስኬት በሽታ ምልክቶች ምንድን ናቸው? ምን ያህል የስኬት በሽታ ዓይነቶች አሉ?

5. የስኬት በሽታን መቆጣጠር የሚቻል ይመስላችኋል? እንዴት? የስኬት በሽታን መቆጣጠር አለመቻል ምን ችግሮች ያመጣል?

6. የትንሿ ዶክተር መንደር ሰዎች የስኬት በሽታን ለመቆጣጠር ክሮች እንዴት ይጠቀማሉ?

ጥቆማ: የመንደሩ ነዋሪዎች የተለያዩ የክሮቹ ቀለም ምን ማለት ነው?

7. የመንደሩ ነዋሪዎች ልጆቹ የሚነግሯቸውን በጥሞና የሚሰሙት ለምንድን ነው?

8. በታሪኩ ውስጥ ስለ ስኬት በሽታ ያለው መረጃ ምን ያህል ግልጽ እና ለመረዳት የሚቻል ነበር?

9. በደም ውስጥ ያለው የስኬት መጠን በመቀነሱ ምክንያት እራሱን የሳተ ሰው ብታገኙ ምን ታደርጋላችሁ?

10. መጽሐፉ ጠቃሚ የሆነ ምክንያት ሰጥቷል?

ጥቆማ: ከመጽሐፉ የተማራቾችን በዕለት ተዕለት ሕይወታቸው እንዴት ተግባራዊ ማድረግ እንደምትችሉ ምሳሌዎችን መስጠት ትችላላችሁ?

ልጆቹ ስለ ታሪክ መጽሐፉ ያላቸውን ስሜት መገምገም

11. ከመጽሐፉ ምክንያት ወደዳቸው? ጓደኞቻችሁ መጽሐፉን ቢያነቡ ይወዱታል ብላችሁ ታስባላችሁ?

12. ግራ የሚያጋቡ ወይም ለመረዳት የሚያስቸግሩ ክፍሎች ነበሩ? ምንድን ናቸው? እንዴት ሊሻሻሉ ይችላሉ?

13. በታሪኩ ላይ ያልወደዳችሁት ነገር ነበረ? ካለ ለምን አልወደዳችሁትም?

14. የታሪኩን መጨረሻ ወዳቸታል? ለምን?

15. ሌሎች ተመሳሳይ መጽሐፎችን አንብባችኋል? ይህን መጽሐፍ ካነበባችዋቸው ሌሎች ተመሳሳይ መጻሕፍት ጋር እንዴት ታወዳድራላችሁ?

16. የአጻጻፍ ስልቱን እንዴት አገኛችሁ? የመጽሐፉን ቃና/ውበት እንዴት ታዩታላችሁ?

17. በመጽሐፉ ውስጥ ስለተካተቱት ሥዕሎች ምን ትላላችሁ? መልእክቱን አጉልተው ያሳዩ ነበር?

18. ይህን መጽሐፍ በራሳችሁ ማንበብ ትመርጣላችሁ ወይስ በድምፅ ተቀድቶ ሲነበብ ማዳመጥ ትመርጣላችሁ?

ምክሮች

19. ከዚህ መጽሐፍ የተማራችሁትን ለቤተሰቦቻችሁ አካፍላችኋል?

ጥቆማ፡ ከዚህ መጽሐፍ ያገኛችሁትን እውቀት ለቤተሰቦቻችሁ በምን ዓይነት መንገዶች አካፍላችሁ? ይህን እውቀት እንዴት እንዳካፈላችሁ የተወሰኑ ምሳሌዎችን ማቅረብ ትችላላችሁ? ከዚህ መጽሐፍ ምን ዓይነት ግንዛቤዎችን ለቤተሰቦቻችሁ አጋርታችኋል? ላካፍላችሁት እውቀት ቤተሰቦቻችሁ ምን ምላሽ ሰጡ?

20. ይህን መጽሐፍ ለሌሎች እንዲያነቡት ትመክራላችሁ? ለምን?

21. ይህን መጽሐፍ ምን ዓይነት አንባቢ ሊወደው ይችላል? ይህን መጽሐፍ ለማን ማጋራት ይፈልጋሉ?

22. ይህ መጽሐፍ መሰራጨት ያለበት የት ነው ብላችሁ ታስባላችሁ?

ጥቆማ፡ በማህበረሰቡ ውስጥ፣ በትምህርት ቤቶች፣ በወጣት ማዕከላት

23. ይህን መጽሐፍ በማንበብ የበለጠ የሚጠቅመው ማን ይመስላችኋል?

Annex IX: Codebook

Sub-themes	Descriptions
Clarity and comprehensibility	This sub-theme describes how easily children understand the language, concepts, and messages presented in the storybooks. It includes assessments of vocabulary simplicity, sentence structure, and overall readability.
Emotional connection	This sub-theme reflects children's emotional responses to the storybooks. It encompasses elements such as relatability of characters, engagement with the storyline, and the ability of the narrative to evoke empathy, interest, concern, or other emotions that make the content more memorable and impactful.
Appearance/attractiveness	This sub-theme refers to the visual appeal of the storybooks, including illustrations, colors, layout, font and overall design. It examines how these aesthetic elements capture children's attention and interest, potentially influencing their willingness to engage with the material.
The content	It encompasses children's ability to accurately recall and summarize the key information presented in the storybooks related to hypertension and diabetes. It includes evaluations of whether key concepts are adequately covered or not.
Preference	This sub-theme refers the children's preferences for different modes of accessing the storybooks' content; audio, print, or video.
Knowledge sharing	This sub-theme describes children's intention, experience and behavior in sharing the knowledge they gained from the storybooks with their peers, family members, or other relatives. It focuses on the storybooks' potential to promote health communication and knowledge dissemination.
Suggestion for	Suggestions related to the dissemination and accessibility of the storybooks. This might include ideas about how to best reach different

distribution	populations or use of different medias. E.g. Age appropriateness, grade level, distribution sites...
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Codes	Definitions
Clear	Describes how the storybooks are well-organized, easy to understand, and engages the reader without causing confusion.
Unclear	Describes how the storybooks are difficult to understand, ambiguous, vague, or confusing.
Difficult	Focuses on how the language used in the storybooks pose challenges for readers, affecting their understanding.
Missed idea	Concepts or messages that readers feel were not adequately explained or were overlooked, impacting their overall comprehension of the material.
The characters	It focuses on children's perceptions and interpretation of characters within the storybooks.
Comparing with	This code indicated that the children comparing themselves with the characters included in the storybooks.
Favorite	A character which is liked or admired by the children. This may be due to positive traits, relatable experiences, admirable actions, or simply a feeling of connection with the character.
Friend	A character perceived as companionable, helpful, or supportive individual within the story, which exhibits positive qualities associated with friendship.
Real	A character viewed as believable, relatable, or representative of real-life individuals, which resonate with the children's understanding of people in the real world.

Scary	The character's actions, appearance, or overall presence evokes feelings of fear or anxiety in the children.
Reality	It explores children's perceptions of the story's authenticity and relevance to real-life experiences.
Like	Describes children's positive feelings and opinions about the storybooks.
Dislike	Describes children's negative feelings and opinions about the storybooks.
Memorable	Refers to the elements that make the narrative, characters, or pictures stand out in the reader's mind.
Pictures	Comments on how the pictures were attractive and effective in conveying the message.
Writing style	Children's assessments of the storybooks' narrative style, including its engagement, readability, tone, and suitability for the target audience.
Relevance	Refers to children's judgment of applicability and importance of the information presented in the storybooks in their daily lives.
Prior knowledge	Describes children's knowledge of hypertension and diabetes before reading the storybooks.
Interconnect	Indicates the interconnection between the storybooks that were written about different non-communicable diseases.
Listening audio	Children would like to listen the audio recordings of the narratives.
Reading book	Children prefer to read the storybooks by themselves.
Watching movie	Children would like to see the narratives in a movie/cartoon.
The reason for not sharing	Describes challenges or obstacles faced by children in sharing the knowledge they gained from the storybooks to others.
Wish	Refers to the individuals or groups to whom children intended to share

	their new knowledge/insights gained from the storybooks.
Suggestions for the future	This sub-theme summarizes all comments, suggestions, and proposed modifications intended to refine, expand, or optimize the storybooks approach to health education.
Recommendation	Refers to children's suggestion to others to read the storybooks.
Comments	General feedback, opinions, and observations children shared regarding the storybooks, their content, presentation, or overall impact.
Edition	Suggestions are directly related to improving the existing edition, rather than creating something entirely new.
Scope	Suggestions related to broadening the storybook's content or target audience.
Questions raised	They are questions raised by the children that might point to areas needing clarification or additional information in future editions.
Comparison	Comparison of the storybook to other similar books that the children have already read to get insights into the storybook's strengths and weaknesses.
Applicability	It illustrates a positive and meaningful impact driven by the storybooks – from knowledge acquisition to behavioral change and impactful social sharing.
Real life application	A practical application of the knowledge gained from the storybooks in everyday life. This could include changes in lifestyle, seeking medical attention, or making informed decisions about their health as well as for others.
Health education	Children's motivation to raise awareness among the community and provide advice to those who are less aware.
Acceptance	The feedback received by children from others regarding the information they shared after reading the storybooks.

Annex X: Curriculum Vitae of the investigator

Name: Mliete Tsega

Ethiopian, Female, March 06, 2002

Tel no: +251920819733

Email: mlietetsega123@gmail.com

Addis Ababa, Ethiopia

Objective

Dedicated Public Health masters student specializing in Health Promotion and Health Education. Passionate about addressing the rising burden of Non-communicable diseases through community-based programs, health education, health communication and policy advocacy. Eager to collaborate with interdisciplinary teams to promote healthy lifestyles and improve health outcomes for at-risk populations.

Education

- Master of Public Health student at Addis Ababa University, Ethiopia, June 2025
- BSc degree in Nursing from Addis Ababa University, Ethiopia, July 2023

Employment

- Internship experience at Global Health Partnerships working on providing practical oversight of social and behavioural change communication for Non-communicable diseases in a primary healthcare setup, from August 2024 to July 2025.

Research experience

- Thesis for partial fulfillment of the requirements for the Bachelor of Science degree in Nursing: "Knowledge, Attitude, and Practice Regarding Sugar-Sweetened Beverages as Risk Factors for Chronic Kidney Disease among Chronic Kidney Disease Patients at Selected Public Hospitals in Addis Ababa, Ethiopia, 2023: A Cross-Sectional Study."

Certificate of trainings and workshops participated

- Certificate of attendance for a CME course on " Clinical Ethics " which was provided as an online webinar on April 5, 2025
- Certificate of participation in the Qualitative Data Analysis Training using MAXQDA software organized by Ethiopian Academy of Sciences (EAS) in collaboration with David and Lucile Pachard Foundation from February 17-21, 2025, Addis Ababa, Ethiopia
- Certificate of achievement for completing Basics of Clinical Trial Management Digital Course by BIO Ventures for Global Health (BVGH), October 11, 2024
- Certificate of completion for Breast Cancer Early Detection & Referral Part 2 Digital Course by BIO Ventures for Global Health (BVGH), July 14, 2025
- Certificate of attendance for the 3rd National SBC Summit from February 27-29, 2024, Addis Ababa, Ethiopia
- Certificate of participation for a webinar on Strengthening Community Engagement: Lessons from Ethiopia by International Institute for Primary Healthcare – Ethiopia in collaboration with Johns Hopkins Bloomberg School of Public Health, July 30, 2025

References

1. Feven Teshome (MSc), Lecturer, School of Nursing, Addis Ababa University

Email: fevishome@gmail.com

2. Miftah Ahmed, Admin and Project officer, Global Health Partnerships (Formerly THET), Addis Ababa, Ethiopia

Email: Miftah.Ahmed@thet.org

Declaration

I hereby declare that this thesis is my original work, has not been presented at this or any other university, and that all resources and materials used in the development of this thesis are properly recognized and cited. I also acknowledge the contributions of all individuals involved.

Name: Mliete Tsega Signature: _____ Date of submission: _____

Advisors

This thesis work has been submitted with our approval as university advisors.

1. Prof. Mirgissa kaba Signature _____ Date _____

2. Dr. Bezawit ketema Signature _____ Date _____

Internal examiner

Name: Dr. Mengistu Yilma Signature _____ Date _____

External examiner

Name: Dr. Wassie Negash Signature _____ Date _____

August, 2025

Addis Ababa, Ethiopia