

1 **Improving Food Safety and Nutrition Knowledge, Attitude, and Practice in Ethiopian
2 Schoolchildren: A School-Based Intervention Study.**

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16

17 **Abstract**

18 Inadequate food safety and nutrition knowledge among school-aged children hampers their
19 developing immune systems, increasing their risk of foodborne illnesses and malnutrition. This
20 longitudinal study examined the impact of a school-based intervention on the food safety and
21 nutrition knowledge, attitudes, and practices (KAP) of 389 randomly selected students in Kuyu
22 District, Northtown, Ethiopia. Data were collected using pre-tested, interviewer-administered
23 questionnaires before and after the intervention. Paired-samples t-tests were performed with SPSS
24 26.0. Significant improvements were observed across all KAP domains following the intervention
25 ($p < 0.05$). Inadequate knowledge decreased from 73.3% to 17.2%. Negative attitudes declined
26 from 86.1% to 26.7%. Additionally, the percentage of students demonstrating good practices
27 increased from 23.1% to 68.6%. Mean scores for knowledge, attitudes, and practices also showed
28 significant improvements with large effects: knowledge (pre: $M=5.57$, $SD=1.68$; post: $M=8.32$,
29 $SD=1.72$; $t(388)=-22.71$, $p<0.0001$, effect size=1.6), attitudes (pre: $M=4.25$, $SD=1.35$; post:
30 $M=7.82$, $SD=2.00$; $t(388)=-28.98$, $p<0.0001$, effect size=2.1), and practices (pre: $M=5.54$,
31 $SD=1.34$; post: $M=8.16$, $SD=1.49$; $t(388)=-31.08$, $p<0.0001$, effect size=1.8). The school-based
32 intervention significantly improved students' knowledge, attitudes, and practices (KAP) regarding
33 food safety and nutrition. These findings underscore the importance of developing targeted
34 initiatives that promote balanced diets and ongoing food safety education for school-aged children,
35 which should be integrated into national food and nutrition policies.

36 **Key words:** Schoolchildren, KAP, Intervention, Food Safety, Nutrition,

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38 **Introduction**

39 Food safety and balanced diets are critical for community health (Silva et al., 2023). The World
40 Health Organization (WHO, 2021) emphasizes the importance of access to healthy food for overall
41 well-being and highlights the necessity of protecting food from contaminants such as microbes,
42 mycotoxins, and pesticides throughout the supply chain (Kovač et al., 2021; Ellahi et al., 2024).
43 Foodborne hazards are a significant global public health concern (Alsubaie & Berekaa, 2020), with

44 schools serving as crucial points of intervention. The WHO advocates for improved food safety
45 education in schools to reduce the global burden of foodborne illnesses (WHO, 2021).

46 In traditional food preparation in the study area, the staple dish is “injera”, a fermented, soft
47 flatbread typically made from teff flour (*Eragrostis teff*). Injera is served with a hot stew made
48 from legumes, vegetables, or meat, which is cooked just before mealtime. Leftovers, if any, are
49 usually eaten as a snack or during the next meal. Nevertheless, the burden of foodborne diseases
50 in Ethiopia is thought to be high (Mekonnen et al., 2021), and it possibly arises from cross-
51 contamination during food handling.

52 Schools are vital in promoting lifelong healthy eating habits (WHO & UNESCO, 2021;
53 O'Brien et al., 2021), and children, as knowledge brokers, can extend the impact of school
54 programs to their homes. Despite this potential, malnutrition and unhealthy eating remain
55 significant challenges, especially among school-aged children (Luo et al., 2021). A primary barrier
56 is the lack of awareness among students, teachers, and caregivers (Kana'an et al., 2021; Mekonnen
57 et al., 2024).

58 Challenges in nutrition and food safety include insufficient understanding, outdated techniques,
59 and substandard procedures (Edin et al., 2024; Rokshana et al., 2022). While proper hygiene can
60 prevent foodborne illnesses (Islam et al., 2023), poor personal hygiene and food handling persist
61 (Disassa & Ashenafi, 2022). Ready-to-eat foods are particularly vulnerable to contamination in the
62 absence of strict safety regulations, posing significant health risks (Islam et al., 2023).

63 These issues disproportionately affect children, who are more susceptible to malnutrition and
64 foodborne diseases due to immature immune systems and physiological sensitivities (Amoadu et
65 al., 2024). Foodborne diseases result in millions of illnesses and thousands of deaths worldwide
66 each year (Mekuanint, 2020). Notably, food handlers in homes and schools are responsible for up
67 to 20% of outbreaks (Minda et al., 2024). For instance, contaminated food causes 70% of diarrheal
68 illnesses in Ethiopia (Mekuanint, 2020).

69 Addressing these challenges requires a multifaceted approach, starting with improving
70 schoolchildren's knowledge, attitudes, and practices related to food safety and nutrition (Habib et
71 al., 2023). While extensive research exists in high-income countries (Carrillo-Alvarez et al., 2025),
72 studies on children in low-resource settings are limited (Bello et al., 2024). Current interventions

73 are often hindered by fragmented curricula and inadequate teacher training (Gebre et al., 2023). A
 74 systematic review of existing knowledge, attitudes, and practices could offer valuable insights for
 75 future efforts (Minda et al., 2024).

76 This paper underscores significant gaps and emphasizes the need for evidence-based strategies
 77 to enhance nutrition and food safety education in schools, particularly in underserved regions. This
 78 supports national efforts to reduce foodborne illnesses and foster healthier futures for children
 79 worldwide.

80 **Materials and Methods**

81 **Study Area and Period**

82 This longitudinal study was conducted in Kuyu District, North Shewa Zone, Oromia Regional
 83 State, Ethiopia, situated 156 kilometers north of Addis Ababa. The district has a population of
 84 187,146, with women making up 50.5% (ESS, 2023; Feleke et al., 2020). There are 41 primary
 85 schools (grades 1-8) in the district, serving 25,656 students, of whom 83.5% attend primary school
 86 (KDEO, 2022). Data collection took place from May 1 to July 30, 2023.

87 **Study Population and Sampling**

88 The study population included primary school children in grades 5 to 8 and their families.
 89 Students in lower grades were excluded because they might have trouble giving accurate responses.

90 **Sample Size Determination: Sample Size Determination**

91 The sample size was calculated using a single population proportion formula with a 95%
 92 confidence level and 5% margin of error (Daniel & Cross, 2018):

$$93 n = \frac{\left(\frac{Z\alpha}{2}\right)^2 \times p(1-p)}{d^2}$$

94 where:

95 $Z\alpha/2$ represents the standard normal deviation for a 95% confidence level (1.96); p indicates the
 96 estimated proportion of KAP (61.3%), and d denotes the margin of error (0.05).

$$97 n = (1.96)^2 \times 0.613 (1-0.613) = 365 +36.5 = 402$$

98 (0.05)²

99 By using the largest sample size of 365 and accounting for a 10% non-response rate, the final
100 sample size is 402 participants.

101 Sampling Procedure

102 A multistage sampling technique was used. Six primary schools were randomly chosen from
103 Kuyu District. The calculated sample size was then proportionally distributed among grades 5-8
104 within these selected schools. Schoolchildren were randomly selected from each grade and sector.
105 Additionally, the mothers or primary caregivers of the chosen schoolchildren were included in the
106 study.

107 Intervention

108 From May 1 to July 30, 2023, a three-month program was implemented to improve the knowledge,
109 attitudes, and practices (KAP) of schoolchildren and their families regarding food safety and
110 nutrition. This initiative used a "school-home approach" where students served as "agents of
111 change."

112 A total of 100 male and female school WASH club members, with 10 to 20 students from each
113 school, participated in a one-week food and nutrition training during the semester break. The
114 objective of the training was to increase the consumption of nutrient-dense foods by school
115 children, increase food consumption frequency among school children, improve food safety and
116 personal hygiene practices of mothers and children, enhance the level of KAP in children and
117 mothers/guardians, and improve school attendance and academic performance of children. The
118 training was based on "Five keys to safer food" (WHO, 2026) and on a balanced diet and healthy
119 eating habits (UNICEF, 2019). Of these, 26 students were carefully chosen by school
120 administrators to take part in the school-home training and monitoring activities. The selection
121 focused on older age, strong academic performance, and excellent behavior. These students,
122 selected from each participating school, were tasked with being change agents in their peers' homes.

123 Using a prepared manual and other training materials, the 26 selected students held weekly, house-
124 to-house training sessions with mothers and caregivers to promote knowledge transfer and
125 encourage behavior change at the household level. They visited each home once a week to discuss
126 food safety and nutrition issues with the mothers and caregivers. Additionally, all participating
127 schoolchildren were encouraged to share their experiences and information with their own families.

128 Data Collection Tools and Procedure

129 A structured questionnaire, developed based on reliable and validated tools from previous
130 studies (Deyasso and Ashenafi, 2022; Oliveira et al., 2023), was used to gather data. The
131 questionnaire consisted of 49 items, divided into four sections: knowledge of food safety and
132 healthy nutrition (12 items), attitude toward food safety and healthy nutrition (12 items), practices
133 related to food safety and healthy nutrition (14 items), and sociodemographic characteristics (11
134 items). It contained both open and closed-ended questions.

135 Data were gathered through interviewer-administered questionnaires with 402 willing and
136 anonymous participants from the selected schools. Schoolchildren filled out paper questionnaires
137 under their teachers' supervision during class hours. Pre- and post-intervention data were collected
138 from schoolchildren and their families using structured KAP questionnaires and observational
139 checklists.

140 Data Processing and Analysis

141 Data were entered using EpiData software (version 3.5.3) and analyzed with SPSS (version
142 26.0). Both descriptive and inferential statistics were used. Regression analysis was used to
143 examine the relationship between various parameters and WASH conditions. Paired-samples t-
144 tests were used to compare individual participants' KAP scores before and after the intervention,
145 with a significance level of $\alpha = 0.05$. Bloom's cut-off point for KAP studies was used to classify
146 results as 'good' ($\geq 80\%$), 'moderate' (60-80%), or 'poor' ($< 60\%$), as in Destaw et al. (2021).

147 Ethical Considerations

148 Ethical approval was received from the Ethical Review Board of the College of Development
149 Studies at Addis Ababa University. Permission to carry out the study was obtained from the

150 relevant education offices at the zone and district levels. Informed consent was obtained from
 151 household heads, school officials, and students over 18 years of age. Before the intervention,
 152 meetings were held with parents to describe the study's purpose and to get their consent for their
 153 children's participation.

154 **Results**

155 A total of 389 out of 402 schoolchildren participated in and completed food safety and healthy
 156 nutrition programs. Of these, 52.4% were female and 47.8% were male. Most participants (72.2%)
 157 were between 10 and 15 years old, while the remaining 27.8% were aged 16 to 20. Regarding
 158 residence, 50.6% of the participants lived in rural areas, and 49.4% lived in semi-urban settings.
 159 Concerning ethnicity, the Oromo group made up 90.2% of the participants (Table 1).

160

161 Table 1: Socio-demographic characteristics of primary schoolchildren in Kuyu district.

Variables	Category	Number (%)
Sex	Male	186 (47.8)
	Female	203 (52.4)
Age	10-15	281 (72.2)
	16-20	108 (27.8)
Residence	Rural	197 (50.6)
	Urban	192 (49.4)
Ethnicity	Oromo	351 (90.2)
	Amhara	27 (6.9)
	Others (Gurage, Walaita)	11 (2.8)
Family religion	Orthodox	280 (72.0)
	Protestant	97 (24.9)
	Others (Muslim, Waqefata)	12 (3.1)
Distance from school	0-2 km	300 (77.1)
	>2 kms	89 (22.9)
Physical Disability	No	374 (96.1)
	Yes	15 (3.9)

162

163 The intervention significantly improved student outcomes (Table 2), reducing the number of
 164 students with average semester scores below 75% (from 49.6% to 35.0%) and increasing the
 165 number of students scoring 75-89% (from 40.9% to 53.5%). Overall disease prevalence decreased

166 from 11.6% to 6.2%, accompanied by a slight decline in the proportion of diarrhea cases (from
 167 68.9% to 66.7%). School attendance also markedly improved, with 91.5% of students missing 0-
 168 2 days per month, a substantial increase from the prior 44.2% who missed over two days.

169

170 Table 2: Educational achievement and health-related issues among primary schoolchildren.

Variables	Intervention		Increase in percentage points
	Pre- Number (%)	Post- Number (%)	
Average semester score			
<75	193 (49.6)	136 (35.0)	-14.6
75-89	159 (40.9)	208 (53.5)	+12.6
>=90	37 (9.5)	45 (11.5)	+2.0
Experienced disease	45 (11.6)	24 (6.2)	-5.4
Types of disease			
Diarrhea	31 (8.0)	16 (4.1)	-3.9
Others (febrile illness, common cold)	14 (3.6)	8 (2.1)	-1.5
Number of days absent from school/month			
0-2 days	217 (55.8)	356 (91.5)	+35.7
>2 days	172 (44.2)	33 (8.5)	-35.7

171 Improved Knowledge Towards Food Safety and Nutrition

172 On average, post-intervention knowledge increased by 31 percentage points to 65% (moderate
 173 knowledge) across the 12 knowledge items (Table 3). A ‘good’ level of post-intervention
 174 knowledge (>80%) was observed in nutritional issues, such as discouraging sugar-rich foods and
 175 understanding the consequences of going to school without breakfast. ‘Good’ knowledge was also
 176 achieved in food safety topics, including storing food in a cool area, avoiding leftovers, preventing
 177 fecal contamination of food, and treating water. ‘Moderate’ post-intervention knowledge level (60-
 178 80%) was observed in signs of well-cooked foods and washing raw fruits and vegetables before
 179 consumption.

180 Improved but still insufficient post-intervention knowledge (<60%) was observed in signs of
 181 undernutrition, causes of undernutrition, and key moments for handwashing. No improvement was
 182 seen in the reasons for separating raw and cooked foods. This is not practiced possibly because, as
 183 stew is prepared and consumed immediately, the need to separate cooked from raw foods is not a
 184 major concern. Overall, the educational intervention has increased the knowledge of our

185 respondents, except for their understanding of how to separate raw and cooked foods to prevent
 186 kitchen contamination.

187 Table 3: Knowledge of nutrition- and food safety-related issues among primary school children
 188 in Kuyu district.

Knowledge variables	Intervention outcome		Increase in percentage points
	Pre-No. (%)	Post-No. (%)	
Consequences of a child going to school without breakfast	161 (41.4)	312 (80.2)	+38.8
Discourages sugar-rich foods	56 (14.4)	313 (80.5)	+66.1
Signs of undernutrition	96 (24.7)	176 (45.2)	+20.5
Causes of undernutrition	101 (26.0)	128 (32.9)	+6.9
Reason for separating raw and cooked foods	88 (22.6)	81 (20.8)	-1.8
Signs of well-cooked foods for safety	107 (27.5)	246 (63.2)	+35.7
Types of food to place in a cool place	217 (55.0)	361 (92.8)	+37.8
Reasons to avoid leftover foods	191 (49.1)	376 (96.6)	+47.5
Washing raw fruits and vegetables before eating	130 (33.4)	243 (62.5)	+29.1
How to prevent fecal contamination of food	265 (68.1)	378 (97.2)	+29.1
Key moment of hand washing	72 (14.5)	82 (21.1)	+6.6
How to treat water	104 (46.0)	368 (94.6)	+48.6
Average knowledge status	132 (33.9)	254 (65.3)	+31.4

189 Improved Attitudes Towards Food Safety and Nutrition

190 The intervention significantly improved students' attitudes towards health and food safety,
 191 which were initially "poor" (below 60%) across all 12 assessed items (Table 4). Post-intervention,
 192 attitudes showed an average increase of 42 percentage points (ranging from 20% to 55%),
 193 elevating the overall classification to a "moderate" level (60-80%). This indicates that the training
 194 notably improved schoolchildren's previously poor attitudes regarding nutrition and food safety to
 195 an acceptable standard.

196 Notable improvements included a rise in the seriousness attributed to food poisoning (8 to
 197 72%), an increase in eating breakfast before school (15 to 70%), a growth in the belief that iron-
 198 rich foods are healthy (15.7 to 66%), and greater awareness of the importance of handwashing (31
 199 to 61%) and boiling water before drinking (12 to 59%).

200

201 Table 4: Attitude of nutrition-related issues among primary school children in Kuyu district.

Attitude variables	Intervention outcome		Increase in percentage points
	Pre-No. (%)	Post-No. (%)	
Good to eat before school	59 (15.2)	274 (70.4)	+55.2
Good to have three meals with a snack	131 (29.0)	236 (60.7)	+31.7
Good to have a meal rich in iron (beef, chicken, liver, ...)	61 (15.7)	257 (66.1)	+50.4
Liking the taste of meat, eggs...	127 (32.6)	206 (53.0)	+20.4
Illness is likely from eating spoiled foods	53 (13.6)	206 (53.0)	+39.4
Food poisoning is serious	31 (8.0)	280 (72.0)	+64
Reheating leftover foods before eating is good	93 (23.9)	277 (71.2)	+47.3
Washing fruits with water is good	25 (6.4)	213 (54.8)	+48.4
Illness from not washing hands is likely	118 (30.8)	237 (60.9)	+30.1
Diarrhea is a serious health problem	86 (22.1)	239 (61.4)	+39.3
Handwashing is good before food preparation	75 (19.3)	195 (50.1)	+30.8
Boiling water before drinking	47 (12.1)	230 (59.1)	+47
Average Attitude status	19.5%	61.1%	+42

202 Overall, this demonstrates the intervention's significant impact in transforming information
 203 into positive behavioral intentions, indicating a substantial shift toward science-based health
 204 practices across all evaluated areas.

205 Improved Practices Towards Food Safety and Nutrition

206 Students' food safety and hygiene practices were initially very poor, with an average pre-
 207 intervention score of 17% (ranging from 6.4% to 26.5%). While the intervention led to a 13
 208 percentage point increase, the improved practices still fell below 60%, indicating that a "moderate"
 209 level of practice was not achieved (Table 5). This suggests that sustained support and monitoring
 210 beyond the study's duration are crucial for further improvement.

211 Table 5: Practice of nutrition-related issues among primary school children in Kuyu district,
 212 North Shewa Zone, Oromia, Ethiopia 2023

Practice variables	Intervention outcome		Increase in percentage points
	Pre-No. (%)	Post-No. (%)	
Eat vitamin A and iron-rich food	59 (15.2)	217 (55.8)	+40.6
Eat animal-source food	66 (17.0)	122 (31.4)	+14.4
Eat Vegetables	81 (20.8)	138 (35.5)	+14.7
Eat fruits	42 (10.8)	63 (16.2)	+5.4
Cleaning dirty utensils	76 (19.5)	129 (33.1)	+13.6
Store perishable foods	103 (26.5)	148 (38.1)	+11.6
Times of handwashing	97 (24.9)	97 (24.9)	+8.4
Treat the Water container for safety	64 (16.5)	87 (22.4)	+5.9
Treat water for drinking	49 (12.6)	108 (27.8)	+15.2
Ways of treating drinking water	25 (6.4)	54 (13.9)	+7.5
Average Practice	17%	29.9%	+12.9

213 Students' food safety and hygiene practices were initially very low, averaging only 17% (with
 214 a range of 6.4% to 26.5%) across the ten assessed items before the intervention. While the
 215 intervention led to a 13-percentage-point increase, these improvements still fell short of the 60%
 216 threshold needed to reach a "moderate" level of practice. This suggests that ongoing support and
 217 monitoring beyond the study period are crucial for achieving more substantial and sustained
 218 improvements in these practices.

219 Impact of intervention on KAP in food safety and nutrition

220 A paired-samples t-test was performed to assess the effectiveness of the food safety and health
 221 intervention by comparing the mean scores for schoolchildren's KAP before and after the
 222 intervention. The analysis showed statistically significant improvements in all three areas.

223 There was a notable increase in knowledge scores from pre-intervention ($M = 5.57$, $SD = 1.68$)
 224 to post-intervention ($M = 8.32$, $SD = 1.72$; $t(388) = -22.71$, $p < 0.0001$). This shows a large effect
 225 size of 1.6, indicating a significant improvement in students' understanding.

226 A notable positive change was observed in attitudes, with mean scores increasing from pre-
 227 intervention ($M = 4.25$, $SD = 1.35$) to post-intervention ($M = 7.82$, $SD = 2.00$; $t(388) = -28.98$, p

228 < 0.0001). This shift resulted in an even larger effect size of 2.1, reflecting a significant positive
229 change in students' attitudes toward food safety and health.

230 Students' practices also improved significantly, with mean scores increasing from pre-
231 intervention ($M = 5.54$, $SD = 1.34$) to post-intervention ($M = 8.16$, $SD = 1.49$; $t (388) = -31.08$,
232 $p < 0.0001$). This change was accompanied by a large effect size of 1.8, indicating a substantial
233 positive shift in health-related behaviors.

234 These results clearly show that the intervention had a highly significant and practically
235 meaningful impact on schoolchildren's knowledge, attitudes, and practices (KAP) regarding food
236 safety and health.

237 **Discussion**

238 The Knowledge, Attitudes, and Practices (KAP) model is a fundamental part of public health
239 research. It provides a systematic approach to understanding health behaviors, enabling researchers
240 to develop effective interventions and evaluate their outcomes (Zarei et al., 2024). The most
241 effective approach to understanding schoolchildren's food safety insights involves assessing their
242 knowledge, attitudes, and practices (Wanniarchchi and Abeysundara, 2023). This framework
243 indicates that improving KAP related to nutrition and food safety can significantly reduce
244 foodborne illnesses, enhance overall health, and lower the risk of malnutrition. Ultimately, KAP
245 greatly influences an individual's dietary choices and routines.

246 The findings of this study highlight the crucial role of school-based food safety and nutrition
247 education programs in improving the knowledge, attitudes, and practices (KAP) of schoolchildren
248 in our study area. The observed improvements align with regional and international research,
249 supporting the effectiveness of such interventions in similar settings (Bello et al., 2024; O'Brien et
250 al., 2021). School-based nutrition initiatives, including education, better food environments, and
251 comprehensive health-promoting strategies, can positively impact dietary outcomes.

252 **4.1 Impact on Knowledge**

253 Our intervention significantly improved schoolchildren's knowledge, as evidenced by a large
254 effect size (Cohen's $d = 1.6$), indicating a substantial increase in nutritional literacy and
255 underscoring the effectiveness of structured school-based programs. This aligns with findings from

256 similar interventions that have enhanced the understanding of healthy eating and nutrition among
257 schoolchildren (Chaudhary et al., 2020; EL Mokadem & Shokr, 2021; Mogre et al., 2024). A
258 consistent Ethiopian study also found that better diet-related behaviors were directly linked to
259 knowledge gains (Lombamo et al., 2024).

260 4.2 Impact on Attitudes

261 The fact that a sufficiently favorable attitude of students ($p < 0.05$) was obtained in the assessed
262 items aligns with other findings showing that nutrition education improves knowledge, attitudes,
263 and practices related to health, nutrition, and hygiene among junior and senior high school students
264 (Rimbawan et al., 2023; Kim et al., 2023). This demonstrates the success of the intervention in
265 fostering positive health-related attitudes, with improved favorable attitudes toward food safety
266 and nutrition (Wanniarachchi et al., 2022).

267 4.3 Impact on Practices

268 Although none of the practice items reached satisfactory levels (all below 60%), we observed a
269 statistically significant increase ($p < 0.05$) in the number of schoolchildren demonstrating good
270 food safety and healthy nutritional practices. This result, which is both statistically and
271 practically significant, highlights the effectiveness of structured health education in schools (El
272 Mokadem & Shokr, 2021; Mogre et al., 2024). It is often observed that a person's knowledge and
273 positive attitude do not always translate into action. This gap between what people know and
274 what they do is influenced by various factors, including environmental conditions, cultural
275 practices, and socioeconomic status. These elements can act as significant barriers, hindering the
276 adoption of desired behaviors even when an individual has favorable intentions.

277 These findings are supported by research from Islam et al. (2023) and Ramu et al. (2023), who
278 also discovered that school-based nutrition and hygiene programs, especially those utilizing hands-
279 on, interactive methods, are highly effective in promoting safe food handling and consumption.
280 These significant improvements emphasize the urgent need to fund similar school-based
281 interventions as part of national health promotion strategies.

282 4.4 Overall Impact and Comparative Strengths

283 The paired-samples t-test results consistently show significant improvements across all KAP
284 domains. Knowledge scores increased notably ($M_{pre} = 5.57$, $M_{post} = 8.32$; $t (388) = -22.71$,
285 $p < 0.0001$), with a very large effect size of 1.6. Attitudes also showed a highly significant positive
286 change ($M_{pre} = 4.25$, $M_{post} = 7.82$; $t (388) = -28.98$, $p < 0.0001$), with an even larger effect size
287 of 2.1. Likewise, practices significantly improved ($M_{pre} = 5.54$, $M_{post} = 8.16$; $t (388) = -31.08$,
288 $p < 0.0001$), reflecting a very large effect size of 1.8.

289 These findings indicate that, while pre-intervention knowledge, attitudes, and practices were
290 initially limited (averaging 34%, 20%, and 17%, respectively), the intervention significantly
291 improved schoolchildren's knowledge and attitudes. These areas saw an average increase of 37
292 percentage points, reaching a sufficient level (over 60%). This aligns with other studies that also
293 observed substantial improvements in schoolchildren's food safety attitudes relative to their
294 knowledge scores (Buyco et al., 2022; Wanniarachchi et al., 2022). This suggests the intervention
295 effectively translated knowledge into positive behavioral intentions and habits.

296 **Conclusion**

297 This study shows that a structured educational intervention significantly enhanced schoolchildren's
298 knowledge, attitudes, and practices (KAP) regarding food safety and nutrition. We observed
299 substantial, statistically significant improvements across all KAP areas, with effect sizes
300 demonstrating both practical and educational importance. Essentially, the intervention effectively
301 changed participants' understanding and behaviors toward safer and healthier food choices.

302 **Recommendations**

303 Given these powerful results, we recommend permanently integrating food safety and nutrition
304 education into school health curricula, ideally starting in primary school with involvement from
305 parents, guardians, and local stakeholders to reinforce learning and promote lasting behavior
306 change at home. We also suggest expanding this effective intervention strategy to more schools
307 and regions, supported by government health and education policies, and conducting longitudinal
308 mixed-method studies to assess the sustainability of these changes and identify areas for future
309 improvement. To better assess the lasting impact of our work, we suggest a follow-up evaluation.

310 This would help us see if the positive changes in knowledge, attitudes, and practices (KAP) are
311 maintained over time.

312 **Limitations of the study**

313 The questionnaires used in this study might cause students to report what they believe is expected
314 rather than their actual behavior. The study was conducted in only one district in Ethiopia; therefore,
315 the findings may not be applicable to other diverse regions or populations. The study did not
316 evaluate the KAP of students in lower primary grades, meaning the impact of the intervention on
317 younger children, who are also vulnerable, was not assessed. The three-month intervention and
318 monitoring period might not be sufficient to observe lasting behavioral changes, indicating the
319 need for longer-term follow-up.

320 **Declarations**

321 8.1 Acknowledgements. None

322 8.2 Consent for publication. Not applicable.

323 8.3 Availability of data and materials. All data generated or analyzed during this study are included
324 in this manuscript.

325 8.4 Conflicts of interest. The authors declare no conflicts of interest

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327 role in study design, data collection, analysis, decision to publish, or preparation of the manuscript.

328 8.6 Authorship. K.K.: Conceptualization, Methodology, Data Collection, Investigation, Analysis,
329 Writing original draft. A.S.: Conceptualization, Supervision, Review & Editing. M.A.
330 Conceptualization, Methodology, Analysis, Supervision, Review & Editing.

331 8.7 Declaration of generative AI and AI-assisted technologies in the writing process.

332 During the preparation of this work, we utilized the Gemini language model to enhance the
333 readability and language of the manuscript. After using this service, we reviewed and edited the
334 content as needed and take full responsibility for the content of the published article.

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