

Prevalence of health conditions among school-age children: Timor-Leste's first nationwide cross-sectional screening study

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Abstract

Background

Timor-Leste has one of Southeast Asia's youngest populations, yet systematic health data on school-aged children has been lacking. The School-Based Primary Health Care Package was implemented nationwide in 2025 to establish baseline health status among school-age children and build coordinated school health services.

Methods

This secondary analysis used data from a nationwide cross-sectional screening program conducted across all 14 municipalities of Timor-Leste from February to November 2025, targeting students in Grades 1–9. Healthcare workers conducted standardized assessments of nutritional status, oral health, vision, hearing, skin conditions, and substance use. Prevalence rates with 95% confidence intervals were calculated at national and municipal levels. Geographic variation was assessed using Pearson chi-square tests with Cramér's V for effect sizes. Subgroup analyses by school type (primary, primary+secondary, secondary) served as proxy age-group stratification.

Results

Among 262,434 students screened (87.0% of 301,596 enrolled; 50.2% male, 49.8% female) across 1,371 schools (98.8%), dental caries affected 78,643 students (30.0%, 95% CI: 29.8–30.1%), undernutrition 53,565 (20.4%, 95% CI: 20.3–20.6%), poor oral hygiene 44,545 (17.0%), and overweight/obesity 12,457 (4.7%). Geographic variation was statistically significant for all conditions (all $p < 0.001$): undernutrition ranged from 11.3% in Manufahi to 29.9% in Oecusse (prevalence ratio 2.66); dental caries from 8.3% in Atauro to 44.9% in Lautem. School-type subgroup analysis revealed a 13-fold gradient in tobacco use (primary 0.6% to secondary 7.9%, $p < 0.001$) and 8-fold gradient in alcohol use (0.5% to 3.9%, $p < 0.001$), consistent with age-related initiation.

Conclusions

This first nationwide school health screening in Timor-Leste establishes oral health conditions and undernutrition as priority health burdens, with significant geographic inequities requiring targeted interventions. Findings provide evidence for implementing school-based oral health programs, prioritizing nutrition interventions in high-burden municipalities, and strengthening coordinated school health systems.

Background

School health programs represent evidence-based approaches to improving child health outcomes by reaching children during critical developmental periods in settings where they spend significant time [1]. Schools provide unique platforms for delivering preventive health services, conducting health surveillance, and promoting healthy behaviors among populations that may otherwise have limited healthcare access [2, 3]. For countries with young populations and developing health systems, school-based health services offer efficient mechanisms for achieving health equity and enabling early disease detection [4].

Timor-Leste, Southeast Asia's youngest nation, has one of the region's youngest populations, with children under 14 years comprising approximately 35% of the total population [5]. While prior surveys have provided valuable data on adolescent health behaviors and nutritional status—the Global School-based Student Health Survey (GSHS) conducted in 2015 and Global Youth Tobacco Survey (GYTS) in 2019 assessed risk behaviors among secondary school students aged 13–17 years, and the 2020 Timor-Leste Food and Nutrition Survey (TLFNS) assessed nutritional indicators among children under 5 years and women of reproductive age—systematic physical health screening data across all primary school-aged children has been lacking. This gap has limited evidence-based policy development and resource allocation for comprehensive child health services, particularly for younger students and for conditions requiring clinical assessment rather than self-report.

Recognition of this evidence gap led to development of the School-Based Primary Health Care Package (PHCP), implemented under the national Say No to 5S program addressing five priority health conditions: malnutrition (Starvation), Skin infections, Soil-transmitted helminthiasis, Smoking (tobacco use), and Sugary and alcoholic beverages. The PHCP represents the first systematic, nationwide effort to assess health status of school-aged children in Timor-Leste.

The program was implemented through multi-sectoral partnership involving the Ministry of Health (MoH) as lead implementing agency, the Ministry of Education (MoE) coordinating school access and student data management, the World Health Organization (WHO) providing technical assistance, and the Korea International Cooperation Agency (KOICA) providing financial support. This coordinated school health approach aligns with international frameworks emphasizing collaboration across sectors to maximize student health, safety, and learning outcomes [6].

Early detection of health conditions during childhood enables timely intervention, preventing progression to more serious conditions and supporting healthy development and academic success [7, 8]. School-based screening programs have demonstrated effectiveness in identifying undiagnosed conditions, connecting students with needed services, and reducing health disparities [9, 10]. However, limited evidence exists regarding implementation and outcomes of comprehensive school health screening in resource-limited settings, particularly in Southeast Asia.

Previous studies in the region have documented high prevalence of dental caries (25–95%) [11, 12] and persistent childhood malnutrition [13], but comprehensive, population-level data from school-based

screening remains limited. This study addresses this evidence gap by providing the first nationwide assessment of multiple health conditions among school-aged children in Timor-Leste.

Using data from the PHCP program, this study aimed to: (1) determine the prevalence of key health conditions among school-aged students in Timor-Leste; (2) examine geographic variation in child health status across municipalities and quantify the magnitude of these differences; (3) assess variation in health conditions by school type as a proxy for age-group stratification; and (4) provide evidence for school health policy development and resource allocation.

Methods

Study design and setting

This study presents a secondary analysis of data collected through the PHCP, a national public health screening program implemented across all 14 municipalities of Timor-Leste from February to November 2025. The PHCP targeted all students enrolled in Grades 1–9 of basic education during the 2025 academic year. Data were collected primarily for service delivery and program monitoring purposes; the present analysis applies epidemiological methods to these existing program data to characterize health conditions among school-aged children.

Participants

The target population comprised all students enrolled in basic education (Grades 1–9) in Timor-Leste (N = 301,596 students across 1,387 schools). Students were eligible for screening if they were present at school during scheduled screening visits and had parental consent. No exclusion criteria were applied based on health status, disability, or other characteristics.

Informed consent

was obtained from parents or guardians of all students prior to screening. Students whose parents declined consent or who were absent on the screening day were not screened. Verbal assent was obtained from children following national ethical guidelines; children were informed about the screening procedures in age-appropriate language and told they could decline any individual assessment without consequence.

Training and capacity building

A cascade training model built workforce capacity at multiple levels. Municipal advocacy sessions oriented leadership to program objectives and implementation planning. Healthcare workers (n = 1,025; 37.2% male, 62.8% female) received 1.5 days of training covering examination techniques for all health domains, referral criteria, and data recording procedures. Training topics included anthropometric

assessment, vision and hearing screening, oral health examination, skin condition assessment, and substance use screening protocols. Teachers (n = 2,594; 55.9% male, 44.1% female) received 1 day of orientation on classroom preparation, student form completion, and health education delivery. Phases 2 and 3 incorporated refresher training for community health centre (CHC) staff to address quality concerns identified in Phase 1.

Screening procedures and instrumentation

Screening was conducted at schools by teams comprising 2–4 healthcare workers and 2–10 teachers using station-based protocols. Students moved through screening stations in small groups while maintaining privacy for individual assessments.

Anthropometric assessment: Height was measured using portable stadiometers to the nearest 0.1 cm with students standing barefoot. Weight was measured using calibrated digital scales to the nearest 0.1 kg. Body mass index (BMI) was calculated and classified using the WHO growth reference for children and adolescents aged 5–19 years [14]. Nutritional status categories included: severely underweight (BMI-for-age < - 3 standard deviation (SD)), underweight (- 3 SD ≤ BMI-for-age < - 2 SD), normal (- 2 SD ≤ BMI-for-age ≤ + 1 SD), overweight (+ 1 SD < BMI-for-age ≤ + 2 SD), and obese (BMI-for-age > + 2 SD).

Oral health examination

Visual inspection using disposable tongue depressors and portable lighting assessed presence of dental caries, oral hygiene status, and soft tissue lesions. Oral hygiene was classified as poor based on visible plaque accumulation and gingival inflammation. No standardized caries index (e.g., decayed, missing, and filled teeth (DMFT)/dmft) was used, as the protocol was designed for rapid screening by non-specialist healthcare workers rather than detailed dental assessment.

Eye health and vision screening

Visual inspection using portable lighting assessed presence of conjunctivitis and eye lesions. Visual acuity was assessed using Snellen charts at 3 meters distance. Color vision was screened using Ishihara plates. Students unable to correctly identify test images or read the designated line on the Snellen chart were flagged for referral.

Ear health and hearing screening

Visual inspection using otoscope assessed presence of otitis media, foreign body, and other lesions. Hearing was assessed through whispered voice test at 0.6 meters. Students unable to correctly repeat whispered words were referred for audiometric evaluation.

Skin assessment

Visual inspection identified common skin conditions including scabies, fungal infections, and other dermatological conditions. Scabies diagnosis followed standard clinical criteria based on characteristic lesions and distribution patterns.

Substance use screening

Self-reported tobacco and alcohol use in the past 12 months was obtained through interviewer-administered confidential interview. Substance use questions were administered to students across all grades as part of the standardized screening protocol. Students were assured of confidentiality to encourage honest reporting, though the interviewer-administered format and school setting may have constrained disclosure, particularly among younger students.

All screening tools were selected for feasibility of use by trained healthcare workers in school settings without specialized equipment requirements.

Implementation phases

Implementation occurred in three phases to enable adaptive learning and quality improvement. Phase 1 (February–May 2025) covered 4 municipalities (Aileu, Dili, Lautem, Liquica; 358 schools, 115,035 enrolled students). Phase 2 (May–September 2025) covered 5 municipalities (Ainaro, Baucau, Bobonaro, Ermera, Viqueque; 674 schools, 134,744 enrolled students). Phase 3 (July–September 2025) covered 5 municipalities (Atauro, Covalima, Manatuto, Manufahi, Oecusse; 354 schools, 63,609 enrolled students). The phased approach enabled program adaptation based on lessons learned from earlier phases.

Quality assurance and monitoring

Multi-level monitoring involved national teams (MoH, MoE, WHO personnel), municipal teams (health and education directors, district public health officers, school inspectors), and facility-level supervisors (CHC heads). Real-time communication through messaging platforms enabled immediate feedback and quality assurance. Supervisors verified adherence to screening protocols through on-site observation.

Referral process

Students requiring further evaluation or treatment received written referrals to CHCs or district hospitals. Referral criteria included: vision or hearing abnormalities, untreated dental caries requiring restorative treatment, severe malnutrition, health conditions requiring medical treatment, and any serious conditions identified during examination.

Data management and statistical analysis

Data were collected using standardized forms and entered into the national health information system (Timor-Leste Health Information System). Individual student records were aggregated at the school level. Data verification was conducted at municipal and national levels to ensure accuracy and completeness.

Descriptive statistics were used to calculate prevalence rates for identified conditions at national and municipal levels, with 95% confidence intervals (CI) estimated using the Wilson score method. Coverage rates were calculated as the percentage of enrolled students screened, with sex-disaggregated analyses. Geographic variation in prevalence across municipalities was assessed using Pearson chi-square tests, with Cramér's V reported as a measure of effect size (benchmarks: < 0.10 negligible–small; 0.10–0.30 small–moderate; 0.30–0.50 moderate–large). Prevalence ratios were calculated comparing the highest- and lowest-prevalence municipalities for key conditions.

Since individual-level age and grade data were not available for analysis (data were aggregated at the school level), subgroup analyses by school type were conducted as a proxy for age-group stratification. Schools were classified as primary (serving Grades 1–6, approximately ages 6–12), secondary (serving Grades 7–9, approximately ages 13–15), or primary+secondary (serving Grades 1–9). Cross-tabulations of substance use by school type and municipality were performed to assess whether geographic patterns persisted after accounting for school-type composition. All analyses were conducted using Python 3.12 with scipy 1.13 and pandas 2.2.

Results

Programme coverage and participation

Of 1,387 basic education schools nationally, 1,371 (98.8%) were reached by the program. Among 301,596 enrolled students, 262,434 (87.0%) participated in screening, including 131,634 males (50.2%) and 130,800 females (49.8%).

Screening coverage varied by municipality, ranging from 76.1% (Ermera) to 93.1% (Manatuto) (Table 1). Five municipalities achieved coverage $\geq 90\%$: Manatuto (93.1%), Aileu (91.7%), Dili (91.5%), Baucau (90.4%), and Lautem (90.3%). Four municipalities remained below 85%: Ermera (76.1%), Ainaro (78.7%), Bobonaro (82.1%), and Oecusse (84.1%). Coverage was also higher in secondary schools (89.2%) than in primary schools (86.5%).

Table 1
Screening coverage by municipality and sex

Municipality	Total Enrolled	Total Screened	Coverage (%)	Male Coverage (%)	Female Coverage (%)	Difference (pp)
Manatuto	11,835	11,024	93.1	92.0	94.4	+ 2.4
Aileu	12,574	11,530	91.7	90.9	92.5	+ 1.6
Dili	67,232	61,531	91.5	89.8	93.3	+ 3.5
Baucau	30,604	27,681	90.4	88.6	92.4	+ 3.7
Lautem	17,223	15,553	90.3	87.7	93.1	+ 5.4
Atauro	2,192	1,971	89.9	87.2	93.0	+ 5.8
Liquica	19,715	17,625	89.4	87.8	91.1	+ 3.3
Covalima	16,125	14,274	88.5	86.3	90.8	+ 4.5
Viqueque	18,475	16,306	88.3	85.3	91.4	+ 6.1
Manufahi	12,869	10,956	85.1	82.3	88.1	+ 5.8
Oecusse	18,221	15,320	84.1	81.7	86.5	+ 4.8
Bobonaro	24,451	20,071	82.1	79.9	84.3	+ 4.4
Ainaro	17,971	14,144	78.7	76.2	81.3	+ 5.1
Ermera	32,109	24,448	76.1	72.6	80.0	+ 7.4
National	301,596	262,434	87.0	84.8	89.3	+ 4.5

Municipalities ordered by coverage (highest to lowest). Difference = female coverage minus male coverage in percentage points (pp). Female students had consistently higher coverage across all 14 municipalities ($\chi^2 = 1,332.3$, $df = 1$, $p < 0.001$).

Sex-disaggregated coverage analysis revealed significantly higher participation among female students (89.3%) compared with male students (84.8%) nationally ($\chi^2 = 1,332.3$, $df = 1$, $p < 0.001$). This difference was consistent across all 14 municipalities, with female coverage exceeding male coverage by 1.6 to 7.4 percentage points. The largest disparities were observed in Ermera (+ 7.4 pp), Viqueque (+ 6.1 pp), and Atauro and Manufahi (+ 5.8 pp each).

Sixteen schools (1.2%) were not reached during implementation due to land disputes preventing school access ($n = 2$), school refusal of participation ($n = 1$), extreme geographic remoteness without adequate transportation support ($n = 2$), administrative boundary confusion between health facility catchment areas ($n = 1$), and unresolved access issues in one municipality ($n = 10$).

Nutritional status

BMI assessment was completed for 261,438 students (99.6% of the screened population). Results revealed a dual burden of malnutrition: 53,565 students (20.4%, 95% CI: 20.3–20.6%) were classified as underweight or severely underweight, while 12,457 students (4.7%, 95% CI: 4.7–4.8%) were overweight or obese (Table 2). Specifically, 11,914 students (4.6%) were severely underweight, 41,651 (15.9%) underweight, 195,416 (74.7%) normal weight, 9,161 (3.5%) overweight, and 3,296 (1.3%) obese.

Table 2
Prevalence of key health conditions among screened students (N = 262,434)

Health Condition	n	Prevalence (%)	95% CI
Dental caries	78,643	30.0	29.8–30.1
Undernutrition (low BMI-for-age)	53,565	20.4	20.3–20.6
Poor oral hygiene	44,545	17.0	16.8–17.1
Other dental conditions	40,173	15.3	15.2–15.5
Referral required	39,488	15.1	14.9–15.2
Overweight/obesity	12,457	4.7	4.7–4.8
Other skin conditions	11,017	4.2	4.1–4.3
Tobacco use (past year)	5,265	2.0	2.0–2.1
Allergies	3,033	1.2	1.1–1.2
Ear abnormality	2,898	1.1	1.1–1.1
Alcohol use (past year)	2,894	1.1	1.1–1.1
Eye abnormality	1,275	0.49	0.46–0.51
Scabies	995	0.38	0.36–0.40
Hearing abnormality	864	0.33	0.31–0.35

CI = confidence interval (Wilson score method). Prevalence calculated as percentage of screened students. Oral health conditions (dental caries, poor oral hygiene, other dental conditions) collectively represent the highest disease burden.

Geographic variation in undernutrition prevalence was statistically significant ($\chi^2 = 2,834.5$, $df = 13$, $p < 0.001$; Cramér's $V = 0.10$), ranging from 11.3% (95% CI: 10.7–11.9%) in Manufahi to 29.9% (95% CI: 29.2–30.7%) in Oecusse (prevalence ratio 2.66, $\chi^2 = 1,289.6$, $p < 0.001$) (Table 3 and Fig. 1). Two municipalities showed prevalence exceeding 28%: Oecusse (29.9%) and Atauro (28.8%, 95% CI: 26.8–30.8%). The capital municipality of Dili showed elevated undernutrition (24.4%, 95% CI: 24.0–24.7%) despite urban status. Municipalities with lowest undernutrition rates included Manufahi (11.3%), Ainaro (14.2%, 95% CI: 13.6–14.8%), and Manatuto (15.2%, 95% CI: 14.6–15.9%).

Table 3
Geographic variation in undernutrition and dental caries prevalence by municipality

Municipality	Screened	Undernutrition n	Prevalence (%)	95% CI	Dental caries n	Prevalence (%)	95% CI
Oecusse	15,320	4,585	29.9	29.2–30.7	3,179	20.8	20.1–21.4
Atauro	1,971	567	28.8	26.8–30.8	164	8.3	7.2–9.6
Dili	61,531	14,993	24.4	24.0–24.7	18,600	30.2	29.9–30.6
Bobonaro	20,071	4,214	21.0	20.4–21.6	5,237	26.1	25.5–26.7
Baucau	27,681	5,589	20.2	19.7–20.7	10,252	37.0	36.5–37.6
Liquica	17,625	3,527	20.0	19.4–20.6	5,449	30.9	30.2–31.6
Lautem	15,553	3,021	19.4	18.8–20.1	6,978	44.9	44.1–45.6
Aileu	11,530	2,160	18.7	18.0–19.5	3,784	32.8	32.0–33.7
Ermera	24,448	4,540	18.6	18.1–19.1	7,067	28.9	28.3–29.5
Viqueque	16,306	2,991	18.3	17.8–18.9	3,676	22.5	21.9–23.2
Covalima	14,274	2,458	17.2	16.6–17.8	3,695	25.9	25.2–26.6
Manatuto	11,024	1,679	15.2	14.6–15.9	4,209	38.2	37.3–39.1
Ainaro	14,144	2,007	14.2	13.6–14.8	3,733	26.4	25.7–27.1
Manufahi	10,956	1,234	11.3	10.7–11.9	2,620	23.9	23.1–24.7
National	262,434	53,565	20.4	20.3–20.6	78,643	30.0	29.8–30.1

Municipalities ordered by undernutrition prevalence (highest to lowest). CI = confidence interval (Wilson score method). Undernutrition: $\chi^2 = 2,834.5$, $df = 13$, $p < 0.001$, Cramér's $V = 0.10$; prevalence ratio (Oecusse vs Manufahi) = 2.66. Dental caries: $\chi^2 = 4,748.4$, $df = 13$, $p < 0.001$, Cramér's $V = 0.13$; prevalence ratio (Lautem vs Atauro) = 5.39.

Side-by-side comparison of municipal prevalence for undernutrition (A) and dental caries (B). Color gradients indicate prevalence levels, with darker shades representing higher rates. Vertical dashed lines denote national average values. Municipalities are ranked from highest to lowest prevalence. Undernutrition ranged from 11.3% (Manufahi) to 29.9% (Oecusse), prevalence ratio = 2.66 ($p < 0.001$). Dental caries ranged from 8.3% (Atauro) to 44.9% (Lautem), prevalence ratio = 5.39 ($p < 0.001$). Error bars represent 95% confidence intervals (Wilson score method).

Overweight/obesity also varied significantly across municipalities ($\chi^2 = 3,618.9$, $df = 13$, $p < 0.001$; Cramér's $V = 0.12$), with Dili showing the highest rate (8.7%, 95% CI: 8.4–8.9%) and Ermera the lowest (1.2%, 95% CI: 1.0–1.3%).

Oral health conditions

Oral health conditions represented the highest disease burden identified among screened students. Dental caries affected 78,643 students (30.0%, 95% CI: 29.8–30.1% nationally), poor oral hygiene was identified in 44,545 students (17.0%, 95% CI: 16.8–17.1%), and other dental conditions affected 40,173 students (15.3%) (Table 2). Ulcers and soft tissue lesions were identified in 1,391 students (0.5%).

Dental caries prevalence varied significantly across municipalities ($\chi^2 = 4,748.4$, $df = 13$, $p < 0.001$; Cramér's $V = 0.13$), ranging from 8.3% (95% CI: 7.2–9.6%) in Atauro to 44.9% (95% CI: 44.1–45.6%) in Lautem (prevalence ratio 5.39, $\chi^2 = 966.1$, $p < 0.001$) (Table 3 and Fig. 1). Municipalities with highest caries prevalence included Lautem (44.9%), Manatuto (38.2%, 95% CI: 37.3–39.1%), and Baucau (37.0%, 95% CI: 36.5–37.6%). Urban areas did not consistently show lower caries rates, with Dili reporting 30.2% (95% CI: 29.9–30.6%), equal to the national average.

Poor oral hygiene showed the largest geographic variation of any condition ($\chi^2 = 14,807.4$, $df = 13$, $p < 0.001$), with highest rates in Ermera (32.3%, 95% CI: 31.7–32.9%), Manatuto (27.9%, 95% CI: 27.1–28.8%), and Baucau (25.8%, 95% CI: 25.3–26.3%).

Vision and hearing conditions

Eye abnormalities were identified in 1,275 students (0.49%, 95% CI: 0.46–0.51%), with 872 students (0.33%) requiring vision referral (Table 4). Color vision abnormalities affected 788 students (0.30%). Only 144 students (0.05%) currently wore corrective lenses, suggesting significant unmet need for vision correction services.

Table 4
Vision, hearing, and skin conditions among screened students (N = 262,434)

Condition	n	Prevalence (%)	95% CI
Eye abnormality	1,275	0.49	0.46–0.51
Vision referral required	872	0.33	0.31–0.36
Color vision abnormality	788	0.30	0.28–0.32
Currently wearing corrective lenses	144	0.05	0.05–0.06
Ear abnormality	2,898	1.10	1.07–1.15
Hearing abnormality	864	0.33	0.31–0.35
Scabies	995	0.38	0.36–0.40
Other skin conditions	11,017	4.20	4.12–4.28

CI = confidence interval (Wilson score method). Geographic variation was statistically significant for eye abnormalities ($\chi^2 = 326.5$, $p < 0.001$), ear abnormalities ($\chi^2 = 740.7$, $p < 0.001$), hearing abnormalities ($\chi^2 = 637.6$, $p < 0.001$), and scabies ($\chi^2 = 438.8$, $p < 0.001$, Cramér's $V = 0.04$). Only 0.05% of students currently wore corrective lenses despite 0.33% requiring vision referral, indicating substantial unmet need.

Ear abnormalities were identified in 2,898 students (1.10%, 95% CI: 1.07–1.15%), and hearing abnormalities in 864 students (0.33%, 95% CI: 0.31–0.35%). Geographic variation was observed for both ear abnormalities ($\chi^2 = 740.7$, $df = 13$, $p < 0.001$) and hearing abnormalities ($\chi^2 = 637.6$, $df = 13$, $p < 0.001$), with elevated rates in Aileu (hearing abnormalities 1.2%, 95% CI: 1.0–1.4%), Viqueque (ear abnormalities 1.6%, 95% CI: 1.4–1.8%), and Manufahi (ear abnormalities 1.6%, hearing abnormalities 0.7%, 95% CI: 0.6–0.9%).

Skin conditions

Scabies was identified in 995 students (0.38%, 95% CI: 0.36–0.40% nationally) with statistically significant geographic variation ($\chi^2 = 438.8$, $df = 13$, $p < 0.001$; Cramér's $V = 0.04$). Three municipalities showed elevated prevalence: Viqueque (1.0%, 95% CI: 0.9–1.2%), Manufahi (0.9%, 95% CI: 0.7–1.1%), and Lautem (0.7%, 95% CI: 0.5–0.8%). Other skin conditions affected 11,017 students (4.2%), with highest rates in Ainaro (8.6%), Liquica (7.7%), and Oecusse (7.3%).

Substance use

Self-reported tobacco use in the past year was identified in 5,265 students (2.0%, 95% CI: 2.0–2.1%), and alcohol use in 2,894 students (1.1%, 95% CI: 1.1–1.1%) (Table 5). Geographic variation was statistically significant for both tobacco ($\chi^2 = 1,819.8$, $df = 13$, $p < 0.001$; Cramér's $V = 0.08$) and alcohol ($\chi^2 = 2,016.2$, $df = 13$, $p < 0.001$; Cramér's $V = 0.09$). Urban municipalities showed higher prevalence: Dili reported tobacco use of 3.7% (95% CI: 3.5–3.8%) and alcohol use of 2.5% (95% CI: 2.4–2.7%), followed by Baucau (tobacco 2.9%, 95% CI: 2.7–3.1%; alcohol 1.8%, 95% CI: 1.7–2.0%).

Table 5
Self-reported substance use by municipality

Municipality	Screened	Tobacco n	Prevalence (%)	95% CI	Alcohol n	Prevalence (%)	95% CI
Dili	61,531	2,264	3.7	3.5– 3.8	1,559	2.5	2.4– 2.7
Baucau	27,681	801	2.9	2.7– 3.1	506	1.8	1.7– 2.0
Oecusse	15,320	433	2.8	2.6– 3.1	55	0.4	0.3– 0.5
Manufahi	10,956	242	2.2	1.9– 2.5	99	0.9	0.7– 1.1
Manatuto	11,024	176	1.6	1.4– 1.8	80	0.7	0.6– 0.9
Lautem	15,553	202	1.3	1.1– 1.5	128	0.8	0.7– 1.0
Liquica	17,625	230	1.3	1.1– 1.5	121	0.7	0.6– 0.8
Bobonaro	20,071	249	1.2	1.1– 1.4	52	0.3	0.2– 0.3
Ainaro	14,144	169	1.2	1.0– 1.4	95	0.7	0.5– 0.8
Ermera	24,448	217	0.9	0.8– 1.0	43	0.2	0.1– 0.2
Covalima	14,274	116	0.8	0.7– 1.0	49	0.3	0.3– 0.5
Atauro	1,971	12	0.6	0.3– 1.1	26	1.3	0.9– 1.9
Aileu	11,530	67	0.6	0.5– 0.7	32	0.3	0.2– 0.4
Viqueque	16,306	87	0.5	0.4– 0.7	49	0.3	0.2– 0.4
National	262,434	5,265	2.0	2.0– 2.1	2,894	1.1	1.1– 1.1

Municipalities ordered by tobacco use prevalence (highest to lowest). CI = confidence interval (Wilson score method). Tobacco use: $\chi^2 = 1,819.8$, $df = 13$, $p < 0.001$, Cramér's $V = 0.08$. Alcohol use: $\chi^2 = 2,016.2$, $df = 13$, $p < 0.001$, Cramér's $V = 0.09$. Urban municipalities (Dili and Baucau) showed the highest prevalence. Substance use estimates should be interpreted as floor values due to the interviewer-administered format.

Subgroup analysis by school type

School-type subgroup analysis (Table 6), revealed tobacco use increased from 0.6% (95% CI: 0.5–0.6%) in primary schools to 2.2% (95% CI: 2.1–2.3%) in primary+secondary schools to 7.9% (95% CI: 7.6–8.2%) in secondary schools ($\chi^2 = 7,988.9$, $df = 2$, $p < 0.001$), representing a 13-fold gradient. Alcohol use showed a similar 8-fold gradient from 0.5% in primary schools to 3.9% in secondary schools ($\chi^2 = 3,129.1$, $df = 2$, $p < 0.001$). Dental caries showed the reverse pattern, with higher prevalence in primary schools (32.8%, 95% CI: 32.6–33.0%) than secondary schools (24.6%, 95% CI: 24.2–25.0%) ($\chi^2 = 1,518.4$, $df = 2$, $p < 0.001$). Undernutrition was highest in primary schools (21.7%, 95% CI: 21.5–21.9%) and lower in primary+secondary schools (18.0%, 95% CI: 17.8–18.3%) ($\chi^2 = 408.0$, $df = 2$, $p < 0.001$). Overweight/obesity showed an increasing trend from primary (4.1%) to secondary (5.9%) schools ($\chi^2 = 349.3$, $df = 2$, $p < 0.001$). Scabies showed no significant variation by school type ($\chi^2 = 2.2$, $df = 2$, $p = 0.338$).

Table 6
Subgroup analysis of health conditions by school type

Condition	Primary (Gr 1–6) n = 156,732	Primary+Secondary (Gr 1–9) n = 69,511	Secondary (Gr 7–9) n = 36,191	χ^2 (df = 2)	p- value
Undernutrition	21.7 (21.5– 21.9)	18.0 (17.8–18.3)	19.5 (19.1– 19.9)	408.0	< 0.001
Overweight/obesity	4.1 (4.0–4.2)	5.6 (5.4–5.8)	5.9 (5.6–6.1)	349.3	< 0.001
Dental caries	32.8 (32.6– 33.0)	26.4 (26.1–26.7)	24.6 (24.2– 25.0)	1,518.4	< 0.001
Poor oral hygiene	17.9 (17.7– 18.1)	15.0 (14.8–15.3)	16.7 (16.3– 17.1)	277.2	< 0.001
Tobacco use	0.6 (0.5–0.6)	2.2 (2.1–2.3)	7.9 (7.6–8.2)	7,988.9	< 0.001
Alcohol use	0.5 (0.5–0.5)	1.0 (0.9–1.1)	3.9 (3.7–4.1)	3,129.1	< 0.001
Scabies	0.4 (0.3–0.4)	0.4 (0.4–0.5)	0.4 (0.3–0.4)	2.2	0.338
Ear abnormalities	1.3 (1.2–1.3)	0.9 (0.8–0.9)	0.8 (0.7–0.9)	116.8	< 0.001
Hearing abnormalities	0.4 (0.3–0.4)	0.2 (0.2–0.3)	0.3 (0.2–0.3)	29.6	< 0.001

Values are prevalence % (95% CI, Wilson score method). School type serves as proxy for age-group stratification: primary schools serve Grades 1–6 (approximately ages 6–12), secondary schools serve Grades 7–9 (approximately ages 13–15), and primary+secondary schools serve Grades 1–9. Substance use showed the strongest school-type gradient (13-fold for tobacco, 8-fold for alcohol), consistent with age-related initiation. Dental caries showed a reverse gradient, consistent with deciduous-to-permanent tooth transition. Scabies showed no significant variation by school type ($p = 0.338$), confirming its geographic rather than age-related distribution.

Cross-tabulation of substance use by school type and municipality confirmed that the urban–rural gradient persisted within school types. Among secondary schools, tobacco use in Dili (13.2%) remained substantially higher than in Lautem (4.6%) or Manufahi (3.6%).

Other health conditions and preventive services

Allergies were reported in 3,033 students (1.2%), serious injury or illness in 380 students (0.14%), and mobility impairment in 247 students (0.09%; 146 male, 101 female). During the program, diphtheria-tetanus (DT) vaccination was administered to 14,691 Grade 1 students and human papillomavirus (HPV) vaccination to 7,922 Grade 6 female students, demonstrating successful integration of preventive services. A total of 39,488 students (15.1%) were referred for follow-up care based on identified health conditions requiring medical evaluation or treatment.

Discussion

This first nationwide school health screening in Timor-Leste successfully assessed 262,434 students across 1,371 schools in all 14 municipalities, establishing baseline prevalence data for key health conditions among school-aged children. The study demonstrates both the feasibility of implementing comprehensive school-based health screening in a resource-limited setting and the substantial disease burden requiring public health intervention.

Principal findings in context

Oral health conditions, particularly dental caries affecting 30.0% of students (95% CI: 29.8–30.1%), emerged as the predominant health burden. This prevalence aligns with patterns documented in neighboring Southeast Asian countries, where school-age dental caries prevalence ranges from 28% to 43% in Indonesia among children aged 12–15 years using DMFT indices [11] and 33% to 65% among 5–6-year-olds in Cambodia using WHO diagnostic criteria [12]. Direct comparison is limited by differences in age groups and assessment methods—our study used visual inspection without standardized DMFT scoring—but the consistency of these findings across the region confirms that oral health represents a critical unmet need in Southeast Asia, consistent with global patterns showing highest dental disease burden in low- and middle-income countries [15].

Undernutrition affected one in five students nationally (20.4%, 95% CI: 20.3–20.6%), consistent with the 2015 GSHS which found 23.5% (95% CI: 17.0–31.6%) underweight among students aged 13–15 years. The 2020 TLFNS provides important context: among children 0–59 months, stunting prevalence was 47.1% (95% CI: 46.2–48.0%), underweight 32.4% (95% CI: 31.5–33.2%), and wasting 8.6% (95% CI: 8.1–9.1%) [13]. Notably, the 2020 TLFNS documented continued improvement from earlier surveys—stunting declined from 58.1% in 2010 to 50.2% in 2016 to 47.1% in 2020, while underweight decreased from 44.7% to 37.7% to 32.4% over the same period. Our finding of 20.4% undernutrition among school-aged children suggests this improving trend may extend into older age groups, though the persistent burden indicates undernutrition remains a critical challenge. The geographic variation observed in undernutrition was

statistically significant with a small effect size (Cramér's $V = 0.10$), and the 2.7-fold prevalence ratio between Oecusse and Manufahi reflects known disparities in food security and development indicators across Timor-Leste's municipalities [16].

The dual burden of malnutrition observed (20.4% undernutrition; 4.7% overweight/obesity) reflects the ongoing nutrition transition documented globally in low- and middle-income countries [17]. These overweight/obesity rates are consistent with the 2015 GSHS findings (4.9% overweight, 0.8% obese among 13–15-year-olds). The school-type analysis further supports this transition pattern: overweight/obesity increased from 4.1% in primary schools to 5.9% in secondary schools, while undernutrition was highest in primary schools (21.7%). This dual burden mirrors findings in Timorese adults: the 2020 TLFNS documented 18.8% underweight and 19.3% overweight/obesity among women of reproductive age, with overweight/obesity nearly doubling from 9.8% in 2016 to 19.3% in 2020 [13]. These converging trends indicate that interventions must address both undernutrition and emerging obesity simultaneously across the life course.

Substance use prevalence in our study (tobacco 2.0%, alcohol 1.1%) was substantially lower than rates reported in prior Timor-Leste surveys targeting older adolescents: the 2015 GSHS found 23.4% current tobacco use and 12.0% current alcohol use among students aged 13–15 years [18], while the 2019 GYTS reported 30.9% current tobacco use in the same age group [19]. The school-type subgroup analysis helps contextualize this difference: tobacco use showed a clear gradient from 0.6% in primary schools to 7.9% in secondary schools, consistent with age-related initiation patterns. Nevertheless, even the secondary school rate (7.9%) remains well below the GSHS estimate (23.4%), likely reflecting the interviewer-administered format versus anonymous self-completed questionnaires, the broader screening context versus dedicated behavioral surveillance, and potential social desirability bias despite confidentiality assurances. The urban–rural gradient in substance use, which persisted within secondary schools specifically (Dili 13.2% vs Lautem 4.6% for tobacco), aligns with global patterns [20]. Substance use prevalence in this study should be interpreted as a floor estimate rather than true population prevalence.

The low prevalence of students with mobility impairment (0.09%) and currently wearing corrective lenses (0.05%) likely reflects both genuine prevalence and potential underdetection or access barriers rather than absence of need.

Implications for public health policy and practice

The findings establish oral health and nutrition as priority areas for public health intervention among school-aged children in Timor-Leste. The 30.0% dental caries prevalence combined with 17.0% poor oral hygiene rate indicates that both preventive and restorative services are needed. The higher caries prevalence in primary schools (32.8% vs 24.6% in secondary) suggests early intervention is particularly important. Evidence-based oral health interventions should include supervised toothbrushing programs, fluoride varnish application, and dental sealant programs [21, 22]. Mobile dental services should be prioritized for municipalities with highest caries prevalence (Lautem 44.9%, Manatuto 38.2%, Baucau 37.0%).

Nutrition interventions must be tailored to municipal contexts and address both undernutrition and emerging obesity. High-burden municipalities (Oecusse 29.9%, Atauro 28.8%, Dili 24.4%) require comprehensive approaches including school feeding programs, nutrition education, and family engagement [23]. The variation across municipalities, though of small effect size (Cramér's $V = 0.10$), is consistent in direction with known development disparities and suggests that uniform national approaches will be insufficient; interventions must be adapted to local contexts and resource availability.

The successful integration of DT and HPV vaccination demonstrates that school platforms can efficiently deliver preventive services beyond screening. This finding supports expanding the use of school health infrastructure for other preventive services including deworming, immunization catch-up, and health education.

Vision screening identified significant unmet need for vision correction services, with only 0.05% of students currently wearing corrective lenses despite 0.33% requiring vision referral. Establishing referral tracking systems and partnerships with vision care providers is essential to ensure students receive needed corrective lenses.

The geographic clustering of scabies in Viqueque (1.0%), Manufahi (0.9%), and Lautem (0.7%)—which showed no association with school type—indicates that transmission is driven by environmental and household factors. Targeted treatment programs to interrupt transmission should be accompanied by improvements in water, sanitation, and hygiene (WASH) infrastructure.

Health equity considerations

Geographic variation was statistically significant for all conditions examined (all $p < 0.001$), with effect sizes ranging from negligible (Cramér's $V = 0.04$ for scabies) to small–moderate ($V = 0.13$ for dental caries). Given the very large sample size ($N = 262,434$), statistical significance alone should be interpreted cautiously; the effect sizes indicate that while municipality of residence explains a relatively small proportion of overall variation, the absolute differences are clinically meaningful. Children in Oecusse face nearly three times the undernutrition risk of children in Manufahi, independent of their individual or family characteristics. This geographic inequity requires explicit attention in resource allocation and intervention design to advance health equity goals aligned with Sustainable Development Goal (SDG) 3 (ensure healthy lives and promote well-being for all at all ages) and SDG 10 (reduce inequality within and among countries).

Sex-disaggregated analysis revealed significantly higher screening coverage among female students (89.3%) compared with male students (84.8%), consistent across all 14 municipalities ($\chi^2 = 1,332.3$, $p < 0.001$). This 4.5-percentage-point difference raises equity questions about barriers to male student participation—potentially related to higher rates of school absenteeism among boys—that warrant investigation. Future implementation should address factors contributing to lower male participation to ensure equitable access to school health services.

The urban–rural disparities in substance use (Dili tobacco 3.7% versus rural municipalities generally below 1.5%) suggest that prevention programs must be context-specific. Notably, the 2019 GYTS found that 67.2% of students were exposed to secondhand tobacco smoke at home and 71.0% in enclosed public places [19], highlighting the need for comprehensive tobacco control measures extending beyond school-based prevention to include smoke-free policies and family-focused interventions.

Implementation feasibility and sustainability

The program achieved near-universal school coverage (98.8%), demonstrating feasibility of coordinating nationwide implementation through multi-sectoral partnership. The cascade training model effectively built workforce capacity across 3,619 health and education personnel. School Health Committees, successfully established in 12 of 14 municipalities, provide functional inter-sectoral coordination mechanisms that can support ongoing school health programming.

Challenges encountered included form completion delays, quality variation in vision testing and anthropometric measurements, and human resource constraints in some locations. These implementation barriers were addressed through adaptive program management including real-time quality assurance via messaging platforms, refresher training in later phases, and coordination of doctor mobilization from facilities with surplus capacity. These experiences provide valuable lessons for scaling similar programs in other resource-limited settings.

For sustainability, school health screening should be institutionalized as standard practice through policy development and sustainable financing mechanisms independent of external donor support. The evidence generated from this baseline assessment can support advocacy for continued investment in school health services.

Study strengths and limitations

This study has several strengths including comprehensive national coverage across all municipalities, large sample size (N = 262,434) providing precise prevalence estimates, sex-disaggregated analyses enabling equity assessment, school-type subgroup analyses providing proxy age stratification, quantification of geographic variation with appropriate effect sizes, and standardized protocols enabling geographic comparisons. The multi-sectoral partnership model demonstrates feasibility of coordinating large-scale implementation. BMI assessment completeness exceeded 97.9% across all municipalities, and no schools reported screening more students than enrolled, indicating data integrity.

However, several limitations warrant consideration. First, this study is a secondary analysis of program data collected primarily for service delivery purposes rather than research. While screening protocols were standardized, data were not collected with research-specific quality controls such as duplicate measurements or calibration exercises. Screening was conducted by 1,025 healthcare workers across municipalities without formal assessment of inter-rater reliability. Although standardized training was provided (with refresher training in later phases), variations in examination techniques may have contributed to observed geographic differences for subjective assessments such as oral health and skin

conditions. Patterns of potential over-detection in some municipalities (elevated hearing and color vision abnormalities in specific locations) and potential under-detection in others (consistently low prevalence across multiple indicators) suggest data quality varied across screening teams.

Second, the school-aggregated data structure precluded individual-level age-adjusted analyses. School type serves as an imperfect proxy for age group because primary+secondary schools contain students across the full grade range, and age-for-grade variation exists. The observed geographic differences may be partially confounded by differences in school-type composition: for instance, municipalities with higher proportions of primary-school students would be expected to show higher dental caries prevalence. Analyses adjusting for school-type composition partially address this, but individual-level data would be needed for precise age-adjustment.

Third, self-reported substance use data are subject to reporting bias. The interviewer-administered format in a school setting, particularly for students as young as approximately 6 years, almost certainly produced substantial underreporting. Direct comparison with the 2015 GSHS and 2019 GYTS prevalence rates is complicated by both methodological differences (self-administered anonymous questionnaires versus interviewer-administered assessment) and different target populations (secondary students aged 13–17 versus aged 6–14 students). These prevalence estimates should be interpreted as floor values.

Fourth, the cross-sectional design limits causal inference. While geographic variation in health outcomes was identified, we cannot determine whether these differences reflect socioeconomic factors, healthcare access, environmental conditions, or other unmeasured variables without adjustment for individual-level confounders. Longitudinal surveillance will be needed to track trends and evaluate intervention impacts.

Fifth, the narrow CIs (reflecting the large sample size) capture sampling precision but do not account for measurement uncertainty from inter-rater variability. The true uncertainty around prevalence estimates is likely wider than the reported CIs suggest.

Sixth, form completion challenges resulted in some missing demographic data, particularly dates of birth needed for precise BMI-for-age calculations. Although BMI completeness exceeded 97.9% across all municipalities, minor uncertainty in nutritional status classification may exist.

Finally, screening was conducted during school hours, inherently excluding children not enrolled in school or chronically absent. Health status of out-of-school children remains unknown and may differ from enrolled students, potentially underestimating true disease burden.

Conclusions

This first nationwide school health screening in Timor-Leste establishes oral health conditions and undernutrition as priority health burdens requiring public health intervention, with statistically significant geographic inequities of small-to-moderate effect size necessitating targeted approaches. Dental caries prevalence of 30.0% (95% CI: 29.8–30.1%) and undernutrition of 20.4% (95% CI: 20.3–20.6%), combined with 2.7- to 5.4-fold geographic variation across municipalities, provide evidence for implementing

school-based oral health programs, prioritizing nutrition interventions in high-burden areas (Oecusse, Atauro, Dili), and strengthening coordinated school health systems.

The school-type subgroup analysis revealed clinically meaningful patterns—including a 13-fold gradient in tobacco use from primary to secondary schools and higher dental caries in younger children—that inform age-targeted intervention design. The feasibility of implementing comprehensive school-based health screening was demonstrated through near-universal school coverage (98.8%), successful multi-sectoral coordination, and effective cascade training of 3,619 health and education personnel.

These findings provide an evidence base for developing school health policies, allocating resources to address identified needs, and monitoring progress toward health equity in line with SDGs. Institutionalizing annual school health screening with sustainable financing, implementing evidence-based oral health interventions, and strengthening referral systems will support continued improvements in health outcomes for school-aged children across Timor-Leste. Future research should evaluate intervention effectiveness, track health trends through longitudinal surveillance, investigate factors contributing to observed geographic and sex-based disparities, and collect individual-level data to enable age-adjusted analyses.

Abbreviations

BMI	Body mass index
CHC	Community health centre
CI	Confidence interval
DMFT	Decayed, missing, and filled teeth
DT	Diphtheria-tetanus vaccine
GSHS	Global School-based Student Health Survey
GYTS	Global Youth Tobacco Survey
HPV	Human papillomavirus vaccine
KOICA	Korea International Cooperation Agency
MoE	Ministry of Education
MoH	

Ministry of Health
PHCP
Primary Health Care Package
SD
Standard deviation
SDG
Sustainable Development Goal
TLFNS
Timor-Leste Food and Nutrition Survey
WASH
Water, sanitation, and hygiene
WHO
World Health Organization

Declarations

Ethics approval and consent to participate

This program was conducted as a public health service delivery initiative by the MoH of Timor-Leste. Informed consent was obtained from parents or guardians of all participating students prior to screening; students whose parents declined consent or who were absent on the screening day were not screened. Verbal assent was obtained from children in accordance with national ethical guidelines and the Declaration of Helsinki; children were informed about the screening procedures in age-appropriate language and told they could decline any individual assessment. The study protocol for publication was approved by the Timor-Leste National Public Health Institute (Reference number: 39/INSP-TL/UEPD-AL/II/2026) as it involves the secondary analysis of existing data that are de-identified.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and analysed during the current study are available from the MoH, Timor-Leste, on reasonable request and subject to appropriate data use agreements. Individual-level data cannot be made publicly available due to privacy and confidentiality protections for minors, but de-identified datasets may be available from the corresponding author on reasonable request with appropriate ethical approvals and data sharing agreements.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

AM, MC and HJ conceived and designed the study. MC, RMS, JRB, FS and ASR coordinated program implementation across municipalities. MC, RMS and HJ managed data collection and quality assurance. HJ conducted statistical analysis and drafted the manuscript. All authors contributed to interpretation of findings, critically revised the manuscript for important intellectual content, read and approved the final manuscript, and agree to be accountable for all aspects of the work.

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References

1. Centers for Disease Control and Prevention. Whole School, Whole Community, Whole Child: A Collaborative Approach to Learning and Health. Alexandria, VA: ASCD; 2014.
2. Langford R, Bonell CP, Jones HE, Poulou T, Murphy SM, Waters E, et al. The WHO Health Promoting School framework for improving the health and well-being of students and their academic achievement. *Cochrane Database Syst Rev*. 2014;4CD008958. <https://doi.org/10.1002/14651858.CD008958.pub2>.
3. Michael SL, Merlo CL, Basch CE, Wentzel KR, Wechsler H. Critical connections: health and academics. *J Sch Health*. 2015;85:740–58. <https://doi.org/10.1111/josh.12309>.
4. Bundy DAP, de Silva N, Horton S, Jamison DT, Patton GC, editors. *Child and Adolescent Health and Development*. 3rd ed. Washington (DC): The International Bank for Reconstruction and Development / The World Bank; 2017.
5. General Directorate of Statistics, Ministry of Finance. *Timor-Leste Population and Housing Census 2022 Main Report*. Dili: General Directorate of Statistics; 2023.
6. Lewallen TC, Hunt H, Potts-Datema W, Zaza S, Giles W. *The Whole School, Whole Community, Whole Child Model: a new approach for improving educational attainment and healthy development for*

- students. *J Sch Health*. 2015;85:729–39. <https://doi.org/10.1111/josh.12310>.
7. Hagan JF, Shaw JS, Duncan PM, editors. *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents*. 4th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2017.
 8. Russ SA, Larson K, Halfon N. A national profile of childhood epilepsy and seizure disorder. *Pediatrics*. 2012;129:256–64. <https://doi.org/10.1542/peds.2010-1371>.
 9. Basch CE. Healthier students are better learners: a missing link in school reforms to close the achievement gap. *J Sch Health*. 2011;81:593–8. <https://doi.org/10.1111/j.1746-1561.2011.00632.x>.
 10. Council on School Health, Holmes BW, Sheetz A, Allison M, Ancona R, Attisha E, et al. Role of the school nurse in providing school health services. *Pediatrics*. 2016;137:e20160852. <https://doi.org/10.1542/peds.2016-0852>.
 11. Maharani DA, Adiatman M, Rahardjo A, Burnside G, Pine C. An assessment of the impacts of child oral health in Indonesia and associations with self-esteem, school performance and perceived employability. *BMC Oral Health*. 2017;17:65. <https://doi.org/10.1186/s12903-017-0358-5>.
 12. Duangthip D, Gao SS, Lo ECM, Chu CH. Early childhood caries among 5- to 6-year-old children in Southeast Asia. *Int Dent J*. 2017;67:98–106. <https://doi.org/10.1111/idj.12261>.
 13. Ministry of Health Timor-Leste, UNICEF. *Timor-Leste Food and Nutrition Survey 2020*. Dili: Ministry of Health; 2021.
 14. de Onis M, Onyango AW, Borghi E, Siyam A, Nishida C, Siekmann J. Development of a WHO growth reference for school-aged children and adolescents. *Bull World Health Organ*. 2007;85:660–7. <https://doi.org/10.2471/BLT.07.043497>.
 15. Peres MA, Macpherson LMD, Weyant RJ, Daly B, Venturelli R, Mathur MR, et al. Oral diseases: a global public health challenge. *Lancet*. 2019;394:249–60. [https://doi.org/10.1016/S0140-6736\(19\)31146-8](https://doi.org/10.1016/S0140-6736(19)31146-8).
 16. General. Directorate of Statistics, Ministry of Finance. *Timor-Leste Demographic and Health Survey 2016*. Dili: General Directorate of Statistics; 2018.
 17. Popkin BM, Corvalan C, Grummer-Strawn LM. Dynamics of the double burden of malnutrition and the changing nutrition reality. *Lancet*. 2020;395:65–74. [https://doi.org/10.1016/S0140-6736\(19\)32497-3](https://doi.org/10.1016/S0140-6736(19)32497-3).
 18. Ministry of Health Timor-Leste. *Report of the 2015 Timor-Leste Global School-based Student Health Survey (GSHS)*. Dili: Ministry of Health; 2016.
 19. World Health Organization. *Global Youth Tobacco Survey (GYTS): Timor-Leste 2019 Fact Sheet*. Geneva: WHO; 2020.
 20. Stanesby O, Labhart F, Dietze P, Wright CJC, Kuntsche E. The contexts of heavy drinking: a systematic review of the combinations of context-related factors associated with heavy drinking occasions. *PLoS ONE*. 2019;14:e0218465. <https://doi.org/10.1371/journal.pone.0218465>.
 21. Marinho VCC, Worthington HV, Walsh T, Clarkson JE. Fluoride varnishes for preventing dental caries in children and adolescents. *Cochrane Database Syst Rev*. 2013;7CD002279. <https://doi.org/10.1002/14651858.CD002279.pub2>.
 22. Ahovuo-Saloranta A, Forss H, Walsh T, Nordblad A, Mäkelä M, Worthington HV. Pit and fissure sealants for preventing dental decay in permanent teeth. *Cochrane Database Syst Rev*.

23. Drake L, Fernandes M, Aurino E, Kiamba J, Giyose B, Burbano C, et al. School feeding programs in middle childhood and adolescence. In: Bundy DAP, de Silva N, Horton S, Jamison DT, Patton GC, editors. Child and Adolescent Health and Development. 3rd ed. Washington (DC): The International Bank for Reconstruction and Development / The World Bank; 2017.

Figures

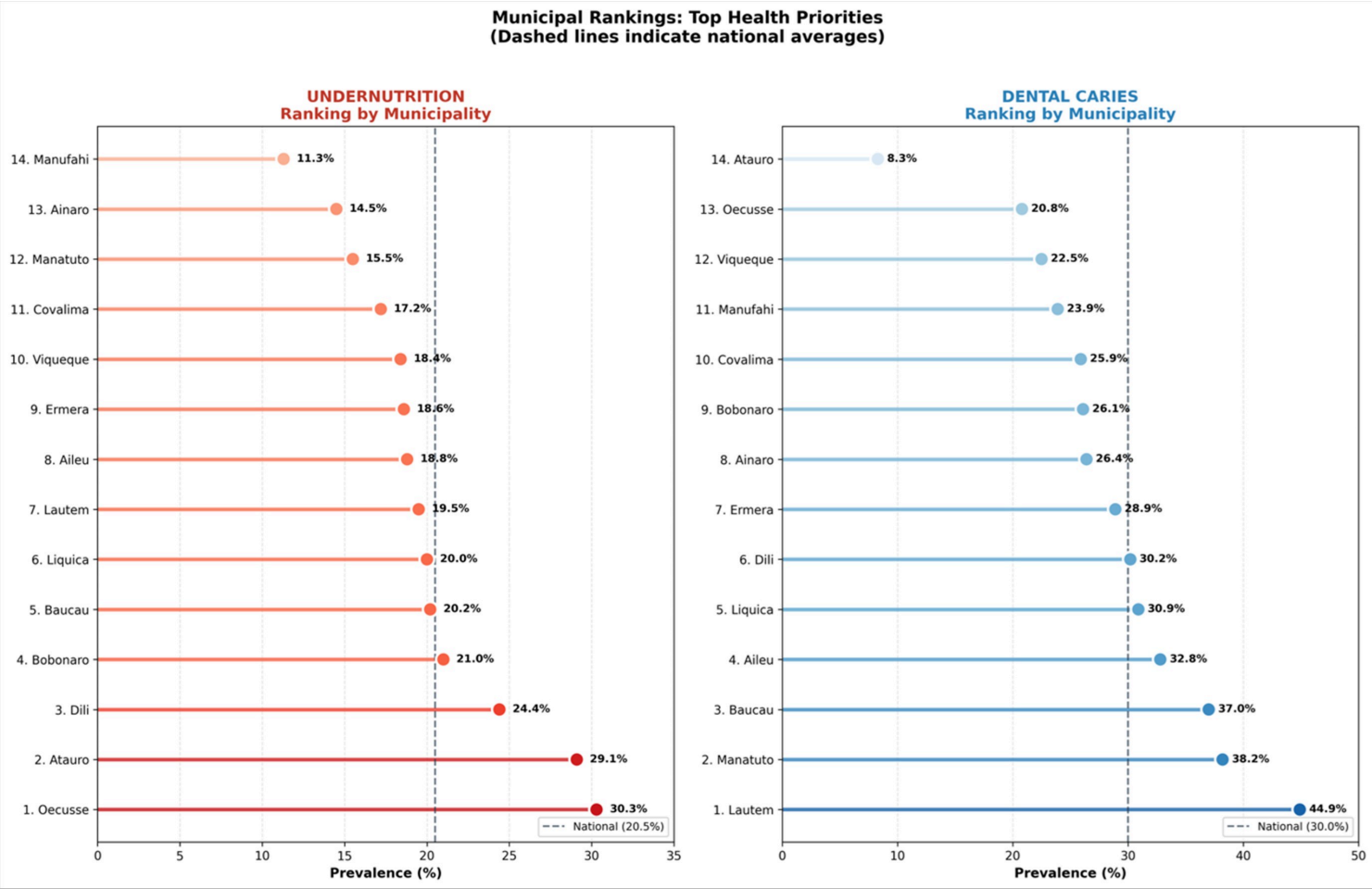


Figure 1

Municipal prevalence of undernutrition and dental caries in Timor-Leste

Side-by-side comparison of municipal prevalence for undernutrition (A) and dental caries (B). Color gradients indicate prevalence levels, with darker shades representing higher rates. Vertical dashed lines denote national average values. Municipalities are ranked from highest to lowest prevalence. Undernutrition ranged from 11.3% (Manufahi) to 29.9% (Oecusse), prevalence ratio = 2.66 ($p < 0.001$). Dental caries ranged from 8.3% (Atauro) to 44.9% (Lautem), prevalence ratio = 5.39 ($p < 0.001$). Error bars represent 95% confidence intervals (Wilson score method).