Oral Health Status and Patterns of Dental Service Utilization of Adolescents in Lesotho, Southern Africa

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Research article

Keywords: Key Words

DOI: https://doi.org/10.21203/rs.3.rs-34915/v1

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Abstract

Objectives: To identify the unmet dental treatment needs and patterns of dental service utilization by adolescents in the Kingdom of Lesotho, Southern Africa, and characterize the best predictors for perceived oral health status and dental visits for these adolescents.

Method: A self-reported 40-item oral health survey was administered, and clinical oral examinations were conducted in public schools in Maseru from August 10 to August 25, 2016. Associations between psychosocial factors with oral health status and dental service utilization were evaluated using simple, bivariate and multivariate regressions.

Results: Five hundred and twenty-six survey responses and examinations were gathered. The mean age of participants was 16.4 years of age, with a range between 12 and 19 years of age. More than two thirds (68%; n=355) of participants were female. The majority reported their quality of life (84%) and general health to be good/excellent (81%). While 95% reported that oral health was very important, only 11% reported their personal dental health as excellent. Three percent reported having a regular family dentist, with the majority (85%) receiving dental care in a hospital or medical clinic setting; only 14% had seen a dental professional within the previous 2 years. The majority of participants did not have dental insurance (78%). Clinical examination revealed tooth decay on 30% of mandibular and maxillary molars; 65% had some form of gingivitis. In multivariate analysis, not having dental education and access to a regular dentist were the strongest predictors of not visiting a dentist within the last year.

Conclusion: Our results suggest that access to oral health care is limited in Lesotho. Dental decay on molars was prevalent. Further patient oral health education and regular dental care may make an impact on this population.

Background:

Oral health is central to general health and wellbeing.\[1\] This becomes particularly important when dealing with adolescents, as oral diseases can have a significant psychosocial impact and restrict daily activities, including hours lost from school and work.\[2\] Oral health in the most under-privileged nations is often neglected due to various psychosocial problems such as limited resources, poverty, and lack of access to dental services.\[3\] The countries of Southern Africa, including South Africa, Namibia, Botswana, Lesotho and Eswatini, are home to 63.4 million people. Of this population, 19.1 million are children under the age of 15.\[4\] The Kingdom of Lesotho is within South Africa, and has a population of 2.2 million people. Children under the age of 15 compose 35.7% of the Lesotho population.\[4\]

The United Nations categorized Lesotho as an underdeveloped country with persistently high unemployment rates (23–28%) over the last 10 years.\[5\] In 10 urban centres in Lesotho, nearly a third of the population was receiving food or cash from friends and family outside the Kingdom to provide living
assistance. In the capital Maseru, 46% of the residents receive assistance in the form of food, cash, or both, from outside of Lesotho making it one of the top 20 most unequal countries in the world.\[6,7\]

Although the government of Lesotho endeavours to provide universal primary health care for all citizens through a decentralized system, facilitating local control and decision-making at the district and community levels, Lesotho has experienced worsening health outcomes over the past decade. The World Bank Group (2018) attributed this trend largely to the burden of HIV/AIDS, comparatively high rates of tuberculosis, and systemic deficiencies.\[7\] Not surprisingly, preventative or therapeutic oral health care is not provided due to the shortage of oral health personnel and challenges in infrastructure.\[8\] A study by Umunna, James & Ricks in 2009, indicated the main barriers to dental care in Lesotho were shortage of staff and general resources compounded by transportation difficulties.\[9\]

According to an epidemiological survey from 1998, 92% of the adult population in Lesotho had dental caries, with 93% of those receiving extractions as treatment.\[10\] Two decades later, a study conducted by Keating et al. (2019) with orphanages in Lesotho only reported on the number referrals to a dental professional;\[11\] the majority of the referrals were due to caries, with dental extraction being the most common form of treatment provided.\[11\] To the best of our knowledge, there is no data regarding the oral health status of the adolescent population in Lesotho. Hence, there was a need to identify psychosocial factors that impact the access to dental care and unmet dental treatment needs in adolescents in Lesotho,\[9\] as elaborated in the framework of health service utilization proposed by Andersen and Newman (A&N).\[12\] This framework categorizes the psychosocial factors into three broad categories of predisposing, enabling and need factors. Predisposing factors include sex, the availability of a medical doctor, access to health education, having a medical condition, and water fluoridation. Enabling factors include financial affordability and means to afford dental care, including annual income, access to transportation, dental insurance, and social support. Need factors include clinical needs such as Decayed, Missing or Filled Teeth (DMFT) index for a given population, and subjective needs including oral hygiene, self-reported oral health, and oral health education. Using this framework helps to understand the propensity of a population to access available dental services to meet their unmet dental treatment needs.\[13,31,32,33\] By utilizing the A&N framework of dental service utilization, this study aimed at 1) identifying the unmet dental treatment needs and patterns of dental service utilization by adolescents in the Kingdom of Lesotho, Southern Africa, and 2) characterizing the best predictors for perceived oral health status and dental visits for these adolescents.

**Methods:**

This study was made possible via a collaboration between Smile Lesotho Foundation (SLF), academics from the University of British Columbia (UBC) and the National University of Lesotho (NUL) in response to Smile Lesotho Foundation’s call to identify the unmet dental treatment need of local adolescents. A collaboration was established with Faculty of Health Sciences, Nursing Department, NUL and SLF to develop a project that would identify these unmet dental treatment needs of adolescents in Lesotho.
Faculty members and students, along with a community dentist from Maseru, educational specialists, Minister of Health and local stakeholders were actively engaged in the development and execution of this project. This project was designed to serve as the foundational step in developing a program to provide long-term primary oral care to the adolescent population in that country.

**Participant Recruitment And Data Collection**

After seeking approvals from the Ministries of Health and Education and Training, participant recruitment was done through convenience sampling in the public schools located in Maseru, the capital city of Lesotho (population 2.14 million). This study utilized a self-reported survey and clinical examinations to collect subjective and objective oral health data according to the A&N model of health service utilization. The self-reported survey was an adaptation from the Canadian Oral Health Measure Survey, and questions from World Health Organization household questionnaire were also included to capture a wide range of predictors associated with the oral health status of study participants.\[^{34,35}\] This manuscript presents only some aspects of the collected data; we have analyzed 40 items from the self-reported data, and other results will be presented in the upcoming manuscripts. The first 28 items on the survey captured the social demographic information, including the environmental risk factors; parents/guardians responded on behalf of the participants to these questions. The last 12 items on the survey were pertinent to self-reported oral health status, including most commonly experienced dental conditions; adolescents responded to these questions, aided by volunteer nursing students from the NUL. Clinical examinations followed the completion of the survey to capture the DMFT data of the study participants. Consent forms and surveys were translated into Sesotho for guardians. Participants included approximately 50 randomly selected students from each of the 10 schools, with participants ranging from grades A/6 to grade E/12. Printed copies of the consent form outlining the study objectives and permission to participate in the dental examination were sent out to the parents/guardians of the participants. The clinical examinations were conducted in available space, either in a classroom setting, a library or an open playground. These examinations utilized single-use disposable instruments including dental mirrors, tongue depressors, cotton rolls, and Marquis® probes.

Four calibrated dentists conducted the oral examinations. Due to time and logistics constraints, the examining dentists collected DMFT data only from teeth #16, 26, 36 and 46 and recorded presence of plaque on any of these four examined molars. All participants were provided with oral hygiene products.

**Statistical analysis**

Descriptive statistics were reported using numbers and percentages and then bivariate analysis was carried out using chi-square tests to identify the independent factors associated with self-reported oral health and dental visits. Univariate and multivariable logistic regression were applied to identify the most important predictors for perceived oral health and dental visits of the study sample. All univariate predictors with $P < 0.10$ were further assessed in the multivariable model. The objective of this analysis
was to identify the independent variables that could strongly explain a statistically significant variation among the dependent variables in a model that is adjusted for other covariates. Adjusted odds ratio (OR) with 95% confidence interval (CI) was reported and the variables with P-value < 0.05 were considered to be statistically significant. Statistical analysis was performed with SPSS, version 9.4 (SPSS Institute Inc, Cary, NC). Missing data was replaced with the overall mean or median of that variable, although it likely reduced variance in the dataset.

**Results:**

A total of 526 students participated in the survey and clinical examinations; not all guardians provided answers to all the demographic items. The A&N model of health service utilization served as a theoretical framework to determine the predictors that influence the unmet dental treatment needs and patterns of dental service utilization in adolescent-aged school population in Maseru, Lesotho. The findings of the univariate analyses are presented in Tables 1 and 2, bivariate and multivariate results are presented in Tables 3 to 5.
Table 1
Descriptive data of the independent study variables (N = 526).

| Independent study variables* | N (%)  |
|------------------------------|--------|
| Sex (N = 519)                |        |
| Male                        | 164 (31.5) |
| Female                      | 355 (68.4) |
| Age (N = 523)               |        |
| 12–18                       | 468 (89.5) |
| 19+                         | 55 (10.5)  |
| Dental Insurance (N = 509)  |        |
| Yes                         | 31 (6.1)  |
| No                          | 396 (77.8) |
| Don’t know                  | 82 (16)  |
| Availability of doctor (N = 511) |    |
| No                          | 469 (91.8) |
| Yes                         | 42 (8.2)  |
| Transportation to school (N = 319) |    |
| Family car                  | 1 (0.3)   |
| Public transit              | 37 (11.5) |
| Walk                        | 281 (87.5) |
| Quality of life (N = 518)   |        |
| Excellent                   | 87 (16.8) |
| Very good                   | 116 (22.4) |
| Good                        | 231 (44.6) |
| Fair                        | 75 (14.5)  |
| Poor                        | 9 (1.7)   |
| Self-reported general health (N = 519) |    |
| Excellent                   | 70 (13.5) |
| Very good                   | 120 (23.1) |

*Response rate was less than 100% due to the missing responses.
| Independent study variables*                  | N (%) |
|----------------------------------------------|-------|
| Good                                         | 229 (44.1) |
| Fair                                         | 83 (16) |
| Poor                                         | 17 (3.3) |

Self-reported brushing frequency (N = 506)

| Frequency                        | N (%) |
|----------------------------------|-------|
| Never                            | 6 (1.2) |
| Only in the morning              | 189 (37.4) |
| Only before going to bed         | 2 (0.4) |
| Both times                       | 277 (54.7) |
| Every time I eat                 | 32 (6.3) |

Water Fluoridation (N = 515)

| Water Fluoridation                | N (%) |
|-----------------------------------|-------|
| No                                | 223 (43.3) |
| Yes                               | 162 (31.5) |
| Don't know                        | 130 (25.2) |

Self-reported last Dental Visit (N = 517)

| Last Dental Visit                  | N (%) |
|------------------------------------|-------|
| Less than a year                   | 60 (11.6) |
| Between 1–2 years                  | 13 (2.5) |
| Between 2–3 years                  | 23 (4.4) |
| Between 3–4 years                  | 13 (2.5) |
| Between 4–5 years                  | 2 (0.4) |
| More than 5 years                  | 43 (8.4) |
| Never                              | 363 (70.2) |

Oral health education (N = 518)

| Oral health education              | N (%) |
|------------------------------------|-------|
| No                                 | 413 (79.7) |
| Yes                                | 105 (20.3) |

*Response rate was less than 100% due to the missing responses.
Table 2
Descriptive results of oral health status of adolescents in Lesotho (N = 526).

| Clinical Oral Health Status | N (%)* |
|-----------------------------|--------|
| DMFT tooth #16 (N = 524)    |        |
| Sound                       | 380 (72.5) |
| Decay                       | 141 (26.9) |
| Missing                     | 3 (0.6)   |
| Filled                      | 0 (0)     |
| DMFT tooth #26 (N = 519)    |        |
| Sound                       | 381 (73.4) |
| Decay                       | 132 (25.4) |
| Missing                     | 5 (1.0)   |
| Filled                      | 1 (0.2)   |
| DMFT tooth # 36 (N = 519)   |        |
| Sound                       | 330 (63.6) |
| Decay                       | 179 (34.5) |
| Missing                     | 8 (1.5)   |
| Filled                      | 2 (0.4)   |
| DMFT tooth # 46 (N = 521)   |        |
| Sound                       | 352 (67.6) |
| Decay                       | 157 (29.8) |
| Missing                     | 10 (1.9)  |
| Filled                      | 2 (0.4)   |
| Plaque status (N = 524)     |        |
| Absent                      | 208 (39.7) |
| Present                     | 316 (60.3) |
| Unhappy with appearance of teeth (N = 523) |        |
| No                          | 413 (79.0) |
| Yes                         | 110 (21.0) |

*Response rate was less than 100% due to missing responses.
| Clinical Oral Health Status                                                                 | N (%)* |
|-------------------------------------------------------------------------------------------|--------|
| **Self-reported dental treatment needs**                                                   |        |
| Toothache (N = 523)                                                                        |        |
| No                                                                                       | 412 (78.8) |
| Yes                                                                                      | 111 (21.2) |
| Sensitivity to hot/cold (N = 523)                                                        |        |
| No                                                                                       | 275 (52.6) |
| Yes                                                                                      | 248 (47.4) |
| Bleeding when brushing (N = 523)                                                          |        |
| No                                                                                       | 314 (60.0) |
| Yes                                                                                      | 209 (40.0) |
| Self-perceived oral health (N = 518)                                                      |        |
| Excellent                                                                                 | 59 (11.4)  |
| Very good                                                                                 | 106 (20.5) |
| Good                                                                                      | 197 (38.0) |
| Fair                                                                                      | 106 (20.5) |
| Poor                                                                                      | 50 (9.7)  |

*Response rate was less than 100% due to missing responses.
### Table 3
Frequency distribution of the Andersen and Newman (A&N) predisposing and enabling factors between self-reported oral health and dental visit.

| Predisposing factors | Self-reported OH | Dental service utilization | P-value | Visit within the last year | Visit more than a year ago | P-value |
|----------------------|------------------|---------------------------|---------|---------------------------|---------------------------|---------|
|                      | Fair/poor N = 156 | Excellent/very good/good N = 362 | P-value | N = 153 | N = 363 |      |
| Age                  |                  |                           | < 0.001 |            |                | < 0.001 |
| 12–18                | 129 (28)         | 334 (72)                  |        | 125 (27) | 337 (73) |        |
| 19+                  | 27 (50)          | 27 (50)                   |        | 28 (52)   | 26 (48)   |        |
| Gender               |                  |                           | 0.4     |            |                | 0.01   |
| Male                 | 53 (33)          | 109 (67)                  |        | 61 (37)   | 102 (63) |        |
| Female               | 102 (29)         | 250 (71)                  |        | 92 (26)   | 258 (74) |        |
| Oral health education|                  |                           | 0.3     |            |                | < 0.001|
| No                   | 129 (32)         | 281 (69)                  |        | 104 (25)  | 306 (75) | < 0.001|
| Yes                  | 27 (26)          | 78 (74)                   |        | 49 (48)   | 53 (52)  |        |
| Enabling Factors     |                  |                           |         |            |                |        |
| Annual income        |                  |                           |         |            |                |        |
| < 1,000 LSL          | 55 (78)          | 175 (71)                  | 0.3     | 24 (75)   | 210 (73) | 0.7    |
| > 1,000 LSL          | 16 (23)          | 70 (29)                   |         | 8 (25)    | 79 (27)  |        |
| Availability a regular MD |      |                           |         |            |                |        |
| No                   | 138 (30)         | 326 (70)                  | 0.9     | 122 (26)  | 341 (74) | < 0.001|
| Yes                  | 13 (31)          | 20 (69)                   |         | 27 (64)   | 15 (36)  |        |
| Availability a regular dentist |    |                           |         |            |                |        |
| No                   | 152 (30)         | 350 (70)                  | 0.6     | 142 (28)  | 360 (72) | < 0.001|
| Yes                  | 3 (21)           | 11 (79)                   |         | 11 (79)   | 3 (21)   |        |
| Predisposing factors                                      | Self-reported OH                      | Dental service utilization                      |
|-----------------------------------------------------------|---------------------------------------|-------------------------------------------------|
|                                                           | Fair/poor N = 156                    | Excellent/very good/good N = 362                |
|                                                           | N = 362                               | P-value                                         |
| Visit within the last year                               | N = 153                               | Visit more than a year ago                      |
|                                                           | N = 363                               | P-value                                         |
| **Dental insurance**                                     |                                       |                                                 |
| Yes                                                       |                                       |                                                 |
|                                                           | 11 (36)                              | 20 (65)                                         |
|                                                           | 0.6                                   | 9 (31)                                          |
|                                                           |                                       | 20 (69)                                         |
|                                                           | 1.0                                   |                                                 |
| No                                                        | 121 (31)                             | 273 (69)                                        |
|                                                           |                                       | 127 (32)                                        |
|                                                           |                                       | 266 (68)                                        |
| **Avoiding dental treatment due to cost**                 |                                       |                                                 |
| Yes                                                       |                                       |                                                 |
|                                                           | 9 (24)                               | 28 (76)                                         |
|                                                           | 0.3                                   | 21 (58)                                         |
|                                                           |                                       | 15 (42)                                         |
|                                                           | < 0.001                               |                                                 |
| No                                                        | 144 (31)                             | 328 (70)                                        |
|                                                           |                                       | 129 (27)                                        |
|                                                           |                                       | 344 (73)                                        |
| **Having social support**                                |                                       |                                                 |
| Yes                                                       |                                       |                                                 |
|                                                           | 1 (1)                                 | 200 (82)                                        |
|                                                           | 0.002                                 | 1 (3)                                           |
|                                                           |                                       | 275 (95)                                        |
|                                                           |                                       | 0.6                                             |
| No                                                        | 29 (41)                              | 16 (7)                                          |
|                                                           |                                       | 30 (94)                                         |
|                                                           |                                       | 15 (5)                                          |
| Below mean                                                | 28 (39)                              | 79 (32)                                         |
|                                                           |                                       | 9 (28)                                          |
|                                                           |                                       | 99 (34)                                         |
| **Dental services**                                      |                                       |                                                 |
| Nowhere                                                   | 7 (24)                               | 22 (76)                                         |
|                                                           |                                       | 2 (7)                                           |
|                                                           |                                       | 28 (93)                                         |
| Dentist                                                   | 11 (33)                              | 22 (67)                                         |
|                                                           | 0.05                                 | 21 (64)                                         |
|                                                           |                                       | 12 (36)                                         |
|                                                           | < 0.001                               |                                                 |
| Nearby clinic                                             | 53 (24)                              | 166 (76)                                        |
|                                                           |                                       | 65 (30)                                         |
|                                                           |                                       | 154 (70)                                        |
| Hospital                                                  | 67 (34)                              | 129 (66)                                        |
|                                                           |                                       | 62 (32)                                         |
|                                                           |                                       | 130 (68)                                        |
| Community centre/other                                    | 2 (40)                               | 6 (60)                                          |
|                                                           |                                       | 2 (11)                                          |
|                                                           |                                       | 9 (89)                                          |
Table 4
Frequency distribution of the Andersen and Newman (A&N) need factors between self-reported oral health and dental visit.

| Need factors                          | Self-reported OH | Dental service utilization |
|---------------------------------------|------------------|----------------------------|
|                                       | Fair/poor N = 156| Visit within the last year N = 153 | Visit more than a year ago N = 363 | P-value | Visit within the last year N = 153 | Visit more than a year ago N = 363 | P-value |
|                                       | Excellent/very good/good N = 362 | < 0.001 | < 0.001 |
| **Self-reported need factors**        |                  | 106 (26) | 301 (74) | < 0.001 |
| **Toothache**                        |                  | 48 (44)  | 61 (56)  |          |
| No                                    | 96 (25)          | 311 (77) |          | < 0.001 |
| Yes                                   | 60 (55)          | 50 (46)  |          |          |
| **Sensitivity to hold or cold**       |                  | 80 (30)  | 189 (70) | 0.1     |
| No                                    | 56 (21)          | 216 (79) |          | < 0.001 |
| Yes                                   | 100 (47)         | 145 (59) |          |          |
| **Bleeding gums when brushing**       |                  | 74 (30)  | 173 (70) | 2.0     |
| No                                    | 73 (23)          | 239 (77) |          | 0.2     |
| Yes                                   | 83 (41)          | 122 (60) |          |          |
| **Unhappy with teeth appearance**     |                  | 100 (32) | 210 (68) | 0.003   |
| No                                    | 102 (25)         | 308 (75) |          |         |
| Yes                                   | 54 (51)          | 53 (50)  |          |         |
| **Self-reported quality of life**     |                  | 109 (27) | 300 (73) |         |
| Excellent/very good/good              | 107 (25)         | 308 (74) |          | < 0.001 |
|                                       | 130 (30)         | 300 (70) |          | 0.6     |
| Need factors                  | Self-reported OH | Dental service utilization |
|------------------------------|------------------|----------------------------|
|                              | Fair/poor        | Excellent/very good/good   |                               |                               |
|                              | N = 156          | N = 362                    |                               |                               |
|                              | P-value           | Visit within the last year | Visit more than a year ago    | P-value                       |
| FAIR/POOR                    | 48 (58)          | 35 (42)                    | 22 (27)                       | 60 (73)                       |
| FAIR/POOR                    | 153 (31)         | 345 (69)                   | 145 (29)                      | 350 (71)                      |
| FAIR/POOR                    | 1 (20)           | 4 (40)                     | 4 (80)                        | 1 (20)                        |
| Extremely important/important| 304 (73)         | 112 (27)                   | 326 (70)                      | 138 (30)                      |
| Not important                | 57 (59)          | 40 (41)                    | 29 (69)                       | 13 (31)                       |
| Excellent/very good/Good     | 54 (76)          | 143 (61)                   | 23 (72)                       | 175 (61)                      |
| Morning                      | 17 (24)          | 87 (37)                    | 6 (19)                        | 102 (35)                      |
| After eating                 | 0                | 15 (6)                     | 3 (9)                         | 23 (8)                        |
| Mean (SD): 6.86 (12.45)      | 41 (58)          | 119 (47)                   | 20 (63)                       | 143 (50)                      |
| Above mean                   | 30 (42)          | 126 (51)                   | 12 (38)                       | 146 (51)                      |
| Need factors | Self-reported OH |  | Dental service utilization |  |
|-------------|----------------|---|---------------------------|---|
|              | Fair/poor N = 156 | Excellent/very good/good N = 362 | Visit within the last year N = 153 | Visit more than a year ago N = 363 | P-value |
| Reason for last dental visit |  |  |  |  |  |
| Within a year for prevention | 5 (7) | 21 (9) | 0.5 | 4 (13) | 23 (8) | 0.05 |
| Emergency/Never | 66 (93) | 223 (91) |  | 28 (88) | 266 (92) |  |
| Clinical need factors |  |  |  |  |  |
| Tooth #16 |  |  |  |  |  |
| Sound | 97 (26) | 278 (74) | 0.002 | 106 (28) | 271 (72) | 0.3 |
| Decayed | 56 (40) | 84 (60) |  | 45 (33) | 92 (67) |  |
| Tooth #26 |  |  |  |  |  |
| Sound | 276 (73) | 100 (27) | 0.03 | 93 (25) | 284 (75) | 0.001 |
| Decayed | 82 (63) | 49 (37) | 52 (40) | 77 (60) |  |
| Tooth #36 |  |  |  |  |  |
| Sound | 246 (76) | 79 (24) | 0.003 | 88 (27) | 239 (73) | 0.4 |
| Decayed | 112 (63) | 66 (37) | 54 (31) | 121 (69) |  |
| Tooth #46 |  |  |  |  |  |
| Sound | 259 (75) | 87 (25) | 0.006 | 93 (27) | 256 (73) | 0.3 |
| Decayed | 98 (62) | 59 (38) | 48 (31) | 106 (69) |  |
| Plaque status |  |  |  |  |  |
| No | 34 (48) | 103 (42) | 0.4 | 9 (28) | 131 (45) |  |
| Yes | 37 (52) | 142 (58) | 23 (72) | 158 (55) | 0.05 |
Table 5
Multivariate logistic regression depicting predictors from Andersen and Newman framework.

| A&N factors                  | Bivariate analysis | *Multivariate analysis |
|------------------------------|--------------------|------------------------|
|                              | Crude OR (95%CI)   | P-Value    | S.E. | Adjusted OR (95%CI) | P-Value | S.E. | R^2  |
| Self-perceived oral health   |                    |            |     |                   |         |     |      |
| No health education          | 2.414 (1.051, 5.541) | 0.04 | 0.424 | 2.732 (1.144, 6.521) | 0.02 | 0.444 | 0.177 |
| Yes, oral health education   | 1                  |           |     |                   |         |     |      |
| Poor/fair general health     | 2.619 (1.368, 5.014) | 0.004 | 0.331 | 3.233 (1.590, 6.575) | 0.001 | 0.362 |      |
| Good/excellent general health| 1                  |           |     |                   |         |     |      |
| Last dental visit            |                    |            |     |                   |         |     |      |
| No health education          | 4.381 (2.090, 9.183) | <0.001 | 0.378 | 4.559 (2.052, 10.130) | <0.001 | 0.407 | 0.045 |
| Yes to health education      | 1                  |           |     |                   |         |     |      |
| Unavailability of doctor     | 7.962 (2.780, 22.803) | <0.001 | 0.537 | 7.201 (2.273, 22.811) | 0.001 | 0.588 |      |
| Readily available doctor     | 1                  |           |     |                   |         |     |      |
| Less frequent brushing       | 1.302 (0.889, 1.905) | 0.2   | 0.194 | 1.631 (1.034, 2.575) | 0.04   | 0.233 |      |

*Forward conditional method adjusted for other predisposing, enabling and need factors.
### Outcome variables:

The two outcome variables in this study were grouped as

1. 1. *Self-reported oral health*, with (0) indicative of excellent/very good/good and (1) indicative of fair/poor;
2. 2. *Last dental visit*, with (0) less than year ago and (1) one to five years ago/never.

### Independent variables:

The independent variables for this study were grouped into three domains: predisposing, enabling and needs based predictors. **Predisposing factors** included: age, sex and access to oral health education. **Enabling factors** included: annual income, availability of a regular dentist and medical doctor, having dental insurance, avoidance of dental treatment due to cost, availability of social support, and availability of dental services were sought. **Need factors** included having clinical dental conditions such as toothaches, temperature sensitivity, bleeding when brushing, plaque status, and decay, as well as satisfaction with the overall appearance of the dentition, self-reported quality of life and general health, the importance of oral health, frequency of tooth brushing, distance to the nearest dental facility, and the reason for the last dental visit.

### Univariate Results

The mean age of the study population was 16.4 (SD = 6.3) years and 68% of the examined adolescents were female. The majority of the participants walked to school (88%), with only one participant travelling to school by car. Most of the participants’ parents/guardians (83%) reported that they could not afford dental insurance and that a family dentist was not available in their community (92%). Many of the participants reported that they have good to excellent general health (81%) and good to excellent quality of life (84%). Around 55% of the adolescents brushed their teeth twice per day; 37% brushed their teeth only once, in the morning hours. Only 32% of the participants reported consuming fluoridated water; 25% were not aware of the presence of fluoride in their drinking water. The majority (80%) of participants were not exposed to oral health education in school or at home (Table 1).
Table 2 shows that almost one third (30%) of participants reported their oral health as fair or poor. Oral health examination revealed that many of the adolescents had decay in a lower left molar (35%, tooth #36) followed by a lower right molar (30%, tooth #46). More than half of the study population had visible dental plaque.

**Bivariate Analysis**

Outcome 1: *Self-reported oral health*

All the predisposing, enabling and need factors were investigated to find significant predictors for the two outcome variables. Amongst the predisposing factors, age ($p < 0.001$) was significantly associated with self-reported oral health. Participants within the age range of 12–18 were more likely to report the health of their mouth as excellent/good then the participants 19 years of age or older. The enabling factors associated with self-reported oral health included having social support ($p = 0.02$) and access to a dental office ($p = 0.05$; Table 3). The children of parents/guardians who reported having social support were more likely to rate their oral health as excellent/good. For self-reported need factors, it was observed that having a toothache ($p < 0.001$), tooth sensitivity ($p < 0.001$), and bleeding when brushing ($p < 0.001$) were significantly associated with self-reported oral health. Adolescents with no toothache, tooth sensitivity and bleeding gum were more likely to rate the health of their mouth as excellent/good than their counterparts. Other need factors related to self-reported oral health include dissatisfaction with appearance of teeth ($p < 0.001$), general health ($p < 0.001$), and brushing frequency ($p = 0.009$). The clinical need factors included decay in teeth #16 ($p = 0.002$), #26 ($p = 0.03$), #36 ($p = 0.003$), and #46 ($p = 0.006$; Table 4).

Outcome 2: *Last dental visit*

The predisposing factors positively associated with a dental visit within the year included age ($p < 0.001$), sex ($p = 0.01$), and having exposure to oral health education ($p < 0.001$; Table 3). Adolescents with exposure to some form of oral health education were more likely to visit a dental professional with the last year than the adolescents who did not have such exposure. The enabling factors positively associated with having a dental visit within the last year were: availability of a regular medical doctor ($p < 0.001$), availability of a regular dentist ($p < 0.001$), avoiding dental treatment due to cost ($p < 0.001$), and where dental services were sought ($p < 0.001$). Participants who had access to a regular dentist and a regular medical doctor were more likely to visit a dental professional within the last year. The self-reported need factors of having a toothache ($p < 0.001$), dissatisfaction with the teeth appearance ($p = 0.003$), and having excellent/good general health ($p = 0.007$) were positively associated with the last dental visit. Of the clinical need factors, the presence of dental plaque ($p = 0.05$) and increased decay in tooth #26 ($p = 0.001$; Table 4) were associated with a dental visit within the past year.

**Multivariate Analyses**
Multivariate logistic regression (forward conditional logistic regression) was adopted to report the adjusted odds ratio and identify the most important predictors from A&N framework for perceived oral health and last dental visit. Missing data pairwise option assisted in excluding subjects from the analyses with missing variables.

**Outcome 1: Self-reported oral health**

The A&N factors that best predicted perceived oral health status in adolescents are presented in Table 5. After adjusting for other predisposing, enabling, and need factors, the most important predictors for perceived oral health of adolescents were oral health education and general health. Participants were nearly 3 times more likely to report fair/poor oral health if they had no oral health education, compared to those with oral health education exposure (OR: 2.732; 95%CI: 1.144, 6.521). The odds of reporting fair/poor oral health were 3 times greater in study participants with self-perceived fair/poor general health in comparison to those with good/very good/excellent general health (OR: 3.233; 95%CI: 1.590, 6.575).

**Outcome 2: Last dental visit**

The A&N factors that best predicted regularity of dental visits among the adolescents are presented in Table 5. After adjusting for other predisposing, enabling, and need factors, it was observed that oral health education, availability of medical doctor, and increased frequency of brushing were identified as the most important predictors for regularity of dental visits. Adolescents with oral health education were four times (OR: 4.559; 95%: 2.052, 10.130) more likely to visit a dentist within the last year in contrast to adolescents with access to no oral health education. Also, availability of medical doctors within the residing area of the participants increased the odds of visiting a dentist within the last year by seven times, compared to those with no access to a regular medical doctor (OR: 7.201; 95%CI: 2.273, 22.811).

**Discussion**

This is the first study to identify the self-reported oral health status and patterns of dental service utilization within the adolescent population in Lesotho. We utilized the A&N model of health service utilization to identify the strongest predictors of self-reported oral health and dental service utilization as employed in our previous studies. [31, 32, 33]

For predisposing factors, we found that adolescents who reported receiving some oral health education were more likely to have visited a dental professional within the last year, which corroborates the findings from Jessani et al. in 2016, and Jessani et al. in 2019. [32, 31] However, 80% of adolescents had not been exposed to any form of oral health education. This is concerning as adolescents are in a developmental stage during which they establish lifelong habits, attitudes, and beliefs. [15] Their early knowledge and behavioural habits can substantially shape their long-term habits, including improper oral care, [16] such as advocated during pregnancy. [32] Hence, not getting proper oral health education can lead to less than adequate oral care practices, with the consequence of oral infections including dental decay. This was further substantiated in our multivariate analysis that identified a lack of oral health education as a major
predictor of both fair/poor self-reported oral health, as well as infrequent dental visits. Henceforth, for capacity building, the volunteer nursing students were trained to provide oral health education session in all the secondary classes at end of each day. These sessions included interactive presentation regarding proper brushing and flossing technique and healthy eating habits including limiting the consumption of sugary beverages.

Our study identified several A&N enabling factors that were significantly associated with the two outcome variables, having social support and reporting excellent/very good/good oral health, which is similar to other studies. It has been shown that having social supports such as transportation, housing, and employment, can lead to better oral health and dental service utilization. This social support can result in a better quality of life that can be positively related to a better perception of oral health, as reported in this study. We also found that avoiding dental treatment due to cost was significantly associated with irregular dental visits, as financial constraints remain the most important barrier preventing access to dental care. Lack of financial affordability and unmet dental treatment needs can lead to poor oral health status. In several low-income countries such as Lesotho, the cost of treating dental caries can cause an extra burden on the healthcare system. Therefore, preventive oral health programs including oral health education may substantially reduce these infections and personal cost associated with the treatment. Having access to a regular medical doctor and a regular dentist were positively related to having had a dental visit within the last year, as was also found by Jessani et al in 2020. In fact, our multivariate analysis revealed the lack of availability of medical doctors within their neighbourhood increased the odds of irregular dental visits by seven times. Participants who were unable to access a medical doctor were also less likely to visit a dental professional within the last year. This indicates that barriers to access to health care are widespread across health disciplines. The health care system in Lesotho is faced with the challenge of insufficient health care professionals in the fields of medicine, pharmacy, and dentistry. Medical care in Lesotho is provided at all three levels: national, district and local health centers, while oral health is not currently provided at the local level due to shortages of professionals and crumbling infrastructure.

Our study also showed positive associations between A&N needs factors such as self-reported quality of life and general health with self-reported oral health, as discussed by others, including Jessani et al 2016 and 2020. Adolescents who reported fair/poor oral health were more likely to also report fair/poor general health and quality of life. A study in Yemen found out that people who perceived their general health as very good/excellent were also likely to perceive their oral health as very good/excellent. Our results further indicated that adolescents who reported having toothache, bleeding gums, and were unhappy with the appearance of their teeth, were more likely to report their oral health status as fair/poor. Similar results have been reported by David et al in a 2006 study in Kerala, India, where self-reported oral status was found to be related to appearance of teeth and caries experience. The reason for this finding might be attributed to a lack of education and preventive oral health services.
The clinical need factor associated with self-reported oral health status was having dental decay. Not surprisingly, adolescents were more likely to report their oral health status as fair/poor if they had decayed teeth. Tooth decay is one of the most common infections reported globally, which can affect overall well-being and the quality of life. Our study found that 35% of the adolescents had decay in a lower left molar and 30% had decay in a lower right molar. This is a concern as the average age of our population was 16.4 years, which means their first molars have erupted less than a decade ago. Although these findings are similar to other studies, it is a starkly different from countries such as Finland, where the authors found that at age 15, only 5% of participant first permanent molars were decayed.[30] In addition, our results showed that more than half of the study population had plaque deposits, and a very slight number were identified with restored teeth. This indicates that there is a significant proportion of adolescents with unmet oral health needs and improper oral hygiene practices, as found in another study.[17] Such findings can negatively affect academic performance, social development and nutritional intake, thus impeding the well-being and development of adolescents.[18] Adolescents with no dental plaque and less tooth decay were more likely to report regular dental visits, which yet again confirms the association between access to care and better oral health outcomes.[27]

Conclusion

This is the first assessment of the oral health of adolescents in Lesotho that identified predisposing factors, enabling factors, and needs predictors. We found several psychosocial factors that correlated with the self-reported oral health status and patterns of dental service utilization in our study population. The literature on oral health promotion strategies is heavily in favour of sustainable, culturally appropriate, and community-based initiatives. Results from this study can be utilized by oral health professionals and policy makers to provide long-term prevention-based dental care to adolescent population in the Kingdom of Lesotho.

Limitations:

Our results did not come without limitations. The targeted sampling approach resulted in only a small percentage of students from each school being included in the data collection. The surveys were not completed in full by all parents/guardians, and missing data may have skewed the results. Dental decay was not examined on full dentition, which may have biased the implication of the findings. No radiographic examinations were performed to confirm the extent of dental decay, which likely means that decay was underestimated as radiographs may identify decay that the dentist cannot see on visual inspection. Despite these limitations, this initial study of provides valuable insights into the unmet oral health needs of adolescents in Maseru, Lesotho.

Abbreviations

DMFT
Decayed, Missing, Filled Teeth
A&N
Andersen and Newman
SLF
Smile Lesotho Foundation
BC
British Columbia
NUL
National University of Lesotho
WHO
World Health Organization
MS
Microsoft
SPSS
Statistical Package for the Social Sciences
CI
Confidence Interval
SD
Standard Deviation
OR
Odds Ratio

Declarations

Ethics approval and consent to participate

Ethics approval was sought by University of Saskatchewan Behavioural Ethics Board. Consent was sought by the parents of all the adolescents who participated in this study.

Consent for publication

All the coauthors have provided their consent for the publication.

Availability of data and materials

N/A

Competing interests

Authors declare no competing or conflict of interest.

Funding
This project was funded by Smile Lesotho Foundation

Authors’ contributions

AJ is the primary author of this manuscript. His task in this research included writing the research proposal and developing this manuscript (introduction, results, discussion and conclusion). Statistical analysis and interpretation of results were performed by FQ, JL and DL while EN and MB helped in designing and writing the manuscript. Two undergraduate dental students AE and KH also significantly contributed in developing this manuscript. Their tasks mainly included conducting the literature review and have significantly contributed to this manuscript, from presenting ideas to formatting and presentation.

Acknowledgements

We would like to thank the volunteers and Smile Lesotho Team members including: Dr. Nicholas Seddon, Dr. Abbas Jessani, Dr. Mario Brondani, Mrs. Lebohang Motaung, Mr. Letlotlo Lefoka, Ms. Bronwyn Zuck, Dr. Karim Ramji and Dr. Tsepiso Makoa for their efforts to carry out this project; Smile Lesotho foundation for providing the financial support including traveling, accommodation and oral hygiene supplies for this project; Dr. Pulane Lefoka, former Director Centre for Teaching and Learning at the National University of Lesotho, for her tireless efforts to make all the important arrangements to run this project; the Ministry of Health and Ministry of Education & Training for giving us permission to conduct oral examinations in schools; Dr. Tsepiso Makoa (Retired Nurse) and Mrs. Lebohang Motaung (Retired Senior Administrator) for supporting the project and at the same time translating the research instrument into Sesotho (the local language); Ms. ‘Maliahelo Qhobela - and Dr. Isabella Nyangu for supervising the nursing students; Nursing students from the Faculty of Health Sciences Nursing Department. National University of Lesotho for volunteering their time with us. Lastly, we would like to thank the students, their parents, and the principals from all the schools who participated in this project.

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