ORAL – SYSTEMIC PARADIGM: ASSESSING MEDICAL STUDENTS' KNOWLEDGE, ATTITUDE AND PRACTICE OF DENTISTRY

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ABSTRACT

Background and Objectives: Oral health remains one of the longstanding health challenges. Traditional medical curricula do not focus on oral health care and prevention resulting in misperceptions and limited understanding among medical students.

Methods: This study compared a total of 2412 medical and non-medical students for their oral health knowledge, attitudes and practices including tobacco use. It achieved a response rate above 95% on self – reported questionnaire.

Results: About 22% participants undertook annual dental checkups regularly while 77% cited satisfactory oral health as a reason for not needing to visit a dentist. Logistic regression results showed slightly better compliance among non-medical students with pre-defined oral self – care regime while adjusting for other predictors, as indicated by more frequent daily tooth – brushing (OR 0.79, 95% CI 0.66 – 0.94, $p < 0.05$). However, medical students had comparatively better awareness and positive oral health self – perceptions (OR 1.29, 1.07 – 1.54, $p < 0.01$), were less likely to experience dental fear (OR 0.66, 95% CI 0.53 – 0.82, $p < 0.0001$), and were more receptive towards oral – systemic perspective (OR 1.73, 95% CI 1.37 – 2.19, $p < 0.0001$).

Conclusion: Medical education should incorporate oral health competencies to foster a culture of multidisciplinarity with corresponding reconfiguration of national health system.

Key words: Oral health, dental fear, curricula, interdisciplinary, dentistry.

INTRODUCTION

Contemporary public service needs have put health professions education at cross – roads.[1] Despite acceptance of its integral nature to general health and quality of life, oral health does not figure coherently in traditional, discipline – specific medical training imparted in most countries.[2,3] Worldwide emergence of comorbidities, growing burden of diseases of orofacial complex including tobacco use, increasing elderly populations, and widening social disparities represent the need for interdisciplinary workforce that deliver oral health care based on a public health perspective.[4,5] This means reconfiguring education as well as health service system.[1] In the early 1990s, 9% of the U.S. population, or 22 million people, reported unmet dental care needs. Eight million more people reported unmet oral health needs than reported medical care needs that were not met. In past few decades, there has been a flurry of research advocating for introduction of medical curricula based on "oral – systemic health" or "interdisciplinary care" that further builds on recognition of oral health biomarkers as drivers of innovations in diagnostic technology and clinical practices.[4] Learning outcomes of such training models seek to develop oral health competencies of medical students so that future medical professionals could offer caries counselling, conduct oral health assessments and perform basic preventive procedures on their patients while maintaining professional identities.

Oral health influences and is related to nutrition and growth, pulmonary health, speech production, communication, self – image and societal functioning.[1,6] Mouradian further proposed that oral health is intertwined with all aspects of a child's developmental processes, genetic potential and environmental circumstances. In United States, dental caries (tooth decay) is the most common chronic disease of children aged 5 to 17 years and one of the most common causes of missed school days. This means an inherent appeal for involvement of physicians in paediatric oral care particularly when most children receive primary medical care beginning very early in life but not dental care.[7-9] Similarly, oral disease burden among adults is significantly large while negligible oral health benefits are offered at state level.[2] On the other hand, medical graduates lack adequate understanding of adult dental

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problems despite association of poor oral health with various chronic conditions such as under – nutrition, cardiovascular disorders, diabetes types 1 and 2, cancers, autoimmune diseases, and perinatal problems.[10-12] Its note worthy that 133 million Americans have at least one chronic condition and that treatment for those patients accounts for nearly 75% of all medical expenditures.[13] These skill shortages and structural deficiencies warrant curricular introspection at medical schools in order to institutionalize development of non-dentist professionals while addressing the historic dilemma of "surreal duality" faced by dental education at the same time.[1,4]

Oral health is generally considered secondary and of lesser importance.[2,15] Such misperceptions are known to shape personal hygiene practices and physicians' professional ability to offer appropriate preventive advice. This study hypothesized that due to training in health care settings, oral self – care practices of medical students were more frequent, diverse and risk – averse; as compared to non-medical students. Therefore, medical students oral health knowledge, attitudes and practices (KAP) were assessed and compared with non-medical undergraduate students. Furthermore, both groups were compared for their annual dental attendance and its self – reported barriers, in order to inform the need for oral– systemic training model in low and middle – income settings.

METHODS

Study Design and Setting

This was a cross-sectional study carried out by Department of Prosthodontics, FMH, College of Medicine and Dentistry, Lahore, during spring of 2011. It was approved by Institutional Review Board at the college.In line with a priori sample size calculations with 90% power (G*Power 3), a total of 2412 undergraduate students from eight academic institutions were recruited. They were divided into two groups and were matched for age and gender. First group comprised of 1292 medical students from four medical colleges while the other group included 1120 students of management and computer sciences enrolled in four non-medical institutions. In this setting, it takes a minimum of five years of full – time studies for graduation in medicine (MBBS) while each major in management (BBA) and computer sciences (BCS) takes about four years (eight or more academic semesters). Average annual intake in a medical school is of the order of two non-medical programs (BBA and BCS) combined. Other bachelor courses offered under this system (B.A in disciplines such as Humanities, Fine Arts, Economics, Civic Sciences) take two years in completion and were thus unsuitable for inclusion. Law and engineering students who take about five years for graduation were not taken due to their annual examination coinciding with the data collection period. The medium of education was English in all participating institutions.

Sampling

Recruitment was carried out in two phases. In phase 1, invitations for participation were sent to Heads of all shortlisted institutions via registered post. Considering logistics and allocated timeframe, non-medical institutions offering BBA and BCS programs within same campus were invited. It was followed up with telephonic contact. Of the eight medical colleges in the city, four consented for participation. Four out of eight non-medical universities also agreed to participate. In phase two which commenced in the middle of spring semester, study participants were recruited during data collection visits scheduled in agreement with respective faculties. To minimize participation bias, all institutions were requested to keep the schedule unannounced. Data were collected before lectures on alternate weekdays with sampling interval of 3 as per seated in the classroom. Trained data collectors were recruited so that study objectives were clearly explained to participants before handing them the questionnaire. An overall response rate of 95% was observed.

Study Instrument

The study instrument was derived from World Health Organization (WHO) Simplified Questionnaire for Interviewing Adults on Oral Health (2004) which was expanded to record demographic information, dental attendance history with self – perceived barriers to dental checkups, oral health KAP, and frequency of tobacco smoking as well as intake of sugary diet. It consisted of 27 major response options, itemized as binary and multiple scales. It was also revised twice in light of pre-testing involving a total of 105 undergraduate students enrolled in the institution carrying out this study. Standardized alpha of 0.71 achieved investigators' consensus on reliability. Data collectors followed applicable codes of ethical, social and environmental conduct during visits and ensured that each participant signed statement of consent and confidentiality printed on the title page of the questionnaire. On average, the questionnaire took less than 12 minute to complete with observed completion rate above 95%.

Study Measures

The self – reported questionnaire comprised of major study constructs divided into four sections. Demographic information included academic details, place of birth, current residence and boarding status. The frequency of tobacco smoking and intake of various sugary foods and beverages were reported on a Likert – like nested scale (0 = Never, 1 = several times a year, 2 = several times a month, 3 = several times a week, 4 = at least once a day, 5 = Several times a day). Respondent's dental attendance history and its barriers were recorded on ordinal scales while oral health KAP were itemized as binary response options, as per the-

oretical framework. The section on oral health KAP was also the longest. It assessed their awareness of fluoride function in commercially available toothpastes (Yes/No). To capture oral health attitudes including self – perceptions (positive/ negative), respondents were asked if they considered oral health as a component of general health (Yes/No), and if fear/anxiety of dental pain and/or intraoral local anaesthesia ever kept them from visiting dental office (Yes/No). Lastly, oral self – care practices comprising tooth – brushing frequency (Once a day/Twice a day), daily use of mouthwash and/or dental floss in addition to brushing (Yes/No), and regular annual dental checkups (Yes/ No) was self – reported.

Data Analyses

Stata/SE 12.0 (Stata Corp LP, College Station, TX) was used for data analyses. Descriptive statistics were summarized for respondents' demographic characteristics, dental check-up frequency and self – reported barriers to checkups. These statistics were reported by study groups as percentages and presented as figures and tables. In view of arbitrarily missing data, multiple imputations using chained equations (MICE) were carried out. In line with objectives, study constructs were compared for both groups using logistic regression. Diagnostics and goodness of fit evaluations of univariate and multivariate models were based on criterion comprising descriptive (Negelkerke R^2, McFadden adjusted R^2, Efron's R^2, Pseudo R^2, AIC) and inferential statistics (group classifications, Hosemer and Lemeshow Test, sensitivity/specificity plotted against probability cut-off of 0.5, and C-statistic). This was summarized by C-statistic (equivalent to the area under the Receiver Operating Characteristic [ROC] curve at Alpha (p-value ≤ 0.05) as indicative of predictive probability. Assumption of nested null model (Likelihood Ratios Test at Alpha (p-value ≤ 0.05) was tested for inclusion of each predictor in the adjusted model. Tobacco smoking was merged into binary category (0 = Non-smokers, 1 = Daily smokers) after defining those who reported smoking at least one cigarette a day as smokers (4 = at least once a day, 5 = Several times a day) while all others as non-smokers. Partial multivariate models were also generated in order to analyze oral health knowledge and perceptions separately from self – care practices while adjusting for demographic characteristics. Estimates of measures in final model included Odds Ratios (ORs) of predictors, computed through exponentiation of beta coefficient with Confidence Interval (CI) of 95% and Alpha (p-value ≤ 0.05). To detect any confounding and/or spurious relationships, data were stratified by gender and birthplace (urban or rural). As per theoretical framework, participant's age, year of study and measures of intake of sugary diet were excluded. The final regression model summarized estimated measures of each predictor while adjusting for other covariates.

Table 1: *Sample characteristics: Demographic details and academic status.*

Sample Characteristics	*N (%)*	*Medical Students N (%)*	*Non-medical Students N (%)*
Count	2412 (100)	1292 (53.6)	1120 (46.4)
Gender			
Male	830 (34.5)	440 (18.2)	390 (16.1)
Female	1582 (65.5)	852 (35.3)	730 (30.2)
Boarding status			
Boarder	787 (32.6)	573 (23.7)	214 (08.9)
Non-boarder	1625 (67.4)	719 (29.8)	916 (37.6)
Place of Birth			
Urban	1687 (69.9)	860 (35.7)	827 (34.2)
Rural	725 (30.1)	432 (17.9)	827 (34.2)
Place of current permanent residence			
Urban	1824 (75.6)	997 (41.3)	827 (34.3)
Rural	588 (24.4)	295 (12.2)	293 (12.2)
Study year			
1st	586 (24.3)	272 (11.3)	314 (13.0)
2nd	498 (20.6)	230 (09.5)	268 (11.1)
3rd	554 (23.0)	303 (12.6)	251 (10.4)
4th	470 (19.5)	234 (09.7)	236 (09.8)
5th	304 (12.6)	253 (10.5)	051 (02.1)

RESULTS

Majority of study participants (70%), which comprised of about 65.5% females, were born in urban settings or cities (Table 1). Fewer than 23% of all students reported visiting dentist at least once per year while 77% cited absence of any existing dental pathology as a reason for not visiting a dentist (Figure 1). Table 2 summarizes descriptive measures of central tendency for each predictor included in regression models. Overall oral self – care among both study groups was mostly similar while adjusting for gender, place of birth, oral health knowledge and attitudes (Table 3). In fact, non-medical students were more likely to brush their teeth twice a day or more (OR 1.21, 95% CI 0.66 – 0.94, p < 0.009).

However, medical students were more likely to be aware of fluoride function within toothpastes (OR 2.28, 95% CI 1.88 – 2.75, p < 0.0001), considered oral health as part of general health (OR 1.73, 95% CI 1.37 – 2.19, p < 0.0001), had positive oral health self – perceptions (OR 1.29, 1.07 – 1.54, p < 0.01), and were less likely to experience dental fear/anxiety as a barrier to dental visit (OR 0.66, 95% CI 0.53 – 0.82, p < 0.0001). Since most of the study findings indicated similarities among both groups, Figure 2 explains that predictive probability of the final model is attributed to variations observed in measures of oral health awareness and attitudes while accounting for remaining predictors.

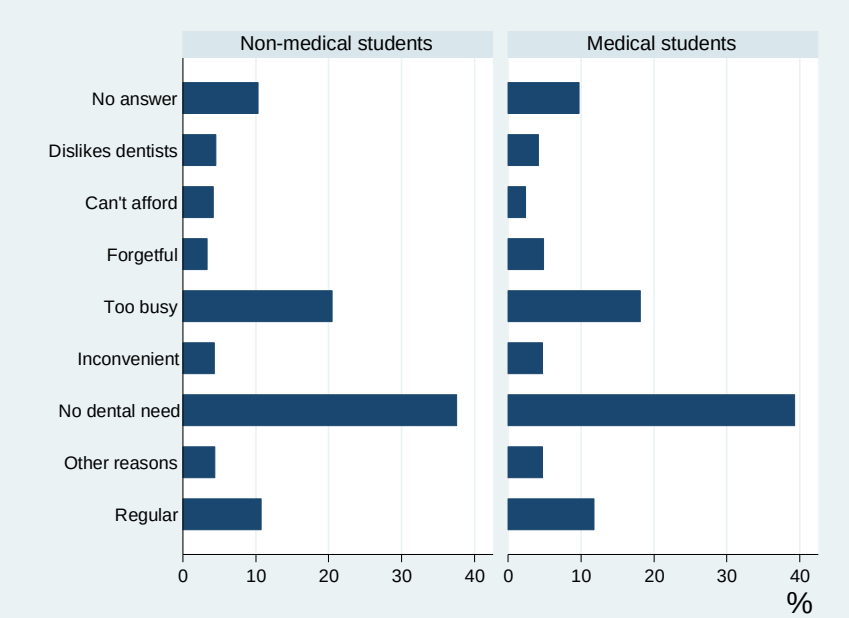

Figure 1: *Frequency of annual dental attendance and various self – reported barriers for not undertaking it.*

DISCUSSION

Our findings supported incorporation of oral health competencies into medical curricula since in comparison with medical students, greater likelihood of twice daily tooth-brushing was observed among non-medical students (OR 1.21, 95% CI 0.66 – 0.94, p = 0.008). Other constructs of oral self – care strategy including frequency of tobacco smoking as proxy for risk – aversion were not significantly different though (Table 3). Self – reported frequency of daily tobacco smoking was less than 10% among all participants (not included in results). These findings refuted the study hypothesis despite significantly better oral health knowledge and attitudes reported by medical students. Excluding psychosocial constructs of oral health from the final model markedly reduced its predictive probability while accounting for gender and birthplace (Figure 2). However, goodness of fit parameters of estimates suggest robustness of modelling approach and underlying theoretical framework (Group correctly classified = 63.18, Hosmer and Lemeshow chi² (8) = 8.76). Furthermore, these findings are in consonance with those of descriptive data on dental attendance and its perceived barriers (Figure 1). Interestingly, the dissociation observed between psychosocial constructs and oral health practices was in disagreement with literature on informed health behaviours.[16] Therefore, inter – group differences in knowledge and attitudes reported here should be interpreted with caution due to possible self – reporting bias inherent in study design, or information bias attributed to medical students, and/or limitation of measures used which were included in line with overall objectives but no extensive study on psychometric

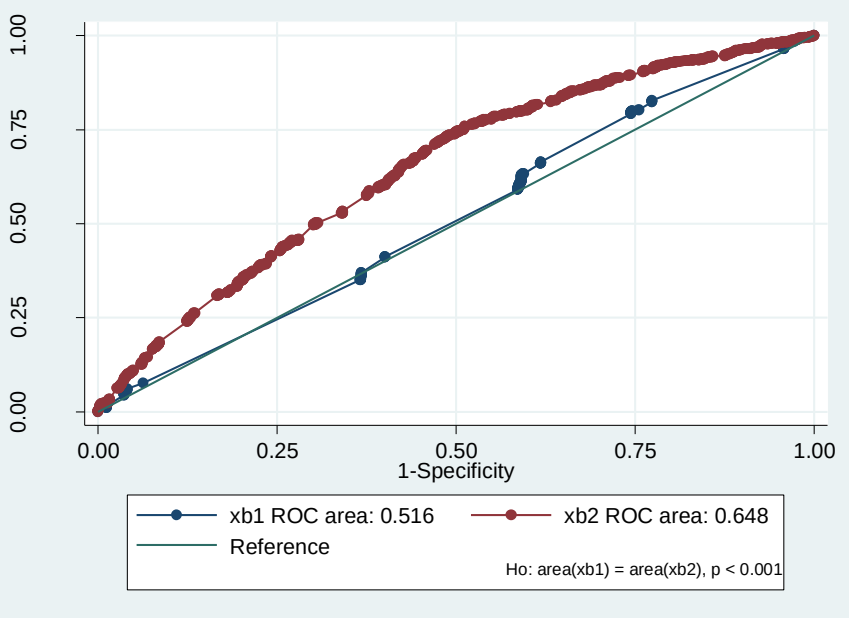

Figure 2: *Receiver Operating Curves (ROC) for multivariate models; 1) xb1 = unadjusted estimates for oral health awareness and perceptions, 2) xb2 = Final adjusted model.*

properties of these measures were conducted. No firm causal interpretation can be made from these data. Nevertheless, absence of symptomatic dental pathology being cited as the reason for not visiting a dental office by 77% respondents warrants attention of curriculum developers and medical faculty.

Unlike most publications, this study assessed oral self – care practices as a regime comprising four sub-measures in order to reflect frequency, diversity, prevention and risk – aversion or modifiable risk.[17,18] While twice a day tooth – brushing and adjunct hygiene measures such as mouth rinses and flossing are accepted as standard self – care practices, evidence for usefulness of regular annual dental attendance is conflicting.[19] Findings from the 1988 Adult Dental Health Survey in the UK revealed that 'regular dental attenders' had a higher dental caries experience (DMFT) and had fewer sound untreated teeth. Other concerns such as financial implication, loss of work hours, discomfort experienced and overtreatment were also raised. Contrarily, regular dental attendance is associated with disease prevention, lesser untreated decay, a lower rate of tooth loss and a higher number of functioning teeth (restored or otherwise sound teeth). It has also been argued that regular dental attenders experience less pain and/or anxiety, have less 'gaps' from tooth loss and have less untreated disease. Inclusion of frequency of tobacco use enhanced the overall inferential value of self – care practices assessed in this study.[16,20,21] But simultaneous oral health examinations could have improved the quality of findings further.

Table 2: *Descriptive analysis of individual predictors according to collected data.*

Variable Name	*Mean*	*SD*	*Minimum*	*Maximum*
*Age in Years**	21.288	2.155	17.910	24.536
Gender				
Full sample	0.344	0.475	0	1
Medical students	0.340	0.474	0	1
Non-medical students	0.348	0.476	0	1
Place of Birth				
Full sample	0.811	0.391	0	1
Medical students	0.793	0.404	0	1
Non-medical students	0.830	0.375	0	1
Knowledge of Fluoride Function				
Full sample	0.708	0.455	0	1
Medical students	0.798	0.401	0	1
Non-medical students	0.605	0.489	0	1
Oral-systemic Health Awareness				
Full sample	0.835	0.370	0	1
Medical Students	0.885	0.319	0	1
Non-medical students	0.780	0.414	0	1
Oral Health Self – assessment				
Full sample	0.689	0.462	0	1
Medical Students	0.727	0.445	0	1
Non-medical students	0.646	0.478	0	1
Dental Fear and Anxiety				
Full sample	0.183	0.387	0	1
Medical Students	0.146	0.354	0	1
Non-medical students	0.224	0.417	0	1
Tooth – brushing Frequency				
Full sample	0.403	0.490	0	1
Medical Students	0.389	0.487	0	1
Non-medical students	0.419	0.493	0	1
Daily use of Mouthwash/Floss				
Full sample	0.484	0.499	0	1
Medical Students	0.480	0.499	0	1
Non-medical students	0.488	0.500	0	1
Annual Dental Checkups				
Full sample	0.113	0.316	0	1
Medical Students	0.117	0.322	0	1
Non-medical students	0.108	0.310	0	1
Smoking status				
Full sample	0.095	0.293	0	1
Medical Students	0.089	0.285	0	1
Non-medical students	0.101	0.302	0	1

*Excluded from final model as per conceptual framework

Key findings from our data were also similar to those already reported in existing literature regarding the need to address misperceptions and shape medical students' behaviours so they could advise their patients on basic oral health care and prevention.[10,22] The large sample size with 90% sample power recruited in this study meets generalizability standards and could serve as

Table 3: *A summary of logistic regression results comparing oral health awareness, attitudes, practices while accounting for demographic characteristics of the two groups Outcome variable: Study discipline (medical or non-medical).*

Variable	*Unadjusted OR[a] (95% CI)S.E.[b]*		*Adjusted OR (95% CI)S.E.*	
Gender Male (1) Female (0)	0.96 (0.81 – 1.14)	0.830	1.10 (0.91 – 1.31)	0.101
Place of Birth Urban (1) Rural (0)	0.72* (0.58 – 0.88)	0.076	0.81 (0.65 – 1.01)	0.090
Knowledge of Fluoride function1 Yes (1) No (0)	2.57** (2.14 – 3.09)	0.238	2.28** (1.88 – 2.75)	0.221
Awareness of oral – systemic health2 Yes (1) No (0)	2.17** (1.73 – 2.71)	0.247	1.73** (1.37 – 2.19)	0.208
Oral health self – description Positive (1) Negative (0)	1.44** (1.21 – 1.71)	0.127	1.29* (1.07 – 1.54)	0.119
Dental fear and/or anxiety3 Yes (1) No (0)	0.59** (0.48 – 0.73)	0.634	0.66 (0.53 – 0.82)	0.073
Frequency of tooth – brushing Twice a day or more (1) Once a day or less (0)	0.88 (0.75 – 1.03)	0.073	0.79* (0.66 – 0.94)	0.070
Use of mouthwash and/or floss4 Yes (1) No (0)	0.96 (0.82 – 1.13)	0.078	0.96 (0.81 – 1.14)	0.083
Annual dental checkups5 Yes (1) No (0)	1.10 (0.85 – 1.41)	0.142	1.11 (0.85 – 1.45)	0.151
Daily cigarette smoking6 Yes (1) No (0)	0.883 (0.67 – 1.15)	0.122	1.05 (0.78 – 1.40)	0.157

** p< 0.05. ** p< 0.001*
a Odds Ratio. b Standard Error of Estimate
1 If respondent is aware of fluoride function in toothpaste
2 If respondent considers oral health as part of general health
3 If fear of dental procedure or anesthesia ever kept respondent from visiting dental office
4 If respondent daily use mouthwash and/or floss in addition to tooth – brushing
5 If respondent gets dental checkup(s) done at least on annual basis
6 If respondent currently smokes at least one cigarette a day
Goodness of fit: Nagelkerke's R^2 = 0.089, McFadden's adjusted R^2 = 0.043, Efron's R^2 = 0.068, Pseudo R^2 = 0.050, AIC = 1.321, Group correctly classified = 63.18, Hosmer and Lemeshow chi^2 (8) = 8.76

baseline for future research and pilot studies on this topic in similar settings.

It is ***concluded*** that introduction of multidisciplinary perspective in medical education should be explored in view of emerging trends in epidemiology and pathophysiology. Encouraging greater familiarization of medical students with fundamentals of oral health and preventive care with necessary reconfiguration of health service system could contribute in institutionalizing a public health perspective that addresses long-standing population health needs and existing gaps in quality of care. Pros and cons of oral – systemic approach and its applicability in low and middle income settings should be weighed further.

CONFLICTS of INTERESTS
None.

Author's Contributions
Methods, analysis and discussion; critical reviews:

S.A. introduction, conclusions and citations: N.Y.

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