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ORIGINAL ARTICLES

Needs assessment for emerging oral microbiome knowledge in dental hygiene education

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ABSTRACT

The curricula of dental hygiene education reflect the knowledge gained through research and clinical advances. Emerging knowledge is often complex and tentative. The purpose of this study is to assess dental hygiene students' confidence in their knowledge about the oral microbiome and to conduct a knowledge needs assessment for expanding their exposure to emerging knowledge about the oral microbiome. Sixty dental hygiene students were surveyed, using a Likert-type scale about their confidence and about current and emerging bacteriological research. The majority of students (60%) reported being confident in their knowledge. The mean score for the ten items was 35.2% (standard deviation, 20.6%). The results of this study indicate a need for emphasis on emerging oral microbiome research in dental hygiene education. This is important so that dental hygiene students can properly share information with their patients about advances in dental care.

Key Words: Dental hygiene education, Oral microbiome, Dental hygiene needs assessment

1. INTRODUCTION

van Leeuwenhoek and Robert Hooke discovered microorganism circa 1665 with a single lens microscope.^[1,2] Historically, bacteria were sketched and named based upon appearance (phenotype).^[1] In the mid-1700's Linnaeus developed a standardized naming system (taxonomy) creating groups based upon Domain, Kingdom, Phylum, Class, Order, Family, Genus and Species where a taxon was a standard name from domain to species.^[3] There were controversies about naming and classifying bacteria. They were identified as plants; then grouped in the phylum Moneres; then regrouped as prokaryote (one-cell organisms without true nuclei, mitochondria, or other true organelles). Through the mid-1900's, different researchers had different names for the same bac-

teria (synonymy).^[4] Challenges also occurred with naming bacteria which transferred genes laterally (bacterial recombination)^[5] and with naming similar bacteria in different ecological niches. A unifying taxonomy theory for bacteria including the genetic characteristics (phylogenetics) and bacterial habitat remains controversial.^[6,7]

In the 1970's, researchers recognized putative bacterial species called operational taxonomic units, OTUs or OTU clusters^[8] using the 16S section of bacterial ribosomal ribonucleic acid (16S rRNA). It has a cluster of unique sequences for a species despite lateral gene transfer of other sections.^[6] Researchers used statistical algorithms to classify the small subunits (SSU) of rRNA as OTUs. Global datasets of bacterial rRNA sequences exist. The approach is

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considered theory-agnostic, but the algorithms for OTU clusters have been shown to also have high levels of ecological consistency.^[6]

The oral microbiome is diverse and different for people living in different geographical areas. Researchers indicated that the Batwa Pygmies of Uganda had 3,115 OTUs, whereas Germans had 887 OTUs, and native Alaskans from Barrow had 2,015 OTUs.^[9] The Human Oral Microbiome Database (HOMD) has data on approximately 700 human oral prokaryotes with 49% officially named, 17% cultivated, but not named, and 34% which have not been cultivated.^[10] There are genomes for 315 oral taxa which are publicly available at the HOMD website.^[10]

It is important for dental professionals to be current with oral microbiome research, but it is difficult to remain current as the advances are rapid and the details are intricate and complex. The curriculum for dental professionals is rigorous, time-consuming, and intensive. Adding additional content to the curriculum often involves removing other content, therefore any change requires justification and an assessment of need. The purpose of this study was to assess dental hygiene students' confidence in their knowledge about the oral microbiome and to conduct a needs assessment to determine their exposure to emerging research about the oral microbiome. It should be noted that this level of detail is not a standard of the Commission on Dental Education which requires that the microbiology coursework be comparable to college transferable liberal arts course work.^[11]

The research hypothesis for the study was that third and fourth year dental hygiene students would have higher scores for knowledge concerning the oral microbiome as compared

with the first and second year dental hygiene students. The rationale for this study was that it is important to have an understanding of the students' assessment of their own understanding of the oral microbiome so that they can properly inform their patients. Having and sharing such knowledge is a component of dental literacy.

2. METHODS

This study was approved by the West Virginia University Institutional Review Board. The study population consisted of all of the enrolled dental hygiene students in the dental hygiene program (81 students). Students self-identified as being first, second, third, or fourth year students. There were 22 first year students, 20 second year students, 25 third year students, and 14 fourth year students in the dental hygiene program. To increase the power of the available sample, the first and second year students were merged into one group and the third and fourth year students were merged into another group. Additionally, the study population was less than 5% male, less than 5% minority, and less than 10% over 25 years, therefore the researchers did not include sex, race/ethnicity, or age as requesting such demographic data presented the real possibility of student identification.

We created a 12-item survey in a cross-sectional study design. Ten items in the survey related to student knowledge, one item queried the student about his or her class (first year, second year, third year, or fourth year), and one item was related to the student's self-perception of confidence in his or her knowledge about the oral microbiome. The survey was created by the authors. Its content was tested with dental faculty and it was revised based on the feedback provided. The complete list of questions is provided in Table 1.

Table 1. Survey statements and Responses

Number (60)	Correct Response	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Confidence						
I feel confident in my knowledge about oral bacteria.		4	32	13	10	1
Knowledge						
A taxonomy is a standardized naming system.	True	7	23	23	5	2
Operational taxonomic units are putative bacterial species.	True	2	14	35	7	2
A common RNA segment for speciation is 16S rRNA.	True	0	14	34	10	2
The oral microbiome is consistent for all people.	False	2	8	12	27	11
There are approximately 145 human oral prokaryotes.	False	1	9	33	16	1
The HOMD is the hominid database.	False	2	16	37	4	1
All oral microbes have been cultivated.	False	1	12	20	20	7
Phenotype refers to the appearance of an organism.	True	5	22	23	7	3
A prokaryote has a true nucleus.	False	6	18	22	7	7
All researchers define OTUs in the same manner.	False	1	6	31	18	4

The variable of interest was the percentage of correct responses (ostensibly true/false statements) to ten items. The statements were presented in a Likert-type format with five responses: “strongly agree; agree; neutral; disagree; and strongly disagree.” The data were dichotomized to “correct” or “incorrect” with neutral responses assigned with the incorrect response.

Students were presented with the statement: “I feel confident in my knowledge about oral bacteria.” They were asked to select the degree of agreement or disagreement with the Likert format described above. This was the first item on the survey.

Statistical analyses included frequency determinations for the questions, percent correct for first/second year students as well as percent correct for third/fourth year students. A T-test for mean differences was performed. Logistic regression on student confidence in knowledge about the oral microbiome in association with being either first/second year students or third/fourth year students was conducted. Statistical analyses were performed with IBM SPSS Statistics 21 (Armonk, New York).

3. RESULTS

There were 60 (74%) of the dental hygiene students who responded to the survey. Of the participants, there were 13 first year students, 25 second year students, 16 third year students, and 6 fourth year students who responded. There were 3 missing knowledge items which were coded as neutral responses. The missing items were 0.5% of the 600 items.

There were 36 (60%) students who agreed or strongly agreed that they were confident in their knowledge about the oral microbiome. There were 27 (71.1%) of first/second year students who agreed or strongly agreed and 9 (40.9%) of the third/fourth year students who agreed or strongly agreed that they were confident in their knowledge about the oral microbiome. In logistic regression, the first/second year students were more likely to report being confident in their knowledge about the oral microbiome than the third/fourth year students (OR= 3.55; 95% CI: 1.18, 10.7). With a cut-point percentage of 60% correct, there were 13 students (21.7%) who were at or above 60% and of these students, 8 reported being confident in their knowledge about the oral microbiome. Of the 47 students with a percentage below 60%, 28 reported being confident in their knowledge about the oral microbiome. There was no significant difference in the confidence level of the students with scores at or above 60% with students who scored below 60% (asymptotic 2-sided $p=.898$).

Most responses to the knowledge questions were neutral responses. The results of the survey are presented in Table 1.

The overall mean correct percentage for the ten knowledge questions was 35.2% (standard deviation, 20.6%). The median and mode were 30%. The minimum was 0% and the maximum was 80%. The 75th percentile was 50%.

The mean score for the first/second year students was 35.5% (standard deviation, 20.2%). The mean score for the third/fourth year students was 34.5% (standard deviation, 21.8%). The results of the T-test for mean differences was $p=.550$ (58 df), indicating there was not a significant difference between groups.

4. DISCUSSION

In this study on needs assessment for oral microbiome knowledge in dental hygiene education, the researchers found a need to address emerging oral microbiome knowledge. The mean oral microbiome knowledge for ten emerging knowledge questions was 35.2(%) and there were no significant differences between first/second and third/fourth year students. Sixty percent of students expressed confidence in their knowledge of the oral microbiome. However, only 13 students (21.7%) actually had $\geq 60\%$ of the questions correct. In terms of the logistic regression on confidence in their oral microbiome knowledge, the question about confidence in knowledge was presented in advance of the knowledge questions. The students may have responded differently about their confidence about their knowledge about the emerging research about oral microbiome had they had the knowledge questions presented to them before being asked about their confidence. The knowledge and confidence in the knowledge are crucial and highlight the need for addressing emerging research.

This is a novel study with few previous similar studies to compare. In terms of dental hygiene student knowledge concerning their bacterial knowledge, PubMed, EbscoHost and Google Scholar searches using the key words, “dental hygiene bacteriology education,” “dental hygiene bacteria,” “dental hygiene microbiome,” and similar searches returned no results which were similar to this current study.

In terms of student confidence with their dental hygiene education, researchers with dental hygiene education preparedness for careers indicated that 2 out of 6 respondents reported confidence (satisfaction) with the preparedness received during dental hygiene education.^[12] Researchers with dental hygiene education preparedness for accessing websites for information indicated that 396 out of 5007 (7.9%) of dental hygienists responded to requests about the confidence in using a computer and the internet to gain current and emerging knowledge.^[13] Dental hygienists who graduated after 1999 reported receiving evidence-based decision making

training and were confident in information-seeking strategies to stay current in their knowledge.^[13] Dental hygiene program directors strive to keep programs current and are confident that students who graduate from a Commission on Dental Accreditation-approved dental hygiene program and pass the national board examination are competent and ready to practice dental hygiene.^[14] Additionally, in a systematic review of dental hygiene and research, dental hygienists have been extremely supportive of participating in and conducting research to lead to new evidence-based knowledge and were committed to being current in their understanding of the disease process and oral health.^[15]

This study is important as it demonstrates the need for dental hygiene students to learn more about the current and emerging research, skills and technologies that are related to the oral microbiome. The study strengths are a 74% response, an adequate sample size, and 99.5% completion of all items on the survey. A study weakness is the use of one school which was predominately white, female and young. As a result, the

effect of race/ethnicity, sex, and age were not evaluated. The logistic regression on “confidence” may be an underestimate or overestimate of dental hygiene student confidence in their knowledge.

5. CONCLUSION

There is a need for widening dental hygiene experiences to include more emerging knowledge in terms of the oral microbiome and to prepare dental hygiene students with the knowledge and skills to continue their education to stay current with the fast pace of research discoveries and applications.

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