ORIGINAL ARTICLE

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Dental hygienists' research utilization: influence of context and attitudes

Abstract: Background: Research use is a core component of evidence-based practice (EBP), contributing to improved patient outcomes; however, we know little about factors influencing research use among dental hygienists. The purpose of this study is to examine whether individual's attitudes and organizational context influence dental hygienists' research use. Methods: A cross-sectional survey design was used to study research use among a geographically stratified probability sample of 1100 Canadian dental hygienists. A translated French-language version was provided for Francophone dental hygienists. Descriptive and inferential analyses were performed using SPSS. Results: Mean responses were highest for conceptual research use (RU) (4.1), followed by overall RU (3.7), direct RU (3.3), and persuasive RU (3.3), on a five-point Likert scale. Internal consistency reliability for attitude and context scales was high (Cronbach's alpha 0.86 and 0.83, respectively). Repeated measures t-tests found significant differences between willingness to implement research and frequency of actually implementing research (P < 0.001for paired comparisons), and ratings of importance of supportive practice characteristics were significantly higher than their actual presence (P < 0.001 for paired comparisons). A multiple linear regression model found the variables attitude, context, and years of practice explained 19.0% of the variation in responses. Discussion: Significant differences between willingness to implement research and actual implementation, and between perceived importance of supportive practice characteristics and their presence, require exploration of these differences. Conclusion: These findings support the importance of the practice context and individual attitudes for research uptake by dental hygienists. Knowledge translation theories can inform further research and contribute greater explanatory power to this preliminary model.

Key words: attitudes to research; dental hygiene research; dental hygienists; evidence-based practice; practice context; research utilization

Introduction

Calls for evidence-based practice (EBP), have dominated health professions for much of the past two decades (1–4), yet a time lag exists between the publication of research results and when these findings are routinely implemented in clinical practice. Links between better use of research and improved patient outcomes are well established so addressing this temporal gap is imperative (5–7). Dental hygiene has been active in developing its body of knowledge for practice in recent years, with an increase in the quality and quantity of research being published. This is encouraging, as EBP requires increased access to more and better sources of scientific evidence to guide practice decisions. However, despite this increasing availability the research-practice gap persists (8). We need to better understand factors that successfully influence research utilization (RU) by dental hygienists, which in turn are necessary to design and test interventions for more rapid movement of research findings into practice.

The study of research utilization in dental hygiene is in its infancy (9, 10), thus we do not yet understand why research uptake is slow and haphazard, nor do we yet understand how to improve it. Chichester *et al.* (11), who have studied the incorporation of evidence-based (EB) practice principles in dental hygiene educational programs, found many programs were not taking these principles to the final step '...making recommendations to patients based on current evidence, or applying EB findings to the clinical setting when making decisions' (p. 65). Ohrn *et al.* (9) found that Swedish dental hygienists from longer educational programs (2 years versus 1 year) had more positive attitudes toward research and used research to a greater extent, whereas noting that many of the respondents from longer programs were employed in public health settings.

Three types of research utilization are described in the literature - instrumental/direct, conceptual/indirect, and symbolic/persuasive (12-14). Instrumental or direct research use is the use of dental or non-dental research where findings are directly used in providing dental hygiene therapy. Conceptual or indirect research use includes the use of dental or non-dental research findings to change thinking or opinions about how to approach certain patient care or client situations. Persuasive or symbolic research use is the use of dental or non-dental research findings to persuade others, usually those in decision making positions, to make changes in conditions, policies, or practices relevant to dental hygienists, patients/clients, and/or the health of individuals or groups (15). Overall research utilization is the use of any kind of research findings (dental or non-dental), in any kind of way, in any aspect of a registered dental hygienist's work (10, 15). A pilot study of dental hygienists that examined the use of different types of research use reported that dental hygienists used research on about half of their work days, reported conceptual research use more frequently than overall, direct, or persuasive use, and found moderate correlations between overall research use (ORU) and critical thinking dispositions (10).

In a systematic review of nursing RU studies, authors found that 'attitude towards research' presented a consistent positive effect on RU, with other determinants of RU (such as education and involvement in research) associated with equivocal findings (16). Kitson *et al.* (17), the authors of a conceptual framework known as Promoting Action on Research Implementation in Health Services (PARIHS), suggest that implementation of research findings is more likely to be successful when the evidence is robust, the context is receptive, and the change process is supported. Ohrn pointed out the influence of practice context in her study of Swedish dental hygienists' research use; she found higher support for research use in public dentistry settings where more hygienists work together and have greater opportunities for interaction (9). Rycroft-Malone (18) and Kitson (19) have questioned whether research use should be perceived as an individual activity or whether the context or organizational systems influence the uptake of research findings. The purpose of this study is to examine whether, and to what extent, individual attitude and organizational context factors influence research use by dental hygienists.

Methods

We obtained permission from authors of two nursing RU studies to adapt their questionnaires for use in dental hygiene (15, 20). These adaptations consisted of changing terms in existing questions - no new questions were added. The RU questionnaire was refined following a pretest and subsequent pilot study (10, 21). This modified RU questionnaire, a demographic questionnaire, and a critical thinking instrument were mailed to a geographically stratified probability sample of 1100 dental hygienists in Canada; a translated French-language version was provided for Francophone hygienists. A complete package of questionnaires was mailed to non-respondents 4 weeks after the original mailing date in order to increase response (22). The University of Alberta's Health Research Ethics Board Panel B provided ethics approval for the study, in accordance with the Tri-council Policy Statement for Ethical Conduct of Research. This study reports on data from three sections of the questionnaires: RU, context, and attitudinal items. Other data will be reported elsewhere.

Data were entered into Excel, imported into sPSS (SPSS Inc., Chicago, IL, USA), and basic descriptive statistics (frequencies and measures of central tendency) were performed on all measures to assess characteristics of study respondents. Bivariate correlations were performed to examine statistical relationships between research utilization measures and attitude and context measures. Tests of internal consistency reliability, specifically Cronbach's alpha, were calculated for the attitude and context sections of the questionnaire. Repeated measures *t*-tests were used to compare presence of context characteristics and perceptions of their importance to research use. Multiple linear regression was used to determine the influence of the explanatory (independent) variables upon the response (dependent) variable research utilization.

Results

Two-hundred ninety questionnaires were returned; 10 with incorrect address labels, for a response rate of 25.7%. Fortyseven questionnaires were incomplete for various reasons, including the fact that many respondents were not in active practice at the time. As a result, the analysis is based on 233 respondents. Age categories of respondents are presented in Table 1 and respondents' years of practice are presented in

Table 1.	Frequency	distributions	of a	age	categories	of
respond	ents					

Age category (years)	Frequency	%
≤24	19	8.2
25–29	29	12.4
30–34	58	24.9
35–39	32	13.7
40–44	29	12.4
45–49	32	13.7
50–55	19	8.2
55+	9	3.9
Missing	6	2.6
Total	233	100.0

Table 2. Frequency distributions of years of dental hygiene practice

Years of practice (years)	Frequency	%
0–4	50	21.5
5–9	44	18.9
10–14	68	29.2
15–19	20	8.6
20–24	23	9.9
25–29	21	9.0
30–34	4	1.7
35+	3	1.3
Total	233	100.0

Table 2. The mean age of respondents was 37.3 and the mean number of years of practice was 12.1 years. Eighteen per cent of respondents reported having a dental hygiene degree, 18% reported having an 'other degree', 1.3% reported having a Masters degree and zero respondents reported having a PhD.

Research utilization

Items were included for respondents to self-assess their frequency of use of direct, indirect, persuasive, and ORU on a Likert-type scale, with response options ranging from 1 (never) to 5 (very often), with an additional option 6 (do not know). For each type of research use, participants were presented with a definition, a practice-related example for that type of research use, and one or more additional questions related to the application of that type of research use. The definitions, examples, and additional questions served as prompts to cognitively prepare the respondent for each subsequent question, such that the response to the final question on ORU is used as the stand-alone measure of RU in our statistical tests. The use of the final ORU response as a stand-alone measure has been confirmed through structural equation modelling (23). Internal consistency reliability statistics were not used with these items because they measure different types of RU. The mean response score for conceptual or indirect research use was highest at 4.1, followed by direct (3.3) and persuasive (3.3). The mean ORU score was 3.7. The majority of dental hygienists (60.1%) responded that they would use research more often in their practice if they could, with a further 33.5% responding 'maybe'. More than half of the respondents (55.8%) agreed or strongly agreed that using research more often would make a positive difference to patient care and outcomes. Frequency distributions and measures of central tendency for types of research utilization (not including prompts) are presented in Table 3.

Attitudinal scale

The abbreviated attitude scale used by Estabrooks (24), which she modified from the work by Lacey (25) and Champion and Leach (26), was further tailored for dental hygiene practice. These remaining nine items were included to assess respondents' attitudes to research using a five-point Likert-type scale ranging from 1 (lowest value) to 5 (highest value). These items asked respondents' opinions about whether researchers produce research that is useful or easy to use. Internal consistency reliability for these items was high with a Cronbach coefficient alpha of 0.86, moderately high item-total correlations (0.5–0.7), and no items required to be deleted to improve alpha. Table 4 includes descriptive statistics and the reliability item-total statistics for the attitudinal items.

Dental hygienists perceived that researchers produced relevant research with a mean score 3.8 (SD 0.9), that was safe to use 3.8 (SD 0.9) and responded with slightly lower scores that research was easy to use 3.5 (SD 0.9). In general, they reported being willing to implement research when it contradicts prior information from education or their workplace, with mean scores ranging from 3.3 (SD 1.0) to 3.8 (SD 1.2), although they reported lower frequencies for actually implementing research that contradicts information from these sources, with mean scores from 2.9 (SD 1.1) to 3.3 (SD 1.3) (see Table 4). Based on repeated measures t-tests we found significant differences between all three variables asking dental hygienists' willingness to implement research when compared with corresponding variables reporting actual implementation of research in the same conditions (P < 0.001 in all three paired comparisons).

Context

Seventeen items were included to assess respondents' beliefs about whether their work environment provides a supportive context for research use. Response choices used a Likert-type scale ranging from 1 (lowest value) to 5 (highest value), with a sixth option 'Do not know'. Items asked whether other dental hygienists or their dentist-employer support research use, or whether there is support within their practice setting to conduct research or attend research conferences, and how important this support is to their use of research. A question about 'support – other' had high non-response (85%) and was removed from further analysis, leaving 16 items in the final scale (see Table 5). Internal consistency reliability for the final set of context items was high with a Cronbach coefficient alpha of .83 and no items to delete to improve alpha.

Table 3. Research utilization items descriptive statistics

		Frequencies reported as percent						
Item statement	n	Never	Rarely	Sometimes	Often	Very often	Do not know	Mean* (SD)
Overall, in the past year, how often have you used research findings in this direct way in some aspect of your dental hygiene practice?	229	7.7	15.5	30.9	29.6	14.2	0.4	3.3 (1.1)
Overall, in the past year, how often have you used <i>research in this non-direct way</i> in some aspect of your dental hygiene practice?	230	0.4	5.2	23.6	28.8	40.8	1.3	4.1 (1.0)
Overall, and including all of the categories of people in #12 below, in the past year how often have you used research in this persuasive way?	208	3.9	18.0	30.9	25.3	11.2	0.9	3.3 (1.1)
Overall, in the past year, how often have you used research in some aspect of your dental hygiene practice?	229	1.3	6.0	34.3	35.6	20.2	0.9	3.7 (0.9)

*Mean scores based on five-point Likert scale.

Table 4. Attitudes to researchers and research findings: frequency distributions and reliability statistics

Item statement	n	Frequencie	es reporte	d as perc	cent		Mean* (SD)	Reliability Cronbach's alpha if Item deleted
How much faith do you have that dental hygiene researchers will produce research:		None				A great deal		
That is <i>relevant</i> to you?	230	0.9	7.3	31.8	33.5	25.3	3.8 (1.0)	0.85
That is <i>easily used</i> by you?	229	0.9	14.6	36.9	31.8	14.2	3.5 (0.9)	0.85
That can safely be used in your practice?	227		5.2	32.2	38.2	21.9	3.8 (0.9)	0.85
How willing are you to implement research when		Very				Very		
it contradicts something you:		unwilling				willing		
Learned prior to your dental hygiene education	230	6.4	8.2	21.0	27.0	36.1	3.8 (1.2)	0.84
Learned during your dental hygiene education	230	4.7	13.3	35.6	34.3	10.7	3.3 (1.0)	0.84
Learned in your place of work	230	2.1	10.7	34.8	40.3	10.7	3.5 (0.9)	0.85
How often do you actually implement research						Very		
when it contradicts something you		Never				often		
Learned prior to your dental hygiene education	227	12.9	15.0	21.0	25.8	22.7	3.3 (1.3)	0.84
Learned during your dental hygiene education	227	9.9	27.9	28.8	23.6	7.3	2.9 (1.1)	0.83
Learned in your place of work	226	6.4	22.7	34.8	24.9	8.2	3.1 (1.1)	0.84

*Mean scores based on five-point Likert scale.

Dental hygienists reported moderate support from other hygienists in their practice with mean scores 3.3 (SD 1.1) and from their dentist employers 3.4 (SD 1.0). Six organizational characteristics were examined for their presence and further whether dental hygienists perceive these as important to their use of research. Dental hygienists reported the presence of moderate support to attend conferences with a mean score of 3.3 (SD 1.2). Lower mean scores were reported for the remaining five characteristics, with mean scores ranging from 1.3 to 2.6 (see Table 5 for detailed statistics). Based on repeated measures *t*-tests we found statistically significant differences between items questioning the presence of each of these supporting characteristics and corresponding items questioning how important dental hygienists perceived these characteristics were to their use of research (P < 0.001 for all paired tests).

Influences of explanatory variables on response variable ORU

To better understand the influence of the explanatory variables, 'attitudes toward research' and 'practice context' were regressed on the dependent (response) variable ORU. To further explore whether any demographic variables would influence the final model, age, years practicing, and presence or absence of a degree were added into the model and backward stepwise regression was performed. Preliminary scatterplots testing the variable ORU against each individual item making up the two scales confirmed that assumptions of linearity were not violated. Results showed a high correlation between age and years worked as a dental hygienist r = 0.8(P < 0.001), raising the possibility of multicollinearity. The degree variable had a non-significant negative correlation

Item statement	n	Frequencies	reported	as percent				Mean* (SD)	Reliability Cronbach's alpha if item deleted
Indicate the degree to which the following people are supportive of you using		Not at all supportive				Very supportive	Do not know		
Other dental hygienists	218	4.7	10.3	19.8	37.9	13.8	7.3	3.3 (1.1)	0.83
Your Dentist employer Other health professionals Other dentist(s) in practice To what extent are the following organizational factors <i>present</i> in your	226 220 199	2.2 6.0 7.3 Not at all	10.3 13.8 7.8 Rarely	28.0 22.8 21.1 Sometimes	42.2 19.4 22.4 Frequently	12.9 5.6 8.6 Always	1.7 27.2 18.5 Do not know	3.4 (1.0) 2.9 (1.1) 3.1 (1.2)	0.83 0.83 0.82
Dental hygienists/others	226	30.2	17.2	17.7	15.1	9.9	7.3	2.6 (1.3)	0.82
Paid time allotted for participation in various	228	53.0	17.2	13.7	6.0	5.6	2.6	1.9 (1.2)	0.83
Attendance at research and clinical conferences	228	12.9	12.9	26.3	25.0	20.7	0.4	3.3 (1.2)	0.83
A group or committee to review and critique	228	67.7	17.2	8.2	1.3	1.7	2.2	1.4 (0.7)	0.83
Money from internal and/or external sources for research	226	76.3	11.2	3.9	0.9	0.9	4.3	1.3 (0.7)	0.83
Training/support for development of research skills	228	58.2	16.4	11.2	5.2	3.0	4.3	1.7 (1.0)	0.82
To what extent do you think these organizational factors are, or would be, important to your own use of research?	n	Not at all important		Quite important		Extremely important	Do not know	Mean* (SD)	Reliability Cronbach's alpha if item deleted
Dental hygienists/others	223	3.4	9.5	33.2	17.7	28.0	4.3	3.4 (1.2)	0.82
Paid time allotted for participation in various research activities	224	3.0	12.5	28.4	22.0	28.9	1.7	3.6 (1.1)	0.82
Attendance at research and clinical conferences encouraged	223	1.7	3.9	20.7	29.7	39.7	0.4	4.0 (1.0)	0.82
A group or committee to review and critique research	224	7.3	18.5	28.0	18.5	21.1	3.0	3.1 (1.2)	0.82
Money from internal and/or external sources for research	224	8.2	22.0	20.3	21.6	18.1	6.5	3.0 (1.2)	0.82
Training/support for development of research skills	224	5.6	15.9	20.3	22.0	28.4	4.3	3.4 (1.3)	0.82

Table 5. Practice context frequency distributions and reliability statistics

*Mean scores based on five-point Likert scale.

with research use. The low number of dental hygienist respondents with a degree may have contributed to this irregularity. The model summary found in Table 6 shows that both of these variables were removed from the final model. The final model explains 19.0% of the variation in the response variable RU.

Table 6.	Backward	stepwise I	inear re	egression	model for
predicto	r variables	and respo	onse var	riable ORI	J

Model summary [§]							
Model	R	R^2	Adjusted R ²	Estimate (SE)			
1	0.441*	0.195	0.175	0.838			
2	0.439 [†]	0.193	0.177	0.837			
3	0.436 [‡]	0.190	0.178	0.837			

*Predictors: (Constant), Attitude, Degree, Age, Average Context, Yrs DH Practice.

[†]Predictors: (Constant), Attitude, Age, Average Context, Yrs DH Practice.

[‡]Predictors: (Constant), Attitude, Average Context, Yrs DH Practice. [§]Dependent variable: ORU.

Table 7. ANOVA test results for regression model

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ANC	DA22					
Model		Sum of squares d.f.		Mean square	F	Sig.
1	Regression	34.313	5	6.863	9.763	0.000*
	Residual	141.995	202	0.703		
	Total	176.308	207			
2	Regression	33.963	4	8.491	12.109	0.000†
	Residual	142.345	203	0.701		
	Total	176.308	207			
3	Regression	33.508	3	11.169	15.956	0.000‡
	Residual	142.800	204	0.700		
	Total	176.308	207			

*Predictors: (Constant), Attitude, Degree, Age, Average Context, Yrs DH Practice.

[†]Predictors: (Constant), Attitude, Age, Average Context, Yrs DH Practice.

[‡]Predictors: (Constant), Attitude, Average Context, Yrs DH Practice.
[§]Dependent variable: ORU.

ANOVA test results as summarized in Table 7 were highly significant [F(3, 204) = 15.956, P < 0.001]. Attitude and context variables were each highly significant (P < 0.001). Years of dental hygiene practice was moderately significant (P = 0.04, one-tailed hypothesis). The normal P-P plot (Fig. 1) of standardized residuals suggests that assumptions of normality have not been violated to a sufficient extent to negatively impact the model.

Discussion

Several EBP models place the emphasis for research uptake on the individual (1, 27), however these findings clearly demonstrate the importance of the practice context for dental hygienists. Currently, no instruments exist to measure RU specifically in the dental hygiene practice setting, thus we are forced to use instruments developed for other disciplines and test their reliability and validity for use in dental hygiene. The pilot study confirmed that these instruments performed adequately in dental hygiene settings (10, 21). RU scores reflect consistent patterns compared with those reported in nursing



Fig. 1. Normal P-P plot of standardized residuals from regression model.

studies using the same instrument, with highest reported mean scores of conceptual and overall RU (28, 29). This study raises the question – does the difference in mean scores between willingness to implement research and implementation of this research suggest the existence of barriers to RU not captured by this questionnaire, which was not designed to identify specific barriers? Additional research is needed to determine if this is the case. For example, studies in nursing have included time and readability of research among barriers to research use (30, 31); could this also be the case for dental hygienists?

The primary aim of increasing research use in practice is to contribute to the improvement of health outcomes of patients receiving dental hygiene therapy. Current methods of studying RU tend to examine behaviours and/or attitudes of practitioners, and stop short of examining oral health outcomes. This is a serious limitation of the field. Future studies and instruments must be constructed to measure health outcomes as the response or dependent variable rather than RU.

Clearly the significant differences in dental hygienists' responses to questions about the importance of characteristics to support their use of research, compared with the presence of these characteristics, demonstrate that they see a need for changes in their workplace to enhance their RU activities. Earlier studies of RU in other health professions focussed on individual characteristics, but more recent work has shifted the emphasis from the individual to the importance of organizational characteristics recognizing the critical role of the latter (18, 19). Our questionnaire examined only a limited number of attitude and context characteristics, and was not theoretically framed. To advance this area, it is imperative that we identify additional personal-, context-, and system-related characteristics, in order to determine predictors of RU and to test their causal influences. Until we understand this better, our progress in moving research findings into routine practice is likely to remain limited.

Much dental hygiene research to date has not been theoretically driven, which has limited our ability to base intervention testing on known relationships between variables. Therefore we believe that the use of a theoretical or conceptual framework is needed in future studies to expand our understanding (32, 33). For example, the use of Rogers' Theory of Diffusion of Innovations could incorporate the study of innovation and communication characteristics, as well as additional adopter characteristics such as cosmopoliteness, or communication with greater external sources of practice information (34). Additionally the PARIHS conceptual framework could be used to achieve greater understanding of the role of context in dental hygiene RU by examining additional aspects of context such as leadership and culture (17, 35). At this time, we have not yet determined which theories will prove most influential for use in dental hygiene practice settings, hence we need to start identifying those that can be used successfully.

This study has some limitations. Data on demographic characteristics of practicing dental hygienists in Canada were not available in a form that enables comparison to respondents. As the questionnaires required self-reporting, there is an inherent potential for social desirability bias. A probability sample was used to minimize the risk of bias but the low response rate may have increased the risk of systematic bias due to nonresponse: therefore, we encourage caution when considering application of these findings. The final regression model explains 19.0% of the variation in the response variable ORU. This is not surprising, given that we used a tool developed for nursing, but the significant findings of dental hygienists' willingness to use research highlight the importance of developing appropriate tools to study this phenomenon in dental hygiene. Future testing of additional factors related to dental hygienists' use of research is required to further develop this model and increase its explanatory power.

The oral health care delivery system operates across a spectrum from primarily private to a combination of private/publicly funded delivery. This market-influenced typically smaller-office environment has different systems characteristics than hospital settings where much of the RU research has occurred, but there may be some useful lessons particularly around use of clinical practice guidelines as a means to increase EBP (9). Further research is needed on the use of clinical practice guidelines by dental hygienists.

Conclusion

Moving research into dental hygiene practice is a very complex undertaking that is not well understood to date. Greater understanding of the interactions between the individual, the research findings, and the practice context is needed. Our findings provide a preliminary view of some of these interactions. We have identified that certain characteristics of attitude toward research use and dental hygiene practice context contribute significantly to variation in ORU, but are not sufficient to explain all of the variation. It is important to continue this work by testing additional characteristics specific to dental hygienists' practice that build on and develop a more robust model. The findings from this study highlight the importance of a supportive practice environment - a challenge given that the dental hygienist does not control it, yet one they may be able to influence.

We can advance knowledge in this area and reduce some of the uncertainty inherent in designing intervention testing with better knowledge of existing relationships between explanatory (predictor) and response variables. Theories and conceptual models are used in other disciplines to frame intervention studies to move knowledge from research into practice more rapidly, and should be used to inform future dental hygiene research designs. Dental hygiene lags behind in this work, and we must 'speed up the spread' (36) in order that our patients/clients can benefit from findings of research.

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