Depression, Self-Efficacy, and Oral Health: An Exploration

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Abstract

Aims: To explore the relationship between depression and self-efficacy and adult dental patients' objective and subjective oral health, oral health behaviour, and oral health-related quality of life (OHRQoL). *Methods:* Survey data and chart review data were collected from 399 regularly scheduled dental patients (173 male/226 female; average age: 50 years; range: 19-93 years). The survey data were collected using a self-administered questionnaire. Depression was measured with the Center of Epidemiological Studies Depression Scale (CESD), generalised self-efficacy with the General Self-efficacy Scale (GSE), and OHRQoL with the Michigan Oral Health-Related Quality of Life Scale—Adult Version (MOHRQoL-A). *Results:* The more depressed the patients were, the more decayed teeth ($r=.13$; $P=.025$) and the fewer restored teeth they had ($r=-.22$; $P<.001$), the poorer their subjective oral health ($r=-.38$; $P<.001$) and ohrqoL were ($r=.46$; $P<.001$), the less saliva they had ($r=-.28$; $P<.001$), and the less often they brushed ($r=-.25$; $P<.001$) and flossed ($r=-.22$; $P=.003$). The more positive the patients' sense of self-efficacy was, the better their subjective oral health ($r=.23$; $P<.001$) and ohrqoL were ($r=-.29$; $P<.001$), and the more often they brushed ($r=.19$; $P<.001$) and flossed ($r=.15$; $P=.003$). *Conclusions:* The results of this study suggest that in the population studied, depression is related to poorer objective and subjective oral health and OHRQoL. It was also correlated with less frequent oral health-related behaviour (brushing and flossing) and with a lower amount of saliva. Clinicians need to understand that depression is a risk factor for poorer oral health and that increasing depressed patients' sense of self-efficacy might positively affect these patients' oral health behaviour and thus ultimately their oral health.

Key Words: Depression, Oral Health, Quality of Life, Self-Efficacy

Introduction

Depression is one of the most prevalent mental health issues in the United States of America (USA). In 2005, nearly 31 million adults reported experiencing a depressive episode once or more often during their lifetime [1]. According to the US National Institute of Mental Health, depression is a mental disorder that is characterised by a low, sad mood, low self-esteem, and loss of interest in life, everyday activities and in those activities that once made the individual happy [2]. Depression affects patients with different severity. However, its symptoms do not only affect the person's mood, but also the ability to work, play, eat, sleep, and life as a whole [2]. With such a profound effect on normal life, it is not surprising that depression might be related to health and oral health-related self-care behaviour and thus potentially affects patients' oral health [2].

When considering the role of depression in an oral health-related context, a first relevant factor could be that a lack of motivation due to depression might affect patients' oral health-related behaviour and thus ultimately even their oral health [3]. A second way in which depression and oral health might be related is through salivary changes in depressed patients. Indeed, research has shown that depression is accompanied by a decreased salivary flow [4], which promotes the growth of cariogenic bacteria and thus ultimately the development of carious lesions. Antilla *et al.* (1998) found a correlation between depressive symptoms and an abundant growth of salivary lactobacilli, a microorganism that has been implicated in dental caries [5]. A third factor is that, once patients take anti-depressant medications, they are likely to encounter xerostomia due to these medications [6], which aggravates the previously described situation.

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Finally, dietary changes in depressed patients might also affect their oral health. A study has shown that depression affects patients' dietary choices and that these patients tend to increase their intake of food with more fermentable carbohydrates—further encouraging the growth of cariogenic bacteria [4]. Each of these four factors, the decreasing oral health efforts, the decrease in salivary flow by itself and due to certain medications, and the dietary changes, might make it likely that patients with depression are at a substantially higher risk of caries and poor oral health.

One psychological factor that might counter the motivational deficits that depressed patients experience is a sense of self-efficacy [7]. A person's sense of self-efficacy is related to the beliefs that the person has the knowledge and capabilities to do what is necessary to reach a certain attainable goal [8]. Personal self-efficacy beliefs affect a person's cognition, psychological state, and behaviour [7] and thus how a person thinks, feels, and acts. Positive self-efficacy beliefs have a substantial impact on a person's motivation, productivity, success, and emotions [7]. In an oral health-related context, one can argue that persons with a low sense of oral health-related self-efficacy beliefs might believe that they cannot do much to prevent poor oral health such as caries and would have a low motivation for oral health-promoting behaviours. Support for such a hypothesis comes from the work of Syrjala *et al.* (1999) who showed that toothbrushing self-efficacy, approximal cleaning self-efficacy, and dental visiting self-efficacy related to corresponding oral health-related behaviours [9]. In a qualitative follow-up study to this earlier research, these authors explored the relevance of self-efficacy further in the context of oral health [10]. Later, Basak *et al.* (2005) and colleagues showed that even a more general measure of self-efficacy, namely dietary self-efficacy, was related to oral health [11]. Two years later, Finlayson *et al.* (2007) showed, in a study that focused on maternal self-efficacy and its effect on children's brushing habits, that mothers with higher knowledge about oral health behaviour had a higher level of self-efficacy, leading to better brushing habits and overall better oral health in both the mothers and their children [12]. These authors therefore suggested that interventions to improve oral health-specific self-efficacy could help to develop healthier dental habits and thus improve patients' oral health [12]. Most recently, Cinar *et al.* (2009) found, in a study

of cross-cultural effects of maternal self-efficacy on pre-adolescent toothbrushing behaviours, that maternal self-efficacy was related to their pre-adolescent children's toothbrushing behaviour regardless of cultural differences [13]. These findings support the conclusion that positive self-efficacy beliefs will result in more positive oral health-related behaviour, and thus ultimately in better oral health. In the current study, the question that is explored in regard to self-efficacy effects, in the context of oral health, is whether self-efficacy is also related to oral health-related quality of life (OHRQoL) [14]. One could argue that self-efficacy beliefs would be positively related to OHRQoL because patients might feel more positively about their oral health-related experiences if they perceive to have control over them. Oral health-related quality of life has become a concept that is widely used when taking a patient-centred approach to oral health and related research. It is a subjective experience that captures how oral health affects the way a person can function (e.g., eat, speak, bite), the degree to which a person experiences pain/discomfort, a person's psychological state and social functioning due to their oral health [14]. One might predict that patients with depression and/or a lower sense of self-efficacy will be likely to have a decreased sense of OHRQoL, whereas patients with more positive self-efficacy beliefs might be more likely to have a more positive OHRQoL.

Whereas depression is likely to decrease personal oral health efforts, a positive sense of self-efficacy is seen as having the opposite effect. This study therefore focused on exploring the effects of these two constructs on adult patients' oral health-related behaviour and their oral health. Prior research has documented how depression and self-efficacy interacted in various health-related contexts such as in smoking-cessation programmes [15], weight management [15], substance-abuse programmes [16] and in determining patients' well-being. However, previously no oral health-related research has explored these effects jointly.

Aims

Against this background, the aims of this study were to investigate:
- The effect of depression and self-efficacy on patients' (a) objective and subjective oral health, and on their (b) oral health-related behaviour.
- The relationship between depression and

self-efficacy and the patients' oral health-related quality of life (OHRQoL).

Methods and Materials

The study was approved by the Institutional Review Board (IRB) for the Health Sciences at the University of Michigan, Ann Arbor, Michigan, USA.

Respondents

Survey data and chart review data were collected from 399 regularly scheduled dental patients, aged 19-93 years (173 male/226 female; average age: 50 years; SD=17.7) who came for a routine appointment to the undergraduate clinics at the University of Michigan School of Dentistry and were recruited to participate in this study. The sample was a convenience sample of dental school patients. Patients were not recruited (a) if they did not speak English, (b) if they were in acute pain or discomfort, and (c) if their mental or physical development was impaired.

Procedure

When the patients arrived for their routine appointment, they were informed about the study and asked whether they were interested in learning more about it. If they expressed interest, they received the consent and the Health Insurance Portability and Accountability Act (HIPAA) forms, which provided a detailed description of the study. If they signed the consent and the HIPAA form, they participated in the study by responding to a self-administered questionnaire *(Figure 1)* and having their clinical chart reviewed. The self-administered questionnaire was completed and returned in a sealed envelope to the researchers. The first author then conducted the chart reviews, as described below. In exchange for their participation, the subjects received a free parking voucher.

Chart reviews

Objective oral health data were collected in a review of the patients' charts. As can be seen in *Table 1*, four objective oral health indicators were included in these analyses:

- The number of decayed teeth as assessed clinically.
- The number of decayed teeth assessed radiographically.
- The number of restored teeth/crowns.
- The number of extracted teeth.

Survey

Data concerning the patients' subjective oral health, their oral health behaviour and the depression, self-efficacy and OHRQoL scores were collected with a self-administered questionnaire (see *Figure 1*). Part 1 of the questionnaire consisted of background questions concerning gender, age, ethnicity/race and years of schooling. Part 2 assessed the General Self-Efficacy Scale (GSE) [17,18] and Part 3 assessed the Center of Epidemiological Studies Depression Scale (CESD) [19]. In Part 4, three questions assessed:

- The respondents' subjective oral health.
- The value that the patients placed on good oral health.
- The respondents' perceived saliva flow.

Table 1. Objective Oral Health

Objective oral health	Mean	SD Range
1. Number of decayed teeth: clinical	1.52	3.43 0-27
2. Number of decayed teeth: radiographic	1.49	3.48 0-27
3. Number of restored teeth/crowns	8.41	5.80 0-24
4. Number of extracted teeth	3.23	3.97 0-31

Answers to these questions were given on a five-point scale (in the answer scales from 1=never and 5=more than once a day), as were two questions on oral health-related behaviour, which were on:

- Frequency of brushing.
- Frequency of flossing.

In Part 5, the patients' OHRQoL was assessed with the 14 items of the Michigan Oral Health-Related Quality of Life Scale—Adult Version (MOHRQoL-A) [20]. A factor analysis (extraction method: principal component analysis; rotation method: Varimax with Kaiser Normalization) was conducted to analyse whether certain items could be combined to OHRQoL subscores. It was found that the first three items ("My teeth and gums limit the kinds or amounts of food I eat", "My teeth and gums cause discomfort", and "My teeth and gums cause a lot of worry and concern") loaded on one factor and the responses to these three items were therefore averaged to create a MOHRQoL subscore of functional and pain-related OHRQoL (Cronbach alpha=0.84). The remaining 11 items loaded on a sec-

Part 1: Background questions concerning gender, age, ethnicity/race and years of schooling
Part 2: General Self-Efficacy Scale (GSE) [17,18]
Part 3: Center of Epidemiological Studies Depression Scale (CESD) [19]
Part 4: Questions related to the respondents' oral health and oral health behaviour

D1. How would you describe the health of your teeth and gums?
❑1   ❑2   ❑3   ❑4   ❑5
poor   fair   good   very good   excellent

D2. How important is your dental health to you?
❑1   ❑2   ❑3   ❑4   ❑5
Not at all   Very important

D3. Think about how dry your mouth usually feels. On a scale from 1 = "much too little saliva" to 5 = "perfect amount of saliva", how much saliva do you have?
❑1   ❑2   ❑3   ❑4   ❑5
Much too   Perfect amount
little saliva   of saliva

D3. Other than today, did you visit a dentist during the last year?
Yes ❑   No ❑

D4. How often do you brush your teeth?
❑1   ❑2   ❑3   ❑4   ❑5
never   rarely   nearly   every day   more than
                        every day   once a day

D5. How often do you floss your teeth?
❑1   ❑2   ❑3   ❑4   ❑5
never   rarely   nearly   every day   more than
                        every day   once a day

Part 5: Michigan Oral Health-Related Quality of Life Scale-Adult Version (MOHRQoL-A) [20]
The following questions are concerned with your dental health and how it affects your life. Please tell us, how much do you agree/disagree with the following sentences on a scale from 1= "strongly disagree" to 5 = "strongly agree"?

	strongly agree				strongly disagree
My teeth and gums limit the kinds or amounts of food I eat.	❑1	❑2	❑3	❑4	❑5
My teeth and gums cause discomfort.	❑1	❑2	❑3	❑4	❑5
My teeth and gums cause a lot of worry and concern.	❑1	❑2	❑3	❑4	❑5
My teeth and gums keep me from socializing/ going out.	❑1	❑2	❑3	❑4	❑5
My teeth and gums make me uncomfortable when eating in front of others.	❑1	❑2	❑3	❑4	❑5
My teeth and gums make me uncomfortable when speaking in front of others.	❑1	❑2	❑3	❑4	❑5
My teeth and gums make me nervous.	❑1	❑2	❑3	❑4	❑5
My teeth and gums make me concerned about the way I look.	❑1	❑2	❑3	❑4	❑5
My teeth and gums keep me from enjoying life.	❑1	❑2	❑3	❑4	❑5
My teeth and gums interfere with my daily activities.	❑1	❑2	❑3	❑4	❑5
My teeth and gums interfere with my intimate relationship.	❑1	❑2	❑3	❑4	❑5
My teeth and gums have a bad effect on the taste of food.	❑1	❑2	❑3	❑4	❑5
My teeth and gums reduce my general happiness with life.	❑1	❑2	❑3	❑4	❑5
My teeth and gums affect my life in all of its aspects.	❑1	❑2	❑3	❑4	❑5

If you would spend the rest of your life with your teeth and gums as they are right now, how would you feel about it?
     ❑1   ❑2   ❑3   ❑4   ❑5
     terrible   mostly   mixed   mostly   delighted
                     dissatisfied   satisfied

Figure 1. *The Questions Asked in the Self-Administered Survey.*

ond factor and the answers to these items were therefore averaged to create a subscore for the psychological and social aspects of the patients' OHRQoL (Cronbach alpha=0.96). In addition, a total OHRQoL score was computed by averaging the responses to all 14 items (Cronbach alpha=0.96).

Depression was measured with the Center for Epidemiological Studies Depression Scale [19]. The reliability of this scale was Cronbach alpha=0.85. Self-efficacy was assessed with the Generalized Self-Efficacy Scale (GSES) [17]. This scale has good reliability and validity [18]. The reliability in this study was Cronbach alpha=0.91.

Statistical analysis

The data were analysed with statistical software (SPSS version 17.0; SPSS Inc, Chicago, USA). Descriptive statistics were used to provide information about the frequency distributions of the responses and average responses as well as the variability of the responses. Cronbach alpha coefficients were computed to determine the reliability of the indices used in these analyses. Pearson correlation coefficients were calculated to test the hypotheses concerning the relationships between depression and self-efficacy and objective and subjective oral health, oral health behaviour and OHRQoL.

Results

Table 1 provides an overview of the objective and subjective oral health responses and the responses related to the patients' oral health behaviour. The objective oral health indicators (items 1-4) were collected by reviewing the respondents' charts. The resulting data showed that the respondents had on average 1.52 decayed teeth when the number of decayed teeth was assessed clinically (without radiographs) (range: from 0 to 27 decayed teeth) and 1.49 decayed teeth (range: 0-27) when the number of decayed teeth were determined solely from radiographs. The patients had 8.41 filled or crowned teeth (range: 0-24). The average number of extracted teeth was 3.23 (range: 0-31). In summary, these data showed that the objective oral health status of these respondents ranged from excellent to rather poor.

The data concerning these patients' subjective oral health, their oral health behaviour, and oral health-related quality of life were collected via the self-administered questionnaire and are reported as items 5-7 in *Table 2*. Only about 13% of the respondents thought that their oral health was very good or excellent, whereas 30% indicated that they had good oral health, 32% that they had fair oral health, and 25% that they had poor oral health. This range of subjective oral health responses paralleled the wide range of objective oral health indicators. Despite this wide range of objective and subjective oral health responses, the majority of the respondents (87%) indicated that oral health was important (n=83) or very important (n=261) to them. Finally, 63% of these respondents reported that they had a perfect (n=124) or good (n=127) amount of saliva, whereas 24% indicated that they had a moderate amount (n=96), 6% that they had little saliva (n=24), and another 6% that they had much too little saliva (n=24).

Concerning the frequency of brushing and flossing, items 8 and 9 in *Table 2*, the majority of

Table 2. Subjective Oral Health and Oral Health-Related Behaviour

Subjective oral health	1	2	3	4	5	Mean SD
5. Subjective oral health[1]	25%	32%	30%	11%	2%	2.34 1.04
6. How important is your dental health to you?[2]	1%	2%	10%	21%	66%	4.50 0.81
7, How much saliva do you have?[3]	6%	6%	24%	32%	31%	3.77 1.14
Oral health-related behaviour						
8. Frequency of brushing[4]	1%	3%	9%	38%	48%	4.29 0.85
9. Frequency of flossing[4]	12%	31%	24%	24%	9%	2.87 1.18

Legend: 1 Answers ranged from 1=Poor, 2=Fair, 3=Good, 4=Very Good, to 5=Excellent.
2 Answers: 1=Not at all, 2=Somewhat, 3=Moderately, 4=Important, and 5=Very Important.
3 Answers: 1=Much too little, 2=Little, 3=Moderate, 4=Good, and 5= Perfect amount.
4 Answers ranged from 1=Never, 2=Rarely, 3=Nearly every day, 4=Every day to 5=More than once a day.

the subjects either brushed once every day (n=148; 38%) or even more than once a day (n=187; 48%), whereas 9% brushed nearly every day (n=35), and only 4% brushed never (n=4) or rarely (n=13). However, the frequency of flossing was relatively lower, with 9% of the subjects indicating that they flossed more than once a day (n=36), 24% flossed every day (n=92), 24% flossed nearly every day (n=93), 31% rarely flossed (n=122), and 12% never flossed (n=46).

Table 3 gives an overview of the average responses to the psychosocial indicators. The subjects' depression scores ranged from indicating no depression (=1) to a very high level of depression (=2.82 on a three-point scale), with an average depression score of 1.58. Concerning self-efficacy, the subjects' responses ranged from a very low level of self-efficacy (1.1) to the highest possible level of self-efficacy (4.0). On average, the subjects had a good level of generalised self-efficacy (mean=3.10 on four-point scale).

The subjects' OHRQoL was assessed with a function and pain-related subscore, a psychological and social aspects related subscore, and a total score. These scores ranged from 1 (=best OHRQoL) to 5 (=poorest OHRQoL). Table 3 shows that the subjects had an average level of function and pain-related OHRQoL of 2.76 (range: 1-5), whereas the average psychological and social aspects subscore was more positive (1.97; range: 1-5).

The central objective was to explore how depression and self-efficacy related to the patients' objective and subjective oral health, to their oral health behaviour, and their oral health-related quality of life. The results in Table 4 suggest that as depression increased, the number of decayed teeth (assessed clinically and radiographically) increased as well. In addition, the more depression that a subject had, the fewer restored teeth and crowns that person had (r=-0.22; P<.001). Depression was also correlated with the patients' subjective oral health (r=-.38; P<.001). The more depressed the subjects were, the less positively they evaluated their oral health and the less important they evaluated their dental health (r=-.15; P<.01). In addition, the more depressed they were, the less saliva they reported to have (r=-.28; P<.001). As predicted, the more depressed the subjects were, the less frequently they engaged in brushing (r=-.25; P<.001) and flossing (r=-.22; P<.01). Table 4 also shows that depression and oral health-related quality of life subscores and total score were significantly correlated with depression, as expected. The higher the depression scores were, the lower and thus more positive the OHRQoL scores were.

Concerning the patients' self-efficacy, the data showed that self-efficacy was not correlated with the patients' objective oral health, but that it was correlated with their subjective oral health. The more self-efficacy the subjects had, the more positively they rated their subjective oral health (r=.23; P<.001), the more important they thought their dental health was (r=.18; P<.001), and the more saliva they reported having (r=.21; P<.001). The predicted relationship between self-efficacy and oral health-related behaviour was confirmed. The

Table 3. *Psychosocial Indicators: Depression, Self-Efficacy and Oral Health-Related Quality of Life*

Depression	Mean	SD	Range	Reliability (Cronbach alpha)
Average CESD score[1]	1.58	.42	1-2.82	0.68
Self-efficacy				
Average generalised self-efficacy score[2]	3.10	.53	1.1-4.0	0.91
OHRQoL				
MOHRQoL function and pain subscore[3]	2.76	1.32	1-5	0.84
MOHRQoL psychological and social aspects subscore[4]	1.97	1.17	1-5	0.96
MOHRQoL total score[5]	2.16	1.14	1-5	0.96

Legend:
1 The depression scores ranged from 1=no depression to 3=highest degree of depression.
2 The self-efficacy scores ranged from 1=no self-efficacy to 4=highest self-efficacy.
3 The MOHRQoL function and pain subscore was computed by averaging the responses to three items of the MOHRQoL-A scale. The answers ranged from 1=best OHRQoL to 5=poorest OHRQoL.
4 The MOHRQoL psychological and social aspects subscore was computed by averaging the responses to 11 items of the MOHRQoL-A scale. The answers ranged from 1=best OHRQoL to 5=poorest OHRQoL.
5 The MOHRQoL total score was computed by averaging the responses to all 14 items of the MOHRQoL-A scale. The answers ranged from 1=best OHRQoL to 5=poorest OHRQoL.

Table 4. *Correlations Between Depression and Self-Efficacy and Objective and Subjective Oral Health,*
Oral Health Behaviour and OHRQoL

Objective oral health	Depression[1]	Self-efficacy[2]
# decayed teeth: clinical	0.12*	0.01
# decayed teeth: radiographic	0.13*	0.002
# restored teeth/crowns	-0.22***	0.11
# extracted teeth	0.05	-.13+
Subjective oral health		
Subjective oral health[3]	-0.38***	0.23***
How important is your dental health to you?[4]	-0.15**	0.18***
How much saliva do you have?[5]	-0.28***	0.21***
Oral health behaviour		
Brushing[6]	-.25***	.19***
Flossing[6]	-.22**	.15**
OHRQoL		
MOHRQoL function and pain subscore[7]	.39***	-.20***
MOHRQoL psychological and social aspects subscore[8]	.44***	-.30***
MOHRQoL total score[9]	.46***	-.29***

Legend: 1 The depression scores ranged from 1=no depression to 3=highest degree of depression.

2 The self-efficacy scores ranged from 1=no self-efficacy to 4=highest self-efficacy.

3 Answers ranged from 1=Poor, 2=Fair, 3=Good, 4=Very Good, and 5=Excellent.

4 Answers ranged from 1=Not at all, 2=Somewhat, 3=Moderately, 4=Important, and 5=Very Important.

5 Answers ranged from 1=Much too little, 2=Little, 3=Moderate, 4=Good, and 5=Perfect amount.

6 The frequency of brushing and flossing ranged from 1=Never, 2=Rarely, 3=Nearly every day, 4=Every day, and 5=More than once a day.

7 The MOHRQoL function and pain subscore was computed by averaging the responses to three items of the MOHRQoL-A scale. The answers ranged from 1=best OHRQoL to 5=poorest OHRQoL.

8 The MOHRQoL psychological and social aspects subscore was computed by averaging the responses to 11 items of the MOHRQoL-A scale. The answers ranged from 1=best OHRQoL to 5=poorest OHRQoL.

9 The MOHRQoL total score was computed by averaging the responses to all 14 items of the MOHRQoL-A scale. The answers ranged from 1=best OHRQoL to 5=poorest OHRQoL.

Note: *=$P<=.05$ **=$P<=.01$ ***=$P=.001$

more self-efficacy the subjects had, the more frequently they engaged in brushing (r=.19; *P*<.001) and flossing (r=.15; *P*<.01). Finally, as the subjects' self-efficacy increased, their oral health-related quality of life subscores as well as their total OHRQoL became more positive.

Discussion

Given the high prevalence of depression, it seems crucial to gain a better understanding of how depression might affect oral health in order to be able ultimately to counter these negative effects in dentist-patient interactions. Understanding whether the negative effects of depression on oral health could potentially be countered by increasing patients' self-efficacy with, for example, a method of health education grounded in motivational interviewing techniques [21] could potentially be quite

productive. This study therefore focused on the effects of self-efficacy and depression on adults' subjective and objective oral health, oral health-related behaviour, and oral health-related quality of life as a first step to gain a better understanding of these relationships.

The finding that the respondents had a wide range of both depression and self-efficacy scores is in itself informative for clinicians, because it can alert dentists to the fact that they are likely to encounter patients with depression and a wide range of different self-efficacy beliefs. The results concerning the relationships between depression, oral health, oral health behaviour, and OHRQoL were as predicted: The higher the subjects scored on the depression scale, the poorer their objective, as well as their self-perceived oral health and OHRQoL were. The fact that depression scores

were correlated with the frequency of toothbrushing and flossing as well as with lower rates of received dental care supports the hypothesis [3] that depression might lead to a motivational deficit that can then result in a reduced level of oral health-related behaviours. In addition, these data also supported earlier research showing that depression and reduced saliva flow might be related and thus might affect oral health [4]. The higher the scores on the depression scale were, the less saliva the patients reported to have.

In addition to these two underlying mechanisms that can shed light on why patients with depression might be more at risk for poor oral health, future research in this area should focus on three additional factors in this context. First, the role of anti-depression medication and its side effects of causing xerostomia should be explored in more detail [6]. Second, the way depression affects dietary intake and in turn increases the likelihood of caries [4] is also not as comprehensively understood as would be needed. Finally, a recent meta-analysis of 23 studies concerning the relationship between depression and low bone mineral density (BMD) showed that depression was a significant risk factor for low BMD [22]. It might be worthwhile to reflect on whether these findings are of any relevance to patients' oral health.

Although the results of this study are quite interesting, several limitations have to be acknowledged. First, patients were not asked whether they had received a definitive diagnosis of depression or whether they were on anti-depression medication. Instead, the patients' responses to the short version of the CESD were used to assess varying degrees of non-depressed and depressive states. Secondly, the patients were not asked whether they used tobacco products or consumed alcohol. Research showed that individuals who suffer from depression were more likely to smoke cigarettes [23], which in turn might affect their oral health negatively. In addition, alcohol consumption and abuse were also

found to be related to depression [24], and thus might also be contributing factors to explaining poorer oral health outcomes in patients with depression. Finally, this study used the Generalized Self-Efficacy Scale to determine each participant's level of self-efficacy. Future research could use self-efficacy scales that focus on oral health-related behaviour.

Conclusions

In conclusion, the findings of this study showed that that there were significant relationships between depression and oral health, oral health behaviour and OHRQoL. The higher the subjects' scores on the depression scale were, the poorer their oral health and OHRQoL were and the less they engaged in oral health-related behaviour. Concerning the patients' self-efficacy, the data showed no relationship with objective oral health-indicators. However, self-efficacy was significantly correlated with subjective oral health and OHRQoL and with productive oral health-related behaviour. These findings could challenge providers to reflect on how to increase patients' oral health behaviour-related self-efficacy in order to increase positive oral health promotion efforts. Future research should look more comprehensively at the complex set of factors that might moderate the effects of depression on oral health and the role that self-efficacy can play in countering such effects.

Contribution of each author
MMcF performed the study and drafted the background and method section of the paper.
MRI supervised the study, drafted the results and discussion/conclusion sections and edited the paper.

Statement of conflict of interests
As far as the authors are aware, there are no conflicts of interest.

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