DENTIST-PATIENT RELATIONSHIPS AND ORAL HEALTH-RELATED QUALITY OF LIFE

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Preface

This academic thesis did not start from purely academic pursuit but arose from innocent practical curiosity about dentist-patient relationships. With hindsight, my long-standing concern as a clinician in both South Korea and Australia happened to guide me to an unexpected and unsolicited journey with the thesis topic. No one pushed me to this path but for what it's worth, I find myself fumbling around in academia to grasp what dentist-patient relationships should be like. With the submission of my thesis for PhD, I am not sure if I managed to attain what I aimed at when I first started my postgraduate studies. Hopefully in my blurred memory, I wish it were not reputable credits or a testamur in order to sit pretty in another rat race of competitive academia. Rather I would settle for dabbling or broaching the topic which is everywhere and nowhere in dental care, the dentist-patient relationship. For me, it seems to be a 'white elephant in the dental room' as everyone is aware of the potential issue in dental practice but commonly leave it ignored or avoided as looking onerously tricky and less worthy for dealing with. Maybe, the two reflective opinion pieces appended to the end can represent what I truly hope to say throughout the whole thesis. Now that the overture of dentist-patient relationships concludes, it is time to play the dance of tango in a dental practice. Both partners of dentists and patients are expected to be in synchronised motion for the dental service to the tune of cheerful music as in an encouraging dental care system.

Let's shape up a great performance from the better relationship!

The human essence is no abstraction inherent in each single individual.

In its reality, it is the ensemble of the social relations.

Karl Marx

Abstract

The clinical encounter remains a key component of the healthcare service. Despite drastic/massive changes thanks to social and technical development, a therapeutic relationship between clinician and patient is still at the centre of healthcare encounters. As such, dentist-patient relationships (DPR) also play a pivotal role in dental encounters. There are, however, limited numbers of studies where predictors of DPR variables have been thoroughly analysed for their association with oral health outcomes. These studies were commonly based on the extrapolation from medicine or generic healthcare, leaving the dentistry-specific context uncharted. For the rationale to fill the gap of previous research findings, the aim of the thesis was to investigate associations between variables in DPR and oral health-related quality of life (OHRQoL). Four papers in the thesis were to explore the topic from a specific construct of trust in DPR to the general associations and extensive framework including psychosocial factors and structural validity.

This thesis adopted two general approaches: reverse/inverted funnel structure and sequential hypotheses of articles. A comprehensive mapping review on a specific subtopic of trust led the theme to a wider scope of empirical analyses for the aim of the thesis. Among three empirical studies, the initial hypothesis tested in the first paper induced subsequent hypotheses for the second and culminated with examining the expansive causal model in the last. The data for the empirical analyses were sourced in self-complete questionnaires from the Dental Care and Oral Health study with a random sample of 12,245 adults aged 18 years or over living in South Australia in 2015-2016. Variables collected from multi-item scales were analysed in multivariable linear regression, exploratory/confirmatory factor analyses, cluster analysis, and structural equation modelling.

The mapping review found three frameworks for the relevant concepts of trust in DPR: the continuum, beneficiaries, and transformational model of trust. Three thematic findings from the review were multidisciplinary approach, patient-centred care and quality of care, and insufficient empirical evidence. Empirical study 1 found general associations asked in the aim of the thesis – better DPR, mainly higher satisfaction and less dental fear, are associated with higher OHRQoL, presenting lower oral health impact. The significant association was consistent between favourable DPR and improved OHRQoL after adjusting for putative confounders. In empirical study 2, the analyses on factor structure showed that trust and satisfaction in dental care settings are unidimensionally different but highly correlated factors concurrently. The final model from structural validity suggested both scales with revision be applied together for further studies on DPR. The last empirical study indicated that psychosocial factors and DPR variables are associated with OHRQoL in both unique and mediated effects. Starting from psychosocial factors via DPR variables to OHRQoL, the 'distal-to-proximal' framework was empirically substantiated by the model.

In conclusion, variables related to better DPR are associated with higher OHRQoL in both direct and indirect paths along with psychosocial factors. The biopsychosocial model of oral health with better DPR should be applied to improve health promotion as is justified by the theoretical and empirical findings from the thesis.

Declaration

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in my name, in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission in my name, for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint-award of this degree.

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I acknowledge the support I have received for my research through the provision of an Australian Government Research Training Program Scholarship.

Dr Youngha Song

Signature

Date 22 / Jul / 2020

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사랑하는 우리 가족, 승우와 지우, 누구보다 저를 응원해주고 도와줬던 아내 명숙에게 진심으로 고마움을 전합니다. 저희 부모님과 장인 장모님께도 항상 걱정을 끼쳐드리고 도움만 받아서 죄송하고 고맙다는 말씀을 드리고 싶습니다.

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Last but not least, Dr S (*in memoriam*), I still remember the minute tremble of your last call for help. I am sorry not to keep you safe from what I had gone through. I hope this thesis can send my regard to you up there, lest I forget.

Research outcomes

Publications contributing to this thesis

Song Y, Luzzi L, Brennan D. Trust in dentist-patient relationships: mapping the relevant concepts. *European Journal of Oral Sciences*. 2020;128(2):110-9.

Song Y, Luzzi L, Chrisopoulos S, Brennan D. Dentist-patient relationships and oral health impact in Australian adults. *Community Dentistry and Oral Epidemiology*. 2020; doi: 10.1111/cdoe.12534

Song Y, Luzzi L, Chrisopoulos S, Brennan D. Are trust and satisfaction similar in dental care settings? *Community Dentistry and Oral Epidemiology*. 2020; doi: 10.1111/cdoe.12559

Song Y, Luzzi L, Brennan D. Psychosocial factors, dentist-patient relationships, and oral health impact: A structural equation modelling approach. Unpublished and unsubmitted manuscript.

Conference presentations arising from this thesis

Song Y, Luzzi L, Chrisopoulos S, Brennan D. Structural validity of trust and satisfaction in dental care settings. 98th General Session of the International Association for Dental Research. Washington D.C., USA. 21st March, 2020. Abstract accepted but presentation cancelled by force majeure of COVID-19 (ePoster presentation).

Song Y, Luzzi L, Chrisopoulos S, Brennan D. Dentist-patient relationships as an explanatory factor for oral health impact. 4th Meeting of the International Association for Dental Research Asia Pacific Region. Brisbane, Australia. 28th November, 2019 (oral presentation).

Song Y, Luzzi L, Chrisopoulos S, Brennan D. Associations of dentist-patient relationships with oral health impact in Australian adults. 2019 General Meeting of the Korean Academy of Preventive Dentistry and Oral Health. Seoul, Korea. 26th October, 2019 (oral presentation).

Song Y, Luzzi L, Brennan D. Patients' trust in dentists: system maps with relevant concepts. 13th Annual Florey Postgraduate Research Conference. The National Wine Centre, Adelaide, Australia. 24th September, 2019 (poster presentation).

Song Y, Luzzi L, Chrisopoulos S, Brennan D. Association between dentist-patient relationships and oral health-related quality of life. Adelaide Dental School Research Day. The National Wince Centre, Adelaide, Australia. 19th July, 2019 (oral presentation).

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2019 Eustace International Travel Award to attend a conference for a presentation. Adelaide Dental School, the University of Adelaide.

2019 Adelaide Dental School Prize. Florey Postgraduate Research Conference. Faculty of Health and Medical Sciences, the University of Adelaide.

Table of contents

List of Abbreviations

CFA	Confirmatory factor analysis
DCOHs	Dental Care and Oral Health study
DCS	Dental Care Satisfaction
DPR	Dentist-patient relationships
DTS	Dentist Trust Scale
EFA	Exploratory factor analysis
HRQoL	Health-related quality of life
NSAOH	National Survey of Adult Oral Health
OHIP	Oral Health Impact Profile
OHRQoL	Oral health-related quality of life
PRO	Patient-reported outcomes
QoL	Quality of Life
SEM	Structural equation modelling
SEP	Socioeconomic positions
SES	Socioeconomic status

Chapter 1: Introduction

Background

Either as face-to-face visits or electronically virtual interactions, clinical encounters remain a core element in the provision of healthcare (Committee on Quality of Health Care in America 2001; Weiss and Lonnquist 2017). The clinical encounter between health professional and patient is a key step of health communication and constitutes a basic unit of analysis in medical sociology (May 2007). Considering its lasting validity, changing dynamics in clinical encounters should be of interest for better medical practices and policies (Boyer and Lutfey 2010). From the initial model of the authoritative dyad and power imbalance, interactions in clinical encounters have changed towards "individualization" and "aggregation" in the period of late modernity (May 2007). The former refers to the paradigm-shift from medical paternalism and disease-centred care to patient-centred care with a focus on qualitative engagement in patients' values. The latter is conceptualised as the rationale of evidence-based care with the application of quantitative knowledge to healthcare service (May et al. 2006). In practice, the changes of dynamics in clinical encounters have appeared predominantly in the relationships between healthcare providers and patients (Boyer and Lutfey 2010): physician-patient relationships in medicine, dentist-patient relationships (DPR) in dentistry, and clinician-patient relationships in healthcare as a collective reference for this thesis.

As clinical encounters take a momentous weight in healthcare service, clinician-patient relationships rest on the heart of it (Boyer and Lutfey 2010). To be more specific, continuous healing relationships between health professionals and patients should be one of the simple rules for the 21st century healthcare system (Committee on Quality of Health Care in America 2001). However counterproductive issues in healthcare systems arise increasingly from the deteriorating relationships to varying extents, including but not limited to: medical litigations

(Kessler et al. 2006), defensive medicine with over-/under-servicing (Brownlee et al. 2017), medical violence (Nie et al. 2018a), and occupational mental stress (Myers and Myers 2004). Even if the importance of clinician-patient relationships has been widely acknowledged since the dawn of the new century from the seminal report of the Committee on Quality of Health Care in America (2001) and the charter of the Project of the ABIM Foundation (2002), the translation of proclamation into the clinical encounter has been insufficiently implemented. For example, given the lack of effective communication in healthcare (Levinson et al. 2010) and the erosion of trust in healthcare professionals (Nie et al. 2018b), there still remains a need to establish or re-establish therapeutic relationships between them.

Before commencing the topic of DPR in dental contexts, a literature review covering relevant themes/concepts would guide to the rationale of the thesis. The review seeks the transition of concepts and theories in healthcare to understand models and frameworks in physician-patient relationships. Following the grounding, a detailed consideration of dentistry-specific contexts will segue into the general aim for the thesis and individual objectives for each article included.

Literature review

Transitions of concepts and theories in healthcare

Biopsychosocial model of health and oral health

Everywhere and nowhere is not only public health (Wylie et al. 1999) but also 'health' itself. Depending on the concept of health, it can be merely reduced to the absence of diseases or broadly extended to comprehensive well-being in life (Hewa and Hetherington 1995). The traditional concept of health, the biomedical model, defines health as the former or physiological malfunctioning with the focus on purely biological structures (Weiss and Lonnquist 2017). The concept finds its origin from the mechanistic model in medicine established through the process of "rationalization" purported by Max Weber (Hewa and Hetherington 1995). The increasing body of scientific knowledge and technical skills have achieved great success in Western Medicine with dogmatic dualism and reductionism – for the former, division of mind and psychological components from the body and somatic ones; for the latter, analysing the complexity of life into smaller parts of composites in biomedicine (Engel 1978). The four primary assumptions of the biomedical model are summarised as (Wolinsky 1988): medical practices in healthcare are all entirely objective phenomena; only medical professionals retain the capacity to deal with health matters; health and illness are solely the subjects of physiological malfunction; health is defined as the absence of disease.

A more extensive spectrum of health and its determinants has been suggested by critics of the biomedical model (Hewa and Hetherington 1995). With fundamental issues of non-communicable chronic diseases and individual differences in the course of diseases (Havelka et al. 2009), the biopsychosocial model introduced diverse aspects of human life to health. For example, the model allows for the social, psychological, political, cultural, economic, and

environmental variables of health and diseases (Hewa and Hetherington 1995; Weiss and Lonnquist 2017). By extension, Engel, the pioneer of the biopsychosocial model, even argues that the ultimate criteria for health from the patient's perspective should be psychosocial although the complaint is physical (Engel 1978). Based on general systems theory conceptualising nature as a hierarchy and continuum (Engel 1978; Hewa and Hetherington 1995), the model incorporates patients and social context in the healthcare system (Weiss and Lonnquist 2017). The four principles of the biopsychosocial approach in primary care are: the patient as a whole person; the clinician-patient relationship should be continuous and consistent; the physician's utilisation of both biotechnical and interpersonal skills; both the patient and the clinician take part in the process of decision making with respective needs and preferences (Quill 1982).

Oral health has also followed in accordance with the transition of concepts of health. The conventional definition based on the biomedical model has changed into more inclusive recognition, such as oral health is "a comfortable and functional dentition that allows individuals to continue in their desired social role" (Dolan 1993). The up-to-date universal definition developed by the FDI World Dental Federation indicates that (Glick et al. 2016):

> Oral health is multi-faceted and includes the ability to speak, smile, smell, taste, touch, chew, swallow and convey a range of emotions through facial expressions with confidence and without pain, discomfort and disease of the craniofacial complex.

The implication of the biopsychosocial model on oral health is its perception of multidimensionality and challenges to measuring those core elements of oral health – disease, physiologic function, and psychosocial function (Lee et al. 2017). In particular, well-being as an outcome of healthcare should be comprehensively measured based on the new definition (Lee et al. 2017).

Patient-reported health outcomes

Clinical outcomes used to be traditionally considered objective medical test results (Fayers and Machin 2013) with a limitation of turning the patients' perspective away. The subjective indicators reported from patients' perception can complementarily evaluate healthcare practices (Patrick et al. 2007) and become the principal outcome of interest in its own right (Fayers and Machin 2013). Patient-reported outcomes (PROs) in healthcare refers to "any report coming directly from patients, without interpretation by physicians or others" (Patrick et al. 2007). As such, the concept has contextual synonyms of *person-reported outcomes* or *self-reported health* (Fayers and Machin 2013). By putting patients at the centre of healthcare, PROs are in conformity to the biopsychosocial model of health out of disease-centred care (Weiss and Lonnquist 2017). The term of PROs is often used as instruments to measure the result at the actual endpoints as aforementioned (Patrick et al. 2007). Thus their taxonomy and psychometric properties have been committed for the consensus on healthcare evaluation such as the COSMIN initiative (COnsensus based Standards for the selection of health Measurement INstruments) (Mokkink et al. 2010). In the dental context, dental PROs have also been advocated for clinical decision making and treatment results in diverse sub-specialties (Listl 2019).

One of the substantial measures in PROs is quality of life (QoL) or health-related quality of life (HRQoL) (Patrick et al. 2007). QoL defined by World Health Organisation in 1997 (World Health Organisation 1997) is:

> individuals' perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns.

Despite the definition suggested with the emphasis on happiness and satisfaction with life, QoL cannot be simply and universally operationalised for its contextually different interpretations (Fayers and Machin 2013). Nevertheless, the effort to estimate HRQoL has produced a large assortment of measures, mainly two categories of generic and disease-specific instruments (Fayers and Machin 2013). Generic instruments are intended to be applicable across diverse health conditions and enable direct comparisons among them (Fayers and Machin 2013). Commonly used instruments are: the Medical Outcomes Study 36-item Short Form (SF-36) (Ware Jr and Sherbourne 1992); the EuroQol (EQ-5D) (Brooks and Group 1996); the World Health Organization Instrument for Quality of Life Assessment (WHOQOL) and its shortened version WHOQOL-BREF (World Health Organisation 1997). For the focus on particular impacts caused by specific disease and their sensitivity to QoL, disease-specific instruments have been developed from varied medical/dental disciplines. Some widely accepted measures for oral health-related quality of life (OHRQoL) are: the Oral Health Impact Profile (Slade 1997); the Oral Impact on Daily Performance (Adulyanon et al. 1996); General/Geriatric Oral Health Assessment Index (Atchison and Dolan 1990); for children's OHRQoL, the Child Perceptions Questionnaire 11-14 (Jokovic et al. 2002); the Early Childhood Oral Health Impact Scale (Pahel et al. 2007).

The Wilson and Cleary model of HRQoL is a powerful theoretical framework engaging a continuum of patient outcomes (Wilson and Cleary 1995). Particularly, the model embraces the concepts of the biopsychosocial approach of health and PROs by introducing the role of individual and environment characteristics in the conceptual causal links to the ultimate QoL. Psychological factors and social determinants moderate the causality of health from biological/physiological variables via symptoms and functional status to the general health perceptions and overall QoL. Ferrans et al. revised the model to include more comprehensive and less restrictive relationships among the five measures and moderating characteristics

(Ferrans et al. 2005). For OHRQoL, the Wilson and Cleary model has also been adopted for constructive development of measuring instruments and empirical analyses with mediated/moderated effects (Baiju et al. 2017; Baker et al. 2008; Gupta et al. 2015).

Social disciplines of health

So far, transitions of concepts about health and health outcomes have been described in an organised summary of individual themes. The convergence between physiologic and psychosocial aspects of health has evolved into a more structured discipline of social science, medical sociology (Weiss and Lonnquist 2017). Ruderman defines medical sociology as "the study of health care as it is institutionalized in a society, and of health, or illness, and its relationship to social factors" (Ruderman 1981). Based on the definition, major topics in medical sociology include subjective experience and behaviours of health and illness; political, economic and environmental circumstances fostering ill health; and relationships between patients, and healthcare practitioners and healthcare system (American Sociological Association 2012; Weiss and Lonnquist 2017). The sociological approach can cast common research questions of health to the relevant subfields of medicine and dentistry, which share a core concept of social aspects of health (Weiss and Lonnquist 2017). Those questions are asked to inform social epidemiology and social medicine/dentistry.

Epidemiology investigates patterns and distribution of diseases in populations (Weiss and Lonnquist 2017). Following the role given, social epidemiology is defined as "the branch of epidemiology that studies the social distribution and social determinants of states of health" (Berkman et al. 2014). As the biopsychosocial model of health has progressed, the subject of epidemiology has broadened its perspectives from identifying responsible microorganisms to social characteristics and the environment on diseases (Weiss and Lonnquist 2017). For this reason, the central question in social epidemiology is "how social conditions give rise to

patterns of health and disease in individuals and populations?" (Berkman et al. 2014). Theories to pursue the answer include psychosocial theory, social production of disease/political economy of health, and ecosocial theory and related multi-level dynamic perspectives (Krieger 2001b). For those theories, some guiding concepts are suggested: a population perspective; the social context of behaviour; contextual multilevel analysis; a developmental and life-course perspective; general susceptibility to disease (Berkman et al. 2014). Further descriptions about the concepts lie beyond the scope of the thesis but more contextual definitions of them can be found in 'A glossary for social epidemiology' (Krieger 2001a).

The definition of social medicine as an academic discipline has been found to be elusive due to its diverse evolution from different social and political contexts (Porter 2006). For educational purposes, however, social medicine is defined as the practice of medicine that integrates (Stevens et al. 2015):

> Understanding and applying the social determinants of health, social epidemiology, and social science approaches to patient care;
>
> An advocacy and equity agenda that treats health as a human right;
>
> An approach that is both interdisciplinary and multi-sectoral across the health system;
>
> Deep understanding of local and global contexts ensuring that the local context informs and leads the global movement, and vice versa (learning and borrowing from distant neighbors);
>
> Voice and vote of patient, families, and communities.

Having been delineated with its vague entity of vast scope, dentistry has also tried to develop the social approach to oral health, social dentistry (Bedos et al. 2018b). A framework of

actions in social dentistry is suggested at three levels: individual and family level (micro level), community level (meso level), and societal level (macro level) (Bedos et al. 2018a). Among those levels, actions at the micro level necessitate the implementation of patient-centred care with psychosocial determinants (Bedos et al. 2018a). The micro level of social dentistry vindicates better relationships between dentists and patients, which is also supported by the generic social medicine (Porter 2006; Stevens et al. 2015). Tracing back to the importance of clinical encounters, clinician-patient relationships are re-emphasised with its fundamental role in medical sociology (May 2007; Weiss and Lonnquist 2017), particularly the individual level of analysis in the 'microsociology' (Ruderman 1981).

Physician-patient relationships

Normative models

The subject of physician-patient relationships can be summarised as "the study of patterns in the way that physicians and patients relate to each other and factors that influence these patterns" (Weiss and Lonnquist 2017). Despite its nature of ever-lasting presence at the clinical encounter, the relationship is still grounded to the 'Parsonian paradigm' as a dyadic system and its normative derivatives (May 2007). Parson's *sick role* of a patient, being in a temporary condition with acute medical symptoms, inevitably perceives patients as a passive participant in the asymmetrical relationship (Boyer and Lutfey 2010). The dominance and power role taken by physicians in the relationship was dictated by three circumstances: professional prestige, situational authority, and situational dependency (Weiss and Lonnquist 2017). The ideal image of physicians pursuing 'mutuality of interests' for the dependent patient has been criticised in accordance with epidemiological, economic, political, and technological developments/changes (Boyer and Lutfey 2010; Weiss and Lonnquist 2017). For example, the increasing prevalence of chronic illness, emphasis on patient-reported

health outcomes, and better access to medical knowledge and healthcare services have driven the paradigm into more dynamic models of relationships (Boyer and Lutfey 2010; Weiss and Lonnquist 2017). Conceptual models of normative relationships between physicians and patients are compared in Table 1. In general, the models are segmented into four categories pursuant to patients' values and autonomy, and physician's obligations and conceived role (Emanuel and Emanuel 1992). In other words, the physician-patient relationship is specified by three key dimensions: the concept of health (biomedical model vs. biopsychosocial model), ethical obligations in the relationship (autonomy, beneficence, and non-maleficence), and the implementation of therapeutic communication (Weiss and Lonnquist 2017). However, it is still advised to reframe the relationship beyond only dyadic dynamics by incorporating systemic structural changes in healthcare (May 2007).

Patient-centred care and quality of care

One of the common themes in the literature review for the topic is patient-centredness (Australian Commission on Safety and Quality in Health Care 2011; Mead and Bower 2000). Patient-centred care can be defined as "providing care that is respectful of and responsive to individual patient preferences, needs, and values and ensuring that patient values guide all clinical decisions" (Committee on Quality of Health Care in America 2001). As opposed to disease- or doctor-centred care, patient-centred care focuses on patients' experience of illness 'as a person' rather than an entity suffering from the disease (Mead and Bower 2000). Dimensions identified in patient-centred care are: respect for patients' values, preferences, and expressed needs; coordination and integration of care; information, communication, and education; physical comfort; emotional support–relieving fear and anxiety; involvement of family and friends (Gerteis et al. 1993). Among associated terms sharing the similar notion is relationship-centred care (Australian Commission on Safety and Quality in Health Care 2011; Beach et al. 2006; Safran et al. 2006). By highlighting relationship matters in healthcare,

patient-centredness can be more specified in translation and extended towards a wider frame (Beach et al. 2006). As the term indicates literally, “all participants appreciate the importance of their relationships with one another” in relationship-centred care (Beach et al. 2006). Therefore the relationships are not contained only between the clinician and the patient, but also extensively applied to the concept of clinician-colleague, -community, and with self (Beach et al. 2006; Safran et al. 2006). For a broader perspective of healthcare, the rationale of patient- and relationship-centred care are acknowledged to improve value-based healthcare quality and safety (Institute for Patient- and Family-Centered Care 2016).

Quality of care should be considered for the topic of physician-patient relationships as “care is based on continuous healing relationships” (Committee on Quality of Health Care in America 2001). Quality in healthcare is defined as “the degree to which health care services for individuals and populations increase the likelihood of desired outcomes and are consistent with current professional knowledge” (Institute of Medicine 1990). Campbell et al. analysed quality of care by adopting the framework of structure, process, and outcome, suggesting two principal dimensions for it: access and effectiveness (Campbell et al. 2000). Despite the effort to ‘cross the quality chasm’ in healthcare delivery system (Committee on Quality of Health Care in America 2001), there are still lots of potentially low-quality/-value healthcare practices being actively performed (Elshaug et al. 2012) and even some yet quantified (Chalmers et al. 2017). Dentistry is also not the exception of exigency for quality of care and value-based healthcare (Listl 2019). Looking through the definition and analyses for quality of care, the inseparability of patient-centredness is rigorously confirmed from both the conceptual and empirical literature (Campbell et al. 2000; Committee on Quality of Health Care in America 2001; Mead and Bower 2000). Beyond their inseparable nature,

Table 1. Normative models in physician-patient relationships

Emanuel et al. (Emanuel and Emanuel 1992)	**Parsons & Szasz-Hollender** (Weiss and Lonnquist 2017)	**Veatch's model** (Veatch 1991)
Paternalistic model • Physician as a guardian • Patient's autonomy: assenting to objective values • Patient value: objective and shared by physician and patient • Physician to promote the patient's well-being independent of the patient's current preferences	**Parsonian model** • Inherent asymmetrical relationships from three circumstances: professional prestige, situational authority, situational dependency • Passive patient role: "*sick role*" in a temporary status of acute symptoms, which is obligated to follow medical advice • Autonomous physician and obedient patient	**Priestly model** • Physician as a priest in the paternalistic model • Parent-child image • Ethical principle: "Benefit and do no harm to the patient"
Informative model • Physician as a competent technical expert • Patient's autonomy: choice of, and control over medical care • Patient value: defined, fixed, and known to the patient • Physician to provide relevant information and implement the selected intervention	**Activity-passivity model** • Analogy with a parent-infant relationship • In parallel with asymmetrical interactions from the Parsonian model • Physician takes control and patient as a passive supplicant	**Engineering model** • Physician as a value-free scientific technician • Decision-making power given to the patient • Medical choices are based upon "significant" levels of statistical tests and factual observations
Interpretive model • Physician as a counsellor or advisor • Patient's autonomy: self-understanding relevant to medical care • Patient value: inchoate and conflicting, requiring elucidation • Physician to elucidate and interpret relevant patient values and implement the selected intervention	**Guidance-cooperation model** • Analogy with a parent-adolescent relationships • Typical of most medical encounters • Patient's increased involvement in informed decision-making • Physician still retains the dominant position in control	**Contractual model** • Relationship based on the contract or covenant • Sharing decision-making between physician and patient on the premise of trust and confidence • Both as free moral agents with the patient retaining control of individual level integrity and the physician day-to-day medical decision
Deliberative model • Physician as a teacher or friend • Patient's autonomy: moral self-development relevant to medical care • Patient value: open to development and revision through moral discussion • Physician to articulate and persuade the patient of the most admirable values as well as inform the patient and implement the selected intervention	**Mutual participation model** • Analogy with two competent adults in medical encounters • Patient elevated to be a full participant or a central player • Three essential traits: both with equal power, mutual interdependence, mutually satisfying interaction	**Collegial model** • Physician and patient as colleagues pursuing the common goal of health • Equality of dignity, respect, and value contributions in the relationship • Lack of practicality in realism: "utopian assumption of collegiality"

relationship-centred care is expected to make a breakthrough for the improvement of quality in healthcare in association with patient-centred care (Safran et al. 2006).

Dentist-patient relationships

Extrapolation and distinctiveness

Dentistry, as a discipline of health and medical sciences, shares a large portion of healthcare concepts and their transitions with that investigated for generic medicine. The layman's term, 'bedside' manner for physician-patient relationships can simply be extrapolated as 'chairside' manner for dentist-patient relationships (DPR) in dental contexts (Kulich et al. 1998). For this reason, the underlying concepts of the biopsychosocial model, patient-reported health outcomes, and social disciplines of health are applied to dentistry as aforementioned. Quality of dental care also invariably entails better DPR (Yamalik 2005a) as is required for physicians. DPR appears to "covers (nearly) all aspects of care" and has the role of increasing "the quality of care and patient satisfaction" (Yamalik 2005a). However, the importance of DPR has not been sufficiently recognised (Kulich et al. 1998; Muirhead et al. 2014) in dental education and practices compared with clinical excellence in expertise. For example, communication skills have not received as much attention as for biomedical knowledge and surgical technique in medical/dental education (Levinson et al. 2010). As the rationale is shared, the status quo of less-than-optimal attention on clinician-patient relationships is also in common at both medical and dental encounters.

Having said that, the distinctive features in dentistry may warrant additional considerations or modified approaches (Guay 2006; Sondell and Söderfeldt 1997). As opposed to medical disease, oral diseases are not generally insurable and the sequelae can persist from childhood throughout one's whole lifetime (Guay 2006). For access to healthcare services, a regular resource for dental care is often more highly limited according to socioeconomic differentials

compared with that for medical care (Kronenfeld 1979). Patients' fear and anxiety about clinical dental practices are so prevalent that they spin the 'vicious cycle' of dental visit avoidance and more deteriorating oral health (Armfield 2013; Armfield and Heaton 2013). Considering dental patients' high vulnerability and sensitivity to oral disease and health, better DPR may be able to find more potential for positive impacts in dental encounters than in medical contexts. For that matter, the extrapolated models and frameworks for the relationship are to be revised towards allowing for different applications of components/factors to the distinctive dental contexts (Sondell and Söderfeldt 1997).

Conceptual models of dentist-patient relationships

Even though the 'abstract' concept of clinician-patient relationships has been attempted for its definition and categories, its inherent multidimensionality and complexity make the operationalisation of the construct harder (Hoff and Collinson 2017). With the absence of comprehensively quantifying measures for the relationship, a review of the non-empirical literature provides a salutary conceptual framework for better understanding the structured dynamics of elements (Hoff and Collinson 2017). The adapted framework to dental contexts presents three subsets of elements in DPR: qualities/components, contextual influencers, and positive outcomes (Figure 1). The first is essential features and characteristics contributing to DPR and positive outcomes such as information (Williams et al. 2007), communication (Ong et al. 1995; Yamalik 2005b), and trust (Nie et al. 2018b). Next is external forces affecting outcome variables and playing interactions with establishing components in DPR such as time (Braddock and Snyder 2005) and resource availability (Kao et al. 1998). The other is positive outcomes resulting from contributory components of DPR, contextual factors, and their interplays such as quality (Committee on Quality of Health Care in America 2001) and satisfaction (Ong et al. 1995). The framework can serve the initiation of exploration for DPR

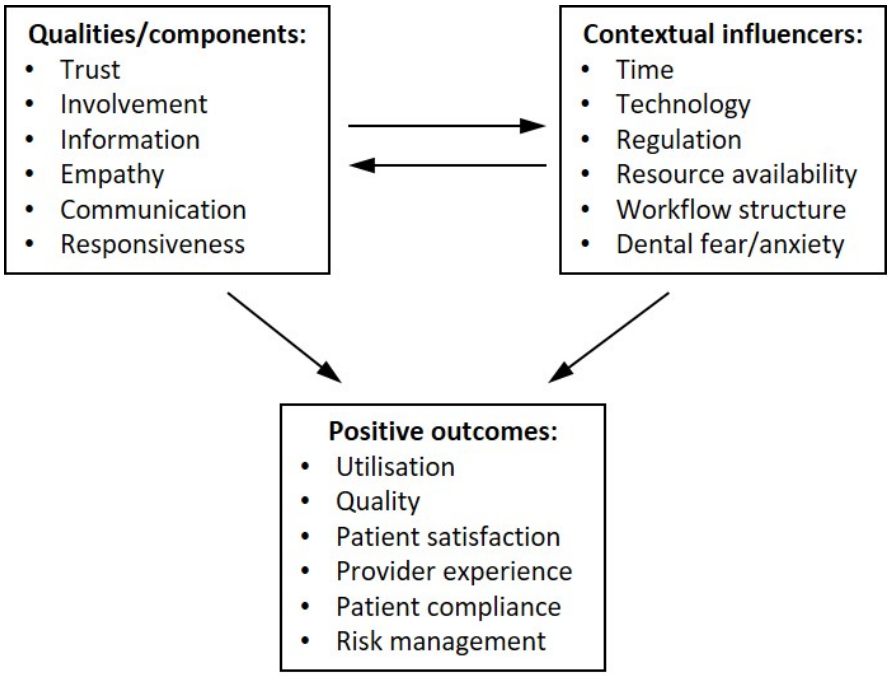

Figure 1. Qualities/components, contextual influencers, and positive outcomes in dentist-patient relationships (adapted from Hoff et al., 2017) (Hoff and Collinson 2017)

as a useful guide despite the limitations of only normative suggestions and inexhaustive reviews with a chance of biases (Hoff and Collinson 2017).

The elements comprising DPR framework are organised in a conceptual model (Figure 2). Sondell et al. reviewed and typologised both empirical and normative models of clinician-patient relationships in medical and dental contexts (Sondell and Söderfeldt 1997). The model was originally suggested to establish a systematic theory for dentist-patient communication in dental encounters. However, its implication is still valid to a broader spectrum of DPR given the weight that communication takes in DPR (Ong et al. 1995; Yamalik 2005b) and common values that both concepts co-occupy. The frameworks mentioned above for improving quality of care (Campbell et al. 2000) and elements in DPR (Hoff and Collinson 2017) are reflected in the model as well. The dyadic and equitable dynamics in the society and environment delineate the perimeter of clinical encounters

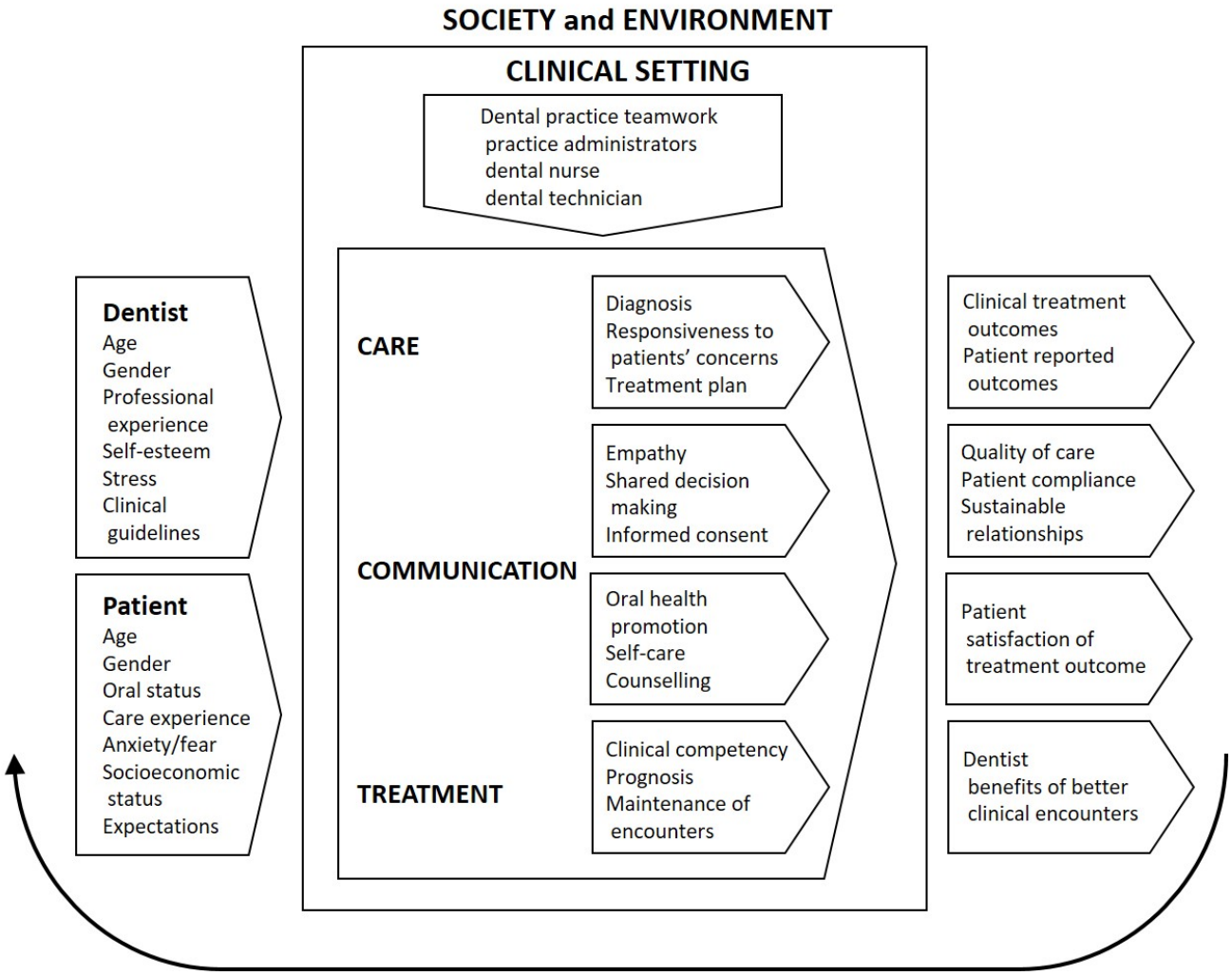

Figure 2. A conceptual model of dental encounters (adapted from Sondell et al., 1997) (Sondell and Söderfeldt 1997)

(structure; contextual influencers). In the clinical setting, the actual DPR is built up under the influence of external factors (process; qualities/components). As a result at the endpoint, subjective and objective outcomes from both participants are produced and formed in an iterative cycle of feedback (outcome; positive outcome). To reinforce the model with solid proof, it is recommended to perform experimental research (Mataki 2000) for causal inference drawn in the diagram (Sondell and Söderfeldt 1997).

Rationale

In the contemporary healthcare system and service with drastic changes and developments of medicine, clinical encounters still retain its key role as a ‘facework’ – social relationships in the context of copresence (Giddens 1990). It is common knowledge that relationships between clinicians and patients axiomatically govern and organise the components in clinical encounters (Yamalik 2005a). With all theoretical background searched from the literature review so far, dentist-patient relationships (DPR) have been academically understudied in research and practically overlooked at dental practices. In this regard, this thesis could find its rationale from three points: the pursuit of empirical findings, contextual considerations on dental encounters, and an opportune chance of exploring disparate variables. First and foremost, the thesis targeted mainly empirical analyses on the data collated from a representative sample of a population excepting the groundwork of mapping review as an initial step. Normative arguments and theoretical discussion on the raison d'être of DPR have already been suggested and acknowledged. Instead of repeating them, more robust evidence for better DPR was to be sought in association with oral health outcomes. Secondly, the focus on *dental* contexts in the topic of clinician-patient relationships could vindicate this thesis to deal with the limitation of naïve extrapolation from generic medical contexts. Having sorted through the common features under a broad faculty of health and medical sciences, the distinctiveness of dentistry for the topic needed to be studied in empirical research. Finally, a disparate group of variables in oral healthcare service could provide an opportunity to fill the niche of underexplored dimensions in DPR. Not only the core constructs of DPR, but other relevant psychosocial factors are also expected to contribute to capturing comprehensive relationships in the biopsychosocial model and social dentistry framework. The rationale found through the literature review and an empirical dataset leads to general aims and

specific objectives of each and every article included in advance of structuring an entirety of the thesis.

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Chapter 2: General aim and specific objectives

General aim

The thesis aimed to investigate associations between variables in dentist-patient relationships (DPR) and oral health-related quality of life (OHRQoL). From a specific construct of trust in DPR to the relevant psychosocial factors in the conceptual model of the topic, the aim of the thesis was to explore DPR comprehensively with regard to oral health outcomes for practical implications.

Specific objectives

- The objective of the mapping review was to explore concepts relevant to trust in DPR in a comprehensive manner and illustrate relationships among the concepts in visual guide maps
- The objective of the empirical study 1 was to investigate whether better DPR variables are associated with an improved oral health outcome (OHRQoL)
- The objective of the empirical study 2 was to compare the similarity of both important constructs in DPR, trust and satisfaction, with regard to factor structure and revise the scales for better psychometric properties
- The objective of the empirical study 3 was to examine and verify the conceptual model comprising hypothesised relationships among psychosocial factors, DPR variables, and oral health outcome (OHRQoL)

Thesis structure

This thesis is structured in the format of a thesis by publication. The four papers included in the thesis target each specific objective aforementioned, collectively achieving the general aim by contributing their findings to the main topic, the association of DPR with OHRQoL. The whole eight chapters in the thesis are also presented as a conventional format of thesis: Chapters 1 and 2 comprise the introduction and aim of the thesis, Chapter 3 the research methodology, Chapters 4 to 7 present the papers of each thesis topic for publication, and Chapter 8 provides a general discussion and conclusion. For a more consistent understanding of the thesis aim, linkage to the body of work and highlights are attached to each original article at the beginning of the respective chapters.

Chapter 1 initiates this thesis by scoping around the background of the topic and searching through literature relevant to the theme/concepts. The rationale of the thesis is supported by the gap of known theories and normative arguments, and unknown empirical findings from the literature review. Chapter 2 establishes the general aim of the thesis and specific objectives for each article, which explains the significance of the study. Chapter 3 elucidates methodologies of the overall approach and each article including the mapping review with visual system maps and analytic methods from the empirical data source. Chapters 4 to 7 present the findings sought for specific objectives from review/original manuscripts in the form of being either published or unpublished/unsubmitted work at the time of writing. Each manuscript is entitled as follows:

- “Trust in dentist-patient relationships: mapping the relevant concepts” in Chapter 4
- “Dentist-patient relationships and oral health impact in Australian adults” in Chapter 5
- “Are trust and satisfaction similar in dental care settings?” in Chapter 6

- “Psychosocial factors, dentist-patient relationships, and oral health impact: A structural equation modelling approach” in Chapter 7

Finally, Chapter 8 provides the summary and general discussion of findings, limitations and strengths of the study, and concluding remarks.

This thesis followed the Council of Scientific Editors (CSE) 8th Name-Year referencing style except for chapters with the original articles formatted conforming to the specified and required style of the journal. For the vocabulary and grammar use, Australian English is applied as standard throughout the thesis unless for citation/quotation, academically coined proper nouns, or otherwise specified.

Significance of the study

Driven by the rationale based on the gap from theoretical and normative arguments, this thesis investigated associations of variables in DPR with oral health outcomes through statistical analyses of empirical data. Practical benefits confirmed in the thesis can provide a more robust justification for establishing better DPR, which has previously been urged as ethical norms and imperatives in professionalism. By extension, further empirical studies on applications of better DPR variables are warranted by the findings of the thesis.

Chapter 3: Research methodology

General approach to the study

This thesis adopted the combination of two general approaches: reverse/inverted funnel structure (Stewart and Cash 2008; White 1981) and sequential hypotheses of articles. The reverse/inverted funnel structure refers to the interviewing method for less motivated respondents, starting from a peripheral question and gradually reaching the subject matter with the interviewee's increasing involvement (Stewart and Cash 2008). For this work, a specific subtopic led to more general themes for better and comprehensively understanding the field of interest up to the practical scope/range of the PhD thesis. The topic of the thesis was initially captured from specific interests with the 'trust' in dental encounters. Findings from a thorough mapping review for relevant concepts to trust applied to a broader theme, dentist-patient relationships (DPR), by shifting the focus to a comprehensive context in clinical dentistry. Empirical studies also started from the general association of DPR with oral health-related quality of life (OHRQoL) and expanded the scope to a more inclusive framework introducing psychosocial factors. The transition of research topic was effectively implemented from trust in DPR, an initial specific concept, to comprehensive DPR and psychosocial variables, the frontier of the biopsychosocial model of OHRQoL.

Sequential hypotheses were proposed and investigated from the first empirical study. The findings of testing the initial hypothesis – general associations of DPR variables with OHRQoL – provided not only the basic premise justifying further studies but also subsequent hypotheses in logical sequence for the next empirical analyses. For example, empirical study 2 dealt with the potential issue of collinearity and applicability of trust and satisfaction in DPR, which was posed by the discussion in the previous article. Moreover, the mediation of DPR variables was hypothesized in the first empirical study and analysed in empirical study 3 along with the factor solution found in study 2. Therefore four of the papers included in the

thesis can suggest more potential implications on the topic as a collective entirety rather than a series of stand-alone manuscripts.

Research method for the mapping review

The mapping review was to explore concepts relevant to trust in DPR in a comprehensive manner. For that reason, a pragmatic approach was adopted to collect evidence from the literature search. Three phases composed the process of the review. An initial literature search with a systematised searching protocol was performed to build a sub-structure of the map and set a starting point. With the findings from the initial search as key concepts, drawing system maps was initiated in a macro-structure for a conceptual model. Finally, the structural deficiency of lacking evidence in the map was supplemented by purposive and targeted searches of citation chaining and hand searching in proximate journals. Throughout the process, the phases were re-attempted in a productive iteration between drawing a map and searching the literature for additional evidence. Over the course of reviewing, a thematic analysis to extract subtopics and relationships among them was carried out until no novel themes emerged as a saturation point.

Across the review, three frameworks were applied: a continuum of studying trust in DPR, beneficiaries of trust utilisation, and a transformational model of trust development. The continuum consisted of the establishment, measurement, and utilisation of trust in DPR. Three parties of beneficiaries were identified, two inherent participants in DPR – patients and dentists – and the oral health system as a systemic factor. Finally, types of trust in a developmental hierarchy were integrated into the framework. The transformation between three bases of trust was introduced to this article for the discrimination of different types of

trust by their nature: identification-based trust, knowledge-based trust, and deterrence/calculus-based trust (Lewicki et al. 2006).

Data source and design for empirical studies

Study background

The data analysed in the empirical studies of the thesis were sourced from the Dental Care and Oral Health study (DCOHs). The conception of the study started from the recognition of different oral health outcomes according to different dental care sectors. Patients in public dental service have reported less favourable outcomes and access than that in private dental care (Brennan et al. 2008). It has often been supposed that private dental service performs better in quality and value of care, but there still remain questions of causal inferences for oral health outcomes and selection biases for those with eligibility to public care. With gaps of evidence for the topic, the primary aim of the DCOHs was to investigate if different pathways of dental care in a cohort of adults affect longitudinal changes in oral health outcomes among groups in different socioeconomic positions (SEP). For the aim of the study, three specific objectives were established: to assess if private dental care leads to better outcomes; to investigate if groups with higher SEP have better outcomes in private dental care; to answer why those eligible for public dental care often take up private dental service.

Study design

The DCOHs was designed as a prospective cohort study with a representative sample of adults aged 18 years or over living in South Australia in 2015-2019. Data for the study were collected using mailed self-complete questionnaires. The cohort was traced down for

subsequent follow-ups over a two-year period of observation. The changes in oral health outcomes between baseline and follow-ups were assessed as dependent variables that would be analysed by dental care pathways and SEP to achieve the aim of the study. The cohort study design in epidemiology is warranted to establish the longitudinal causality between exposures and outcomes, and to track life-stage factors. The time period of two years was set from the findings of previous literature that around 80% of people are expected to use dental services over two years (Slade et al. 2004). In addition, measurable changes in oral health outcomes are also expected to appear over such two-year periods. The outcome measures were of a broad spectrum ranging from clinical dental outcomes to OHRQoL and general health status. The focus of the outcome was on self-reported health status as this reflects the perspective of the participants rather than a normative professional view. The research design and approach were practical and feasible as was based on standard measures that have already been used extensively in the previous literature of similar contexts.

Sampling procedure

The sample for this research was drawn at random from the Electoral Roll by the Australian Electoral Commission, a comprehensive sampling frame for the age group as voting is compulsory in Australia. This frame was applied to identify the contact details of the sample for mailing survey questionnaires. Sample size calculations were performed (Dupont and Plummer 1990) with significance level $\alpha=0.05$ and 80% power using estimates of oral health outcomes from the National Survey of Adult Oral Health (NSAOH) in Australia. Based on the findings from NSAOH, the highest number per group required would be n=200 to detect a statistically significant change in OHRQoL. Sample responses by key study groups were estimated using data from the latest NSAOH report (Slade et al. 2004). The estimate showed that 3,000 responses at the end of the two-year follow-up should give numbers of initial

sampling size assuming 90% of contactable samples, 60% of response rate, and 80% of retention rate for the follow-up each year. A key consideration in the sample was obtaining sufficient numbers of Health Care Card holders after the two-year follow-up to compare participants seeking private care with those serviced from pubic care. Also collecting data from sufficient numbers of non-card holders attending private care was targeted in order to be disaggregated by measures of SEP.

Data collection and preparation

Data were collected in mailed self-complete questionnaires from a random sample of adults drawn from the Electoral Roll, using the Total Design Method (Dillman 1978). A primary approach letter was followed by the mailing of the survey questionnaires, with optional reminder cards, and multiple follow-ups with replacement materials to non-respondents to encourage response rates. For the data preparation, responses were input into a computer to convert as ASCII files and manually checked for integrity. Confidentiality of responses was secured through storing names and address details linked with subject identifiers separately from the questionnaire data. All computer files are being maintained on password-protected computers and only available to the authorised investigators.

Variables collected and analysed

The main outcome variables consisted of oral health outcomes including self-rated oral health status, OHRQoL and health state utility. More specifically, oral health outcomes were measured using global self-ratings of oral health, self-reported number of teeth, OHRQoL, and health state utility values. Global self-ratings of oral health primarily reflect functional limitations (Locker et al. 2005) and have a unique role in people's perceptions of their global oral health that is not fully perceived in self-rated general health (Benyamini et al. 2004).

Tooth loss was recorded using a self-reported number of teeth. Previous studies have supported the validity of self-reported tooth numbers (Douglass et al. 1991) as well as the self-reported incidence of tooth loss over two years (Gilbert et al. 2002). OHRQoL was measured using one of the widely used multi-item psychometric scales, the Oral Health Impact Profile (OHIP) with 14 items (Slade 1997). The OHIP is a disease-specific measure of people's perceptions of the social impact from oral conditions on their well-being (Slade and Spencer 1994). The full-item OHIP contains 49 questions that capture seven conceptually formulated dimensions based on Locker's theoretical model of oral health (Locker 1988). OHIP-14, adopted in the study, was developed as a shortened version of the OHIP for better acceptability in clinical and research settings (Slade 1997). Health state utility values were assessed using the EuroQol instrument. The EuroQol was developed as a standardised generic–non-disease specific–instrument for describing and valuing health-related quality of life (Brooks and Group 1996). The EuroQol was devised to complement other forms of quality of life measures and developed to produce a generic index of health. The EuroQol has been commonly used across different contexts and demonstrated adequate levels of construct validity and reliability (Bowling 1995).

The main explanatory variables comprised the use of dental services, psychosocial factors, and characteristics of participants including SEP. The use of dental services was assessed using a range of different measures mainly with dental visit patterns. Dental visit patterns were quantified using measures of time since the last dental visit, number of dental visits made in the last year, reason and place of the last dental visit. These dental visit items have been consistently employed as national benchmarks in the National Dental Telephone Interview Survey (Slade et al. 2004).

Psychosocial variables were evaluated in two segments: general psychosocial factors and dentist-patient relationships. General psychosocial factors included life satisfaction, social

support, work-family stress, health self-efficacy, psychological stress, personality traits, and orientation to life. Life satisfaction was measured using the Satisfaction with Life Scale, which comprises five items reflecting subjective global life satisfaction as a single factor (Diener et al. 1985). Social support was assessed using the Multidimensional Scale of Perceived Social Support with 12 items loaded on three factors of family, friends, and significant other (Dahlem et al. 1991). Work-family stress was quantified using eight items of Work Family Conflict scale, which focuses on mutual stress induced and influenced each other. Health self-efficacy was assessed using the Perceived Health Competence Scale, combining outcome and behavioural expectancies from eight items including four reverse-coded items (Smith et al. 1995). Psychological stress was measured using both Perceived Stress Scale (PSS-14) (Cohen et al. 1983) and Kessler psychological Distress scale (K10) (Kessler and Mroczek 1994). PSS-14 was developed to measure global stress by asking respondents if they feel unpredictable, uncontrollable, or overloaded in life during the past year. K10 consists of 10 questions on the level of non-specific anxiety and depressive symptoms during the past four weeks. Personality traits were identified by the Ten-Item Personality Inventory, a brief measure for the time-limited occasions with the basis on the Five-Factor Model (Gosling et al. 2003). Orientation to life was assessed using the Sense of Coherence scale with three items for the components of comprehensibility, manageability, and meaningfulness (Antonovsky 1993). Dentist-patient relationships were represented by trust in dentists, satisfaction with dental care, and dental fear. Trust in dentists was assessed using the Dentist Trust Scale (DTS) validated as a single factor structure with 11 items including three reverse-coded items (Armfield et al. 2017). The Dental Care Satisfaction scale (DCS) was used to measure satisfaction with care received at the last dental visit, a short form of nine items including four reversely coded out of 31-item full scale (Stewart and Spencer 2005). The scale of Dental Satisfaction Questionnaire has been employed in the

national oral health surveys in Australia as either the full 31 items of four dimensions (Australian Institute of Health and Welfare 2016) or short version of the current format (Slade et al. 2004). Dental fear was rated by asking a single question if they feel afraid when going to the dentist, which has been consistently administered in national-level surveys in Australia (Armfield et al. 2009).

A large assortment of sample characteristics was collected mainly for demographics and SEP such as income, education, household size, and occupation. In particular, three levels of SEP measures were introduced: individual, household, and community level. At an individual level, the four-item short version of Wright's empirical class typology was used to define a social class (Krieger et al. 1997; Oakes and Rossi 2003). This measure classifies individuals by conceptualising class as a social relationship. The classification is based on the ownership of capital assets, control of organizational assets, and possession of skills or credentials. Education was recorded as the highest credentials completed from regular education courses/programs. At a household level, income was measured in both nominal annual household income and equivalised family income that takes account of the household's size. Household social class was measured on occupation and operationalised in two ways: self-reported occupational class position and jointly stratifying the individual level class position of the relevant heads of household (Krieger et al. 1999). At a community level, SEP was assessed using The Index of Relative Socio-Economic Advantage/Disadvantage, a Socio-Economic Index for Areas based on geographic area classifications developed by the Australian Bureau of Statistics (Australian Bureau of Statistics 2006). The index indicates an average socioeconomic status of all residents living in a certain area as a demographic characteristic.

Ethical approval and funding

Ethics approval for this research was granted by the Human Research Ethics Committee of the University of Adelaide (H-288-2011). All procedures in the study were performed in accordance with the Helsinki declaration for ethical standards. By the nature of the study design, informed consent was implied if participants completed and returned the questionnaires mailed to them. The research was funded by a National Health and Medical Research Council CRE grant (1031310). This funding source had no role in the design of the study, execution, analyses, interpretation of the data from this research.

Analyses for empirical studies

The empirical study 1 was to investigate the general association between DPR variables and oral health outcomes after adjusting for putative confounders. The outcome variable was the OHIP-14 to assess OHRQoL. Explanatory variables included trust in dentists, satisfaction with dental care, and dental fear collectively representing DPR attributes. Other covariates were included to control for potential confounding in four blocks of variables: oral health behaviours, dental services, demographic, and socioeconomic status (SES). Due to the non-normal distribution of the summed OHIP-14 score with a floor effect, non-parametric tests and/or a square-root transformation (Hassel et al. 2010; Roberts 2008) was employed when the outcome variable was modelled. In advance of testing the hypothesis, descriptive statistics and bivariate correlation analyses were performed. Finally, the research question was attempted by conducting multivariable linear regression in different models of variable entry. Variables were entered progressively into the model in five individual block entry steps (DPR and four confounding variable blocks), two clustered block entry steps (dental/oral health cluster and demographic/SES cluster), and a full model, to compare changes of regression coefficients and variance explained.

The empirical study 2 was to carry out the structural validation of trust and satisfaction in dental contexts with the focus on the revision of both psychometric scales for future application. Data analysed in the study were from all items collected in DTS and DCS. Both DTS and DCS consist of multiple items rated on a 5-point Likert scale (1=strongly disagree to 5=strongly agree). Negatively worded items were included in both scales to prevent acquiescence bias (Van Sonderen et al. 2013). The collected data were prepared for statistical analyses in the procedure of data cleaning/screening. The study was performed in two stages of statistical analyses for the factor structure with half-split random samples, so-called

exploratory and confirmatory procedures (Gerbing and Hamilton 1996). First, an exploration of the factor solution was sought with subsample A using exploratory factor analysis and cluster analysis. Next, confirmatory factor analysis was implemented with the other half subsample B to re-check the results from the 'precursor' (Gerbing and Hamilton 1996). Lastly, the final model from subsample B was applied to subsample A to assess the stability of the model with structural invariance through cross-validation (Gregorich 2006).

The empirical study 3 was to assess and modify the conceptual model of OHRQoL predicted from psychosocial factors and DPR variables with direct and indirect effects. The initial conceptual model was drawn with three domains comprising hypothetical associations of paths delineated in the diagram as straight arrow lines with positive/negative signs. All the variables in the analyses were from multi-item psychometric scales except for a single item of global rating for dental fear. The outcome variable was assessed using OHIP-14 representing OHRQoL. The psychosocial domain included psychological well-being, social support, and health self-efficacy – quantified using the Satisfaction with Life Scale, the Multidimensional Scale of Perceived Social Support, and the Perceived Health Competence Scale, respectively. The DPR domain selected the same variables used in empirical study 1: trust in dentists, satisfaction with dental care, and dental fear. The two-step approach in structural equation modelling was employed to develop/revise the conceptual model (Anderson and Gerbing 1988). Firstly, confirmatory factor analyses (CFA) were performed on each domain in subsample A to test the validity of measurement models. Following the result of CFA, the structural model hypothesised was tested for the final causal model. In addition to the two steps, the final model from subsample A was subjected to further invariance tests of cross-validation with subsample B and multi-group analyses across different groups with participants' characteristics (SES and dental service variables) relevant to OHRQoL.

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Chapter 4: Mapping review

Statement of Authorship

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Principal Author

Name of Principal Author (Candidate)	Youngha Song		
Contribution to the Paper	Initial conceptualisation, data collection/preparation and analysis, writing and critically revising the manuscript, performing the duty as corresponding author		
Overall percentage (%)	85%		
Certification:	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.		
Signature		Date	24 Jun 2020

Co-Author Contributions

By signing the Statement of Authorship, each author certifies that:

i. the candidate's stated contribution to the publication is accurate (as detailed above);
ii. permission is granted for the candidate in include the publication in the thesis; and
iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

Name of Co-Author	Liana Luzzi		
Contribution to the Paper	Supervised the development of the methodology and critically reviewed/revised the draft manuscript		
Signature		Date	01/07/20

Name of Co-Author	David Brennan		
Contribution to the Paper	Supervised the development of the methodology, contributed to the interpretation of the results, and critically reviewed/revised the draft manuscript		
Signature		Date	10 July 2020

Please cut and paste additional co-author panels here as required.

Linkage to the body of work

Trust is one of the essential and representative values in dentist-patient relationships along with communication. This mapping review introduces to the construct of trust a range of relevant concepts and sub-concepts found through a pragmatic scoping strategy. Even though this article aimed at a construct of trust in dental contexts, the findings are also applicable to a wider scope of dentist-patient relationships beyond trust as a dimension of it. Most of the keywords and subject matters are shared and mutually supplemented between this paper for trust and the literature review in the thesis. Moreover, replacing ‘trust’ in the system maps with ‘dentist-patient relationships’ not only fits in the implication of the findings but also enables its applicability to more expansive and inclusive contexts. Therefore this article can guide the overview of relevant concepts in dentist-patient relationships through the specific lens of trust.

Highlights

- This mapping review explored concepts relevant to trust in dentist-patient relationships and illustrated their interactions in visual guide maps for a better understanding of inherent complexity.
- Three frameworks for the mapping review were found: the continuum of studying trust (utilisation, measurement, and establishment); beneficiaries of trust utilisation (patients, dentists, and oral health system); and a transformational model of trust development (identification-based, knowledge-based, and deterrence/calculus-based trust).
- The lack of empirical evidence for trust in dentist-patient relationships needs to be assessed in a multidisciplinary approach with the foci of patient-centred care and quality of care.

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Review article

Trust in dentist-patient relationships: mapping the relevant concepts

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Trust has a central role in healthcare encounters. This review explored concepts relevant to trust in dentist-patient relationships. The findings were demonstrated by drawing visual system maps for better understanding of the inherent complexity. A pragmatic approach was employed to search for evidence. The approach was initiated with a systematised searching protocol and followed by an iterative process of drawing maps and complementing references. The analysis-synthesis process found relevant key concepts and sub-concepts presented within three frameworks: the continuum of studying trust (utilisation, measurement, and establishment); beneficiaries of trust utilisation (patients, dentists, and oral health system); and a transformational model of trust development (identification-based, knowledge-based, and deterrence/calculus-based trust). Trust in dentist-patient relationships needs to be assessed in a multidisciplinary approach for interconnectedness among relevant concepts. The findings are represented in patient-centred care and quality of care with common underlying values. Despite the centrality of trust in medical/dental contexts, empirical evidence is insufficient beyond normative suggestions from previous studies. Based on the implications of thematic analysis and interpretation of the system maps, this paper can serve as a guide and source of information for further research of trust in dentist-patient relationships.

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Key words: dentist-patient relations; interpersonal relations; patient-centered care; quality of health care; trust

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Some public health interventions are contested due to conflicting values (1, 2). For example, although most Australian parents (93%) prefer the uptake of all recommended childhood vaccinations, there still remains a small yet not negligible proportion that oppose it (3). Considering 'herd immunity' to protect the community by vaccinations, this opposition can pose a potential risk in public health (3). Water fluoridation has also been challenged in some regional areas despite over 70 yr of its effective implementation and a body of evidence for it reducing dental caries (4). Among diverse reasons for the concerns, the lack of trust in healthcare seems to be one of the central factors (5). Not only are public healthcare schemes facing issues of mistrust, but clinical encounters are also experiencing similar problems. For example, the loss of trust in clinical settings is demonstrated by criminal assaults to physicians by patients discontented with health practices (medical violence) (6) and an increasing incidence of complaints and medical liability claims in Australia, the UK and the USA (7).

The physician-patient relationship remains a key component of healthcare in spite of sweeping developments in medical systems and techniques (8). Throughout historical changes in models of the physician-patient relationship and their ethical implications (9), trust in medical encounters has been acknowledged for its central role (10). A common concept of defining interpersonal trust in healthcare is 'the acceptance of a vulnerable situation in which the truster believes that the trustee will act in the truster's best interests' (10). Trust can contribute to balancing 'market forces' which may compromise the integrity of physician-patient relationships (10) and enabling medical uncertainty to be settled in more consensus-based decision making (11). As a health discipline and profession, dentistry is also primarily embodied in dentist-patient relationships (DPR) and trust is a core value in the encounter (12). In addition, considering patients' relatively high 'vulnerability' in dental settings such as dental fear and anxiety (13), trust should be taken as indispensable in dentist-patient relationships. However, trust has not been studied sufficiently but suggested mainly as a normative imperative in medical contexts (14, 15), let alone dentistry (16). Even in bioethics, one of the most closely associated disciplines for the values in the physician-patient relationship, trust has not been adequately investigated compared with other ethical values (6, 17). There are gaps in research between theories and pragmatic impacts (18, 19) as well as a need to integrate fragmented study findings about trust in dentist-patient relationships.

The first aim of the review was to explore concepts relevant to trust in dentist-patient relationships in a comprehensive manner. The second aim was to illustrate relationships among the concepts in visual guide maps, using the findings from the search. To date, the centrality of trust in human relationships has been applied to medical/dental settings by partially borrowing the rationale and approaches from generic contexts. Moreover, even in the healthcare-specific understanding of trust, associations among relevant findings and suggestions have rarely been organised or structured. Thus, this review was aimed at *extensive* coverage of trust in dentist-patient relationships with a focus on *relevancy* rather than an in-depth analysis to 'answer' a single research question.

Material and methods

In order to achieve the first aim of the review, a pragmatic approach was employed to collate evidence from the literature search. The process of this review was conducted in three phases. An initial literature search with a systematised searching protocol was performed to build a foundation of the map. Details of the initial systematised searching strategy including search terms and inclusion/exclusion criteria are available in Appendix S1. Next, with the findings from the initial search as key concepts, system maps were constructed to present a macrostructure for a conceptual model. Finally, the structural deficiency of a lack of evidence in the map was spotted from disconnected/isolated concepts and complemented by a supplementary search. The complementation was carried out by purposive and targeted searches in so-called 'pearl growing' methods with 'citation chaining' and hand searching in proximate journals. More importantly, the phases were repeated in a productive iteration between drawing a map and searching the literature for additional evidence. Over the course of the process, a thematic analysis to extract concepts and sub-concepts was performed, analogous to that used in qualitative research methods. The extracted units from the thematic analysis were typologized into different levels/categories according to themes/patterns analysed through coding the relationship searched. The iterative analysis-synthesis process was ceased when no new relevant sub-concepts were discovered, indicating saturation of the search was achieved.

For the second aim of the review, the rationale of drawing system maps is supported by the complexity of studying the latent concept of 'trust' comprehensively. Regarding the research topic of trust as a construct, related subject matters with the diverse scope are so mutually interwoven that it is difficult to disentangle the interconnectedness with narrative descriptions (20). For this type of issue, online interactive system maps have been used to organise and visualise components of the structure in an effective way (21–23). Thus, this paper adopted the approach of drawing a system map to 'depict' the interplay and relationships of the concepts at a glance.

With regard to the research methods used in this review, concerns may be raised regarding contexts and subjects. First, there is the absence of specific contexts in the topic: such as trust in dentist-patient relationships for the *elderly* population; on *parents'* decision making for *child* dental patients; or in the *Australian* dental system. However, the analysis beyond contexts can be justified by an insufficient amount of evidence about certain contexts and the loss of trust in healthcare as a potentially global issue (6). Another concern is the consistency of research subjects and terminology. Although dental settings were given priority in the article, contiguous or more extensive terms for the extrapolation from medicine or general healthcare were applied as necessary. For example, when dental contexts were unavailable due to the limited extent of the literature or a collective perspective applied better, we extrapolated to 'medical/physicians' or more inclusively substituted the term 'healthcare/clinicians' for 'dental/dentists' to represent the *context/profession*. Lastly, the referring order of the profession and patients in the review has no underlying connotation for importance or domination in the relationship.

Results

Throughout the review, three frameworks were found and established: a continuum of studying trust in dentist-patient relationships, beneficiaries of trust utilisation, and a transformational model of trust development. The continuum consisted of the utilisation, measurement, and establishment of trust in dentist-patient relationships, which represented the respective review questions: What benefits are expected from the established trust; how can the construct of trust be captured; and what is needed to become trustworthy in dentist-patient relationships? The second framework was about beneficiaries' perspectives on the utilisation of trust. Three parties were identified, two inherent participants in dentist-patient relationships: patients and dentists, while the third was the oral health system. Finally, types of trust in a developmental hierarchy were integrated into the framework. Instead of the traditional uni-/two-dimensional psychological model of trust (20), the transformation between three bases of trust was adopted in this article for the discrimination of different types of trust by their nature. The core concepts of the three bases are briefly summarised as (20, 24): Identification-based trust (IBT, identifying each other's preferences and interests with a mutual understanding); knowledge-based trust (KBT, knowing the counterpart sufficiently to predict his/her behaviour in the relationship); and deterrence/calculus-based trust (DBT, calculating the potential costs of maintaining and discontinuing the relationship).

Figs. 1 and 2 represent collective findings of the review as a schematic diagram for the utilisation and establishment of trust. Detailed references for the components of system maps are available in Appendix S3. Main components in the map are key concepts encircled with different colours and sub-concepts placed close to relevant key concepts. They are drawn as concentrated core themes and their affiliated topics from the thematic analysis. Two precautions about the interpretation of the map should be noted. Firstly, arrows in the map do not necessarily signify causal pathways from the origin to the end as a vector. Rather the

connectors are to link both ends as general associations from the search findings. Next, the division of key concepts by colour coding is not for the exclusive classification into each label. For example, better health outcomes as a patients' benefit should be inherently engaged as one of a clinician's practice goals as well. They are placed ranging across labels on purpose to represent their transitional and overlapping nature. The gradual changes of the colour in the indicator bars should be understood in that regard.

Results are also presented in a descriptive narrative to aid the clarification of system maps. However, the explanation is only for the introduction of relevant concepts and sub-concepts with mutual relationships, not the provision of in-depth information about them. Thus, the description of concepts is grouped and weighted at the discretion of the authors' understanding about their relevance and significance. In order to provide an organised form of findings, summaries of key concepts are tabulated in Table S1 and S2. Simplified system maps with key concepts for educational and clinical applications are also provided in Appendix S2.

Utilisation of trust in dentist-patient relationships

Patients

Better health outcomes have been predominantly targeted as the benefit from the improvement of trust in healthcare relationships (25). A meta-analysis of empirical studies indicates that better subjective health outcomes are more highly associated with greater trust in the clinician than objectively-rated results are (26). In a similar context, health-related quality of life – a perceived health outcome – displays a positive correlation with trust in clinicians from studies on both diabetic (27) and dental patients (28). To provide more dental contexts, dental anxiety/fear is one of the determinants in the receipt of timely, preventive dental services through the 'vicious cycle' – the cyclically aggravating routine among dental fear, avoidance and unmet dental needs, and problem-oriented dental visits (29). Considering patients' vulnerability to dentists for potentially invasive dental practices, patients can benefit from trusting their dentists to achieve better oral health outcomes by increased adherence to clinical treatments/advice (10) and improved self-efficacy for the management of oral health (25).

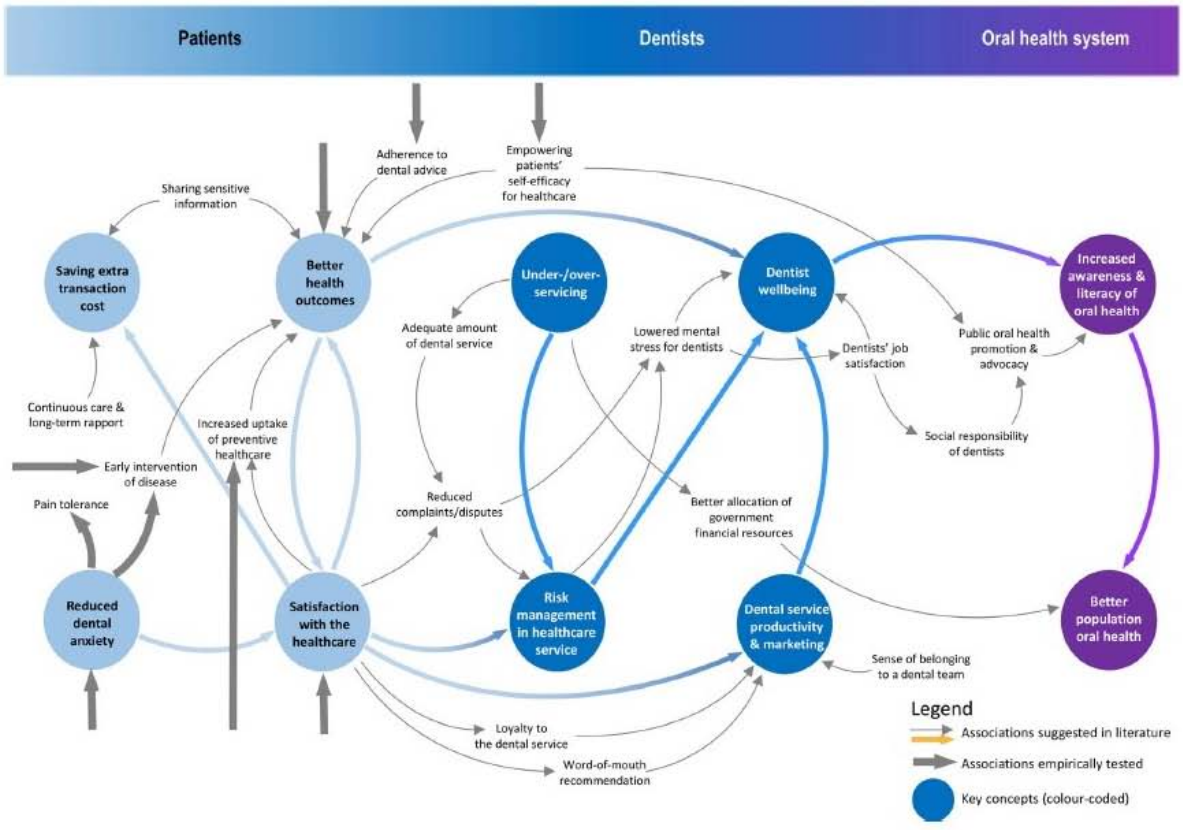

Fig. 1. System map for the utilisation of trust in dentist-patient relationships. Colour-coded bars indicate the label of subjects in each segment, classifying key concepts to the most relevant categories. Connectors with an arrow link each component in uni-/bi-/multi-direction(s)–three types of lines: plain for general associations; coloured for relationships between key concepts; and dark bold as associations supported by empirical evidence from the literature search. The subtraction sign implies negative valence in mutual effects and the starting point omitted in the straight dark bold arrows is from 'trust' in dentist-patient relationships as a whole.

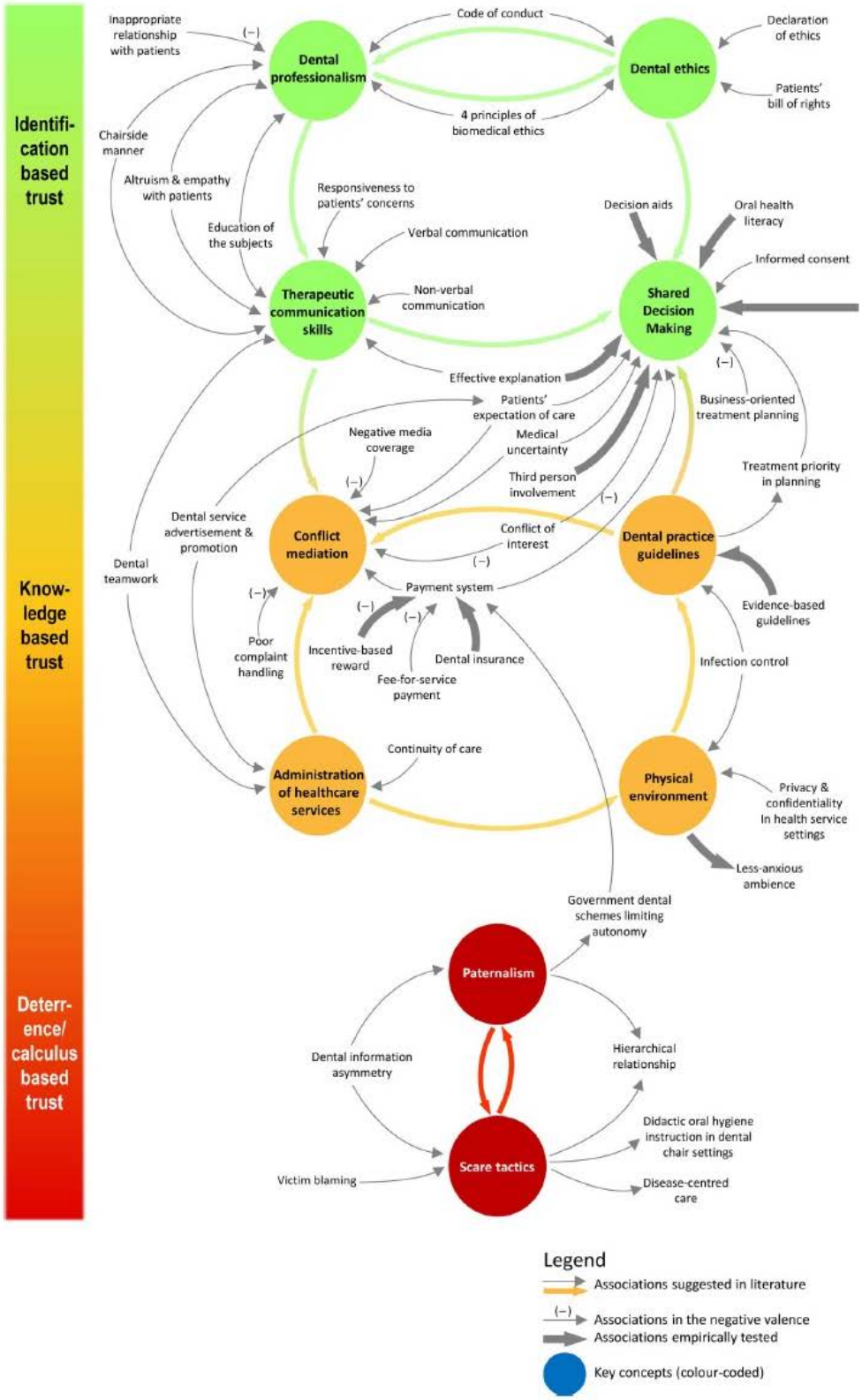

Fig. 2. System map for the establishment of trust in dentist-patient relationships. The same caption as for the system map of the utilisation applies to this.

The improved trust between business counterparts can reduce transaction costs (30). In general, transaction costs are referred to as the costs for actors in a relationship to pay for conducting exchanges 'fair and square' in a transaction (30). If this concept applies to healthcare contexts, trust in dentist-patient relationships can save two major transaction costs: saving extra costs to seek second opinions or new practitioners (31), and costs of sharing health-related information (10). An example of the latter is patients' voluntary disclosure of sensitive health information about themselves for better clinical decision making. The reduction of transaction costs can be contributed to by patients' satisfaction with healthcare service, which is empirically proven to be associated with trust in their clinicians (26, 27, 31). Although conceptual differences between satisfaction with care and trust in healthcare relationships are proposed - satisfaction is predicated on past experiences whereas trust refers to future expectations (10, 31) - the causality of each has yet to be confirmed (26). Taking those cause-effect pathways off the map, satisfaction positively associated with trust in clinicians is also likely to be correlated with more uptake of preventive healthcare services (32) for the improvement of health outcomes.

Dentists

Over-servicing in healthcare – unwarranted medical services providing no good or even harm – is prevalent across the world (33). Among factors driving over-diagnosis/treatment, the main motives are suggested as being two-fold from the healthcare providers' perspective: economic inducement by over-servicing and potential risks of disputes with patients (34). In particular, the latter is termed 'defensive medicine' which refers to '(the) medical practices based on fear of legal liability rather than on patients' best interests' (7). Based on the etymology, not only over-servicing (positive form) but the opposite pattern of practice, under-servicing (negative form of defensive medicine) on 'risky' patients is possible (7) and also observed (35). Moreover, if focus is on disputes from defensive medicine, risk management in healthcare service appears as a proximate concept. Given the 'risk' as an inherent by-product in healthcare (36) and the direct/indirect effects of conflicts on the quality of care (7), trust in clinician-patient relationships is categorically advised (37) along with public policy reforms such as remuneration systems (34) and medical litigation (7).

The benefit of trustful relationships with patients has been understudied from the perspective of clinicians' wellbeing (38) and practice marketing (39). Trust in dentist-patient relationships can encourage dentists to achieve higher job satisfaction and suffer less mental stress from the relationship, which may develop to the point of regarding their occupation as a 'calling' rather than a job (38). In addition, better relationships in healthcare encounters tend to engender patients' satisfaction of perceived care, which can lead to loyalty for a long-term rapport with the clinician and continuity of care. The loyalty established can increase patient retention (39) and recommendations of the service (31) to a local community for the practitioners' advantage in service marketing.

Oral health system

In contrast to patients and dentists, the advantage of trust in dentist-patient relationships for the oral health system was less reported owing to the nature of the topic – trust in *interpersonal* relationships, rather than in the *institutional system*. Despite different levels of trust –interpersonal vs. institutional (14) – the public health system should draw on trust in clinicians for two reasons: benefits flowing from the interpersonal trust and the role of interpersonal trust as a representation of trust in the healthcare system (5, 40). The first is the expectations that patients and clinicians in trustful relationships would contribute to better public health by supporting health promotion and advocacy activities for public health awareness and literacy (41). For example, public oral health can be improved through patients' self-efficacy and clinicians' social responsibility (42) derived from trust in dentist-patient relationships. The latter is the role of 'facework' (established in circumstances of co-presence) to 'faceless' (faith in symbolic tokens or expert systems) trust (40). This relevance is based on the premise that institutional trust is to be preceded/predetermined by the interpersonal trust as represented in the actual healthcare encounters (access points) (19).

Measurement of trust in dentist-patient relationships

Even though the measurement of the construct is central to understanding trust in dentist-patient relationships, it is not drawn in the system map but only indicated as a colour-coded vertical bar with three bases of trust (Fig. 2). This is because of the single factor structure (16) and abstract characteristics of domains in the trust measuring scale: Fidelity, honesty, confidentiality, competence, and global trust (31). The measurement of trust faces two psychometric properties concurrently: the multidimensionality comprising trustworthiness for the trust scale (14) and a single convergent construct as a global trust (10). For example, a trust measuring scale is composed of multiple items representing diverse domains but a collective total score indicates the level of trust that is indistinguishable between the domains (16).

Regarding the type of trust in interpersonal relationships, a framework of the hierarchy is offered in a transformational model (24). The model views interpersonal trust as a changeable construct over time that involves development of the relationship, not a static trait (20). The strength of bonding and motives of linking both parties in the relationship develop from a lower base of trust into higher bases (43). In general, however, the concept of transformation in trust is found rarely from the literature in healthcare contexts, let alone the subfield of measuring trust. Thus, it is represented in the map based on the theoretical

understanding without much illustrative detail due to the lack of empirical evidence.

Establishment of trust in dentist-patient relationships

Identification-based trust

Professionalism is generically recognised as a set of attributes which a profession should have (44). In a healthcare context, it implies ethical and competent practices for patients' best interests (45). By its implicative attributes, healthcare professionalism is closely associated with bioethics. Given the centrality of trust in clinician-patient relationships, it is reasonable to find that many of the underlying themes and values are similar between healthcare professionalism, bioethics, and trust measurement. For example, the domains of the trust measurement scale aforementioned (31) are commonly shared with the principles of medical professionalism (patient welfare, autonomy, justice, competence, honesty and confidentiality (45)) and values in bioethics (autonomy, beneficence, non-maleficence, and justice (46)). Considering the change of professionalism (from the 'nostalgic professionalism'(47)) based on the context of the social contract between society and healthcare professions, reforms in health education (48) and guidance of commitments (45) for engendering trust are suggested. Lessons from costly damages by patients' mistrust have also prompted practical recommendations (49) conducive to the restoration of trust in healthcare contexts. Examples of the recommendations are the declaration of patient bill of rights (50), ethics committees in medical societies, and guidance for ethical practices (49).

Therapeutic communication skills are considered to be critical for patient-centred care (25) and the most supportive means of establishing trust in clinician-patient relationships (38). For example, a study conducted on fearful dental patients shows that communication is more likely correlated with trust in dentist-patient relationships than ethics and control of the situation are (51). Communication in healthcare encompasses a vast array of components across the framework (38). It covers the exchange of health information, proper use of verbal/non-verbal communication skills, managing medical uncertainty with informed decisions, and helping decision making with an effective consultation (25). In particular, decision making in medical/dental encounters is intrinsically integrated into therapeutic communication skills. Trust in the relationship appears to play a central role (52) in the linear scale of preference and control (53) over healthcare decision making. Among other models, shared decision making has been advocated for patient-centred care over the traditional paternalistic or authoritative models (54). Over the whole process of decision making, trust in the relationship is closely associated with shared decision making (55) whether as a promoter (52) or an outcome (56).

Knowledge-based trust

Conflict management is connected to risk management in healthcare services, as presented above. The precept from mistrust in clinicians (6) sheds light on the revision of payment systems in healthcare (as an instigator) and resolution systems to manage conflicts (as a mediator). The conflict of interest between patients' wellbeing and incentive-based reward induces a majority of medical disputes and restriction of autonomy in both patients and clinicians (57). To address this issue, public policy is urged to change towards rebuilding trust in clinician-patient relationships by reforms of legal (7), administrative (58), and financial systems in healthcare (34). To establish justified treatment planning and standards of 'reasonable care' in medical disputes (7), consensus on clinical practice guidelines and protocols is also essential. With the importance of evidence-based practices for quality of care, there is a body of guidelines available even for the scope of restorative dentistry (for example of dental caries only: The International Caries Detection and Assessment System (59), Caries Management by Risk Assessment (60), and caries risk management protocols (61)). Hence, beyond the simple effort to delineate guidelines, more emphasis should be put on the dissemination and encouragement of them to assist clinicians' practical implementation (62).

Patients' trust in dentist-patient relationships is not solely dependent on their interaction with dentists (39, 63). Trust draws on every moment in the administration and workflow of healthcare, even before the start of actual dental practices and after the end of the service (63). In addition, privacy supported by trustful physical settings would contribute to the sense of confidentiality, one of important dimensions in trustworthiness (45). To secure patients' safety in healthcare (64) and engender less anxious/more emotionally stable ambience (65), the overall administrative operation and environmental design needs to be based on trust.

Deterrence/calculus-based trust

Representing a more primitive level of trust in dentist-patient relationships, paternalism and scare tactics in healthcare services are predicated on the 'biomedical model' as contrasted with the 'biopsychosocial model' of health (8). In terms of the transformational hierarchy of trust, they appear on a calculative and inequitable basis –'doctor knows best' policy (66). Among models in dentist-patient relationships, paternalism is deemed to be outdated (47) for its assumption that a dentist, as a *guardian*, promotes a patient's wellbeing irrespective of one's preferences (9). Moreover, in scare tactics, dentists sometimes take an active role of exploiting information asymmetry (67) by judging patients' behaviour and lifestyle about health issues –'victim blaming' (68), not looking at underlying socioeconomic determinants. As a result, this breaches the value of patient-centred care and shared decision making by embracing disease-centred care and hierarchical relationships between dentists and patients with a 'power' imbalance (66). Nevertheless, this could induce *involuntary* and *hegemonic* trust – 'no option but to trust' and 'unquestioning acceptance' (67) – regardless of how sustainable or salutary the trust may be.

Discussion

Thematic findings of the review

This article covers an extensive scope of trust in dentist-patient relationships, along with generic healthcare contexts. To support the rationale of trust, the literature searched suggested practical evidence of the benefit to which trust may contribute. This underpins the significance of trust in dentist-patient relationships with more persuasive justifications than as a normative moral value or ethical imperative (12). For the measurement of trust, relevant concepts are more aligned with psychometric properties for research purposes such as validity and reliability than practical implications to be drawn in the map. In addition, measurement of trust in healthcare contexts has not been sufficiently attempted due to epistemological and methodological difficulties (67). Finally, the trustworthiness required to build up trust is explored within the reflection of three transformational bases. Even though an extensive coverage of interventions and recommendations are placed on the maps with respective colour codes, the links to certain bases should be interpreted with care due to a lack of empirical evidence.

A multidisciplinary approach

There are three major thematic findings from the review: the necessity of a multidisciplinary approach, the integration into patient-centred care and quality of care, and a paucity of empirical evidence for trust in dentist-patient relationships. First, patients' trust in dentists is proved to range over an eclectic array of disciplines, including but not limited to: dental ethics and professionalism; education in dentistry curricula; clinical decision making; legal liability and conflict mediation in dental disputes; evidence-based practice and guidelines in dentistry; public health policy; health economic evaluation and financial resource management; psychology in clinical settings; administration of dental services; and environmental design. The need for a multidisciplinary perspective has already been acknowledged (20) and recommendations conducive to rebuilding physician-patient trust have been offered (49). Regarding the interconnectedness of relevant disciplines, the maps should have intertwined connectors among components but they are only represented with major links for the sake of parsimony and better visibility. In addition to the complexity of the maps, each component comprising the diagram does not carry the same weight of associations with trust in dentist-patient relationships, but appears in equal size and scale. For example, the code of conduct is not only limited to dental ethics and professionalism but also involved in many other sub-concepts in the map. Thus, it is advised to consider its far-reaching significance as compared with less connected sub-concepts such as physical environment to secure privacy. These limitations should be considered when interpreting the system maps.

Patient-centred care and quality of care

The most common underlying values found in the review for trust in dentist-patient relationships are patient-centred care and quality of care. In contrast to disease-centred care, patient-centred care puts an emphasis on 'patients' wants, needs and preferences' in healthcare (62). To shift the paradigm from tackling diseases to caring for patients, relationships between clinicians and patients should be focused, and trust would play a pivotal role in the action (67). As an overarching concept, quality of care – inseparable from patient-centredness – needs to incorporate trust in the relationship for its measurement and evaluation (10). In the assessment of healthcare quality, it is advised for acceptability –an important scale for lay views on quality – to adopt *trust* as a key indicator rather than *satisfaction* for its epistemological challenges (67).

A lack of empirical studies

One of the core findings in the review is an insufficient amount of empirical evidence about trust in dentist-patient relationships. Trust, as a latent value in a relationship, has been committed to from diverse disciplines of social science, but hitherto not illuminated as much as clinical expertise in healthcare (18). Thus, in spite of an entangled bundle of directional connectors in the maps, most of them are normative suggestions/associations with little evidence for causality from the references searched (see limited numbers of dark bold arrows indicating empirical evidence supported). Particularly looking at the establishment of trust, the number of bold arrows directly linked to trust as empirically proven associations is much fewer than those in the utilisation. It is triangulated by the indecisive result that a systematic review found from only three randomised controlled trials for interventions to improve patients' trust (69). Considering the levels of evidence for evidence-based practice (70), findings mainly derived from expert opinion may limit the rationale of trust in dentist-patient relationships compared with empirical evidence. In dental contexts, trust has yet to be studied in a comprehensive manner with only an initial attempt to measure trust in dentists as of late (16). Although dentistry must share common traits with the topic of trust in generic healthcare as a subordinate discipline, the distinction and comparison should also be explored for dental context-specific features.

Limitations of the review

There are some limitations to this review, mainly centring around two aspects: methodological weaknesses and missing topics on trust in dentist-patient relationships. Firstly, this review employs a pragmatic approach. Although the initial literature search was conducted with a systematised searching protocol, an *ad hoc* approach to relevant references by 'citation chaining' and hand searching may be neither as reproducible nor rigorous as a systematic review. Furthermore, evidence from the literature search is not strictly qualified by critical appraisal for the purpose of extensive coverage as a 'mapping' review. Therefore, this article should be used only as a schematic

guide map to identify associated concepts on trust in dentist-patient relationships, not to empirically test hypotheses.

Secondly, this paper misses a few relevant topics on trust in dentist-patient relationships by limiting the scope to *patients'* trust in dentists in a *naïve* way and *interpersonal* approach. Although trust is considered to be mutual and other participants are engaged in trust in dentist-patient relationships, such as dentists' trust in patients and other dental professionals/service staff (71), only *patients'* trust in dentist-patient relationships is focused on in the study. However, this priority of *patients'* perspective on trust is vindicated by the inherent dominance of 'power' to clinicians in clinical encounters (14, 71) (competency gap (8)) and the primary goal of healthcare regulations – to protect the public (72) and put patients' interests first (73). Another limit is a *naïve* way to view trust in dentist-patient relationships – simply for the establishment of trust from zero-base and only positive utilisation of trust as the absolute good. Trust in dentist-patient relationships is dynamic and complex, which means trust is not only to be built up but also maintained/reinforced (20) if established, restored/repaired (74) if broken, or negotiated on occasion (75). In addition, given the functional role of distrust – 'trust but verify' (14) – excessive trust is not necessarily good for the relationship. Rather, the healthy balance of trust and distrust should be pursued to prevent abuse or exploitation of trust (20). The other limiting scope is the *interpersonal* approach to trust. By selectively focusing on 'relations' only, the remaining attributes of trustworthiness (technical competency and agency (10)) and important determinants of trust (community, socioeconomic and cultural factors) are missing in the review. The missing territory of trust in dentist-patient relationships, by the prioritisation due to the limited space of the paper, should be charted in future studies.

Practical implications

Despite the limitations identified, this paper may contribute to scoping out trust in dentist-patient relationships with visual diagrams at a single view, and provide leads to conceive hypotheses for future research. Trust, as a normative value in modernity (40), encompasses an extensive range of relevant concepts with associations but the complexity has been compartmentalised and explicated in a narrative manner (19). Putting those findings together into thematic diagrams with associative links, the system maps about trust in dentist-patient relationships could guide the 'reconnaissance' of the terrain, which previous studies have probed fragmentally hitherto. By extension, future research about trust in dentist-patient relationships could make use of gaps and insufficiency of evidence in the system maps for research topics and hypotheses setting. This might help verify cause-effect pathways among concepts and reinforce the mapping structure with solid evidence for trust in dentist-patient relationships.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Table S1. Summary of key concepts for the utilisation of trust.
Table S2. Summary of key concepts for the establishment of trust.
Appendix S1. Initial literature search strategy.
Appendix S2. Simplified system maps.
Appendix S3. References for system maps.

Appendix Table S1. Summary of key concepts for the utilisation of trust in dentist-patient relationships

Label	Key concepts	Context	Benefits	Description	Main sub-concepts affiliated
Patients	Health outcomes	Predominant target as the benefit from trust in DPR	Improvement of health outcomes	Measurable benefit for the utilisation of trust in DPR In particular, subjectively reported health outcomes are more highly associated with trust in DPR	Adherence to dental treatments/advice Empowering patients' self-efficacy for healthcare
	Dental anxiety/fear	Avoidance/delay of dental care ('vicious cycle')	Relief/resolution of dental fear	Reduction of dental fear in favourable relationships with good communication skills and manner Enabling early interventions against oral diseases	Pain tolerance Early intervention of disease
	Transaction costs	For exchanges to be 'fair and square' in a transaction	Saving transaction costs in DPR	Lower extra costs to seek for second opinions or new practitioners Reduce costs of patients' information sharing	Continuous care & long-term rapport Sharing sensitive information
	Satisfaction with healthcare service	Satisfaction as a conventional indicator in quality of care	Positive association of satisfaction with trust in DPR	Contiguous concept to trust in DPR Satisfaction is predicated on past experiences, whereas trust is oriented to future expectations	Increased uptake of preventive healthcare Reduced complaints Loyalty to the dental service
Dentists	Under-/over-servicing	Economic inducement by over-servicing and potential risks of disputes with patients	Influential to all of three actors in healthcare: patients, clinicians, and the healthcare system	Restoration of trust and public policy reforms to avoid conflicts of interest in remuneration systems and compensation of medical litigation	Adequate amount of dental service Better allocation of financial resource
	Risk management in healthcare service	'Risk' as an inherent by-product in healthcare	The role of conflicts on the quality of care Beneficial to dentists' psychological stress considering the fragility in DPR	Trust to be pivotal to manage or control potential damage from the manifestation of the 'risk'	Lowered mental stress for dentists Reduced complaints/disputes
	Dentist wellbeing	Understudied from the perspective of dentists' wellbeing	Dentists' wellbeing as a benefit from trustful relationships with patients	Increase dentists' job satisfaction and reduce mental stress from the relationship	Dentists' job satisfaction Lowered mental stress for dentists
	Service marketing and productivity	Trust is one of the core values for outbound and internal marketing	Sustainable dental practice by increased productivity and trust induced marketing/promotion	Satisfaction from trust in DPR can lead to loyalty to the dental service and promotion as well as internal marketing	Loyalty to the dental service Word-of-mouth promotion Sense of belonging to a dental team
Oral health system	Awareness and literacy of oral health Population oral health	Only few reports of a benefit to the health system by the nature of the interpersonal trust	Contributions of interpersonal trust to better public health Interpersonal trust as a representation of institutional trust	Trust in DPR would lead to supports for health promotion and advocacy Trust in healthcare system can be predetermined by trust in DPR	Public oral health promotion and advocacy Better allocation of government financial resource

Appendix Table S2. Summary of key concepts for the establishment of trust in dentist-patient relationships

Label	Key concepts	Context	Rationale and suggestions	Description	Main sub-concepts affiliated
Identification-based trust	Dental professionalism	Ethical and competent practices for patients' best interests	Underlying values are in common between professionalism, bioethics and trust measurement	Reforms in health education and guidance of commitments for engendering trust are suggested	Code of conduct Chairside manner Altruism and empathy
	Dental ethics	Trust has been marginalised in global bioethics	Trust to be as vital as four central principles of bioethics	Practical recommendations conducive to trust in healthcare contexts are prompted	Principles of biomedical ethics Declaration of ethics Patients' bill of rights
	Therapeutic communication skills	Not systematically well-integrated in medical education curricula	Communication skills to be critical for patient-centred care and the most supportive means of establishing trust	Encompass a vast array of components across the framework not only in DPR but also in reciprocity among relevant participants	Verbal/non-verbal communication Responsiveness to patients' concerns Dental teamwork
	Decision making	Important translational process from planning optimal practices to health outcomes	Shared decision making to be advocated for patient-centred care	Trust to be integrated over the process for shared decision making–initial choice offers; supports for options; and informed preferences on a decision	Decision aids Oral health literacy Informed consent
Knowledge-based trust	Conflict mediation	The resolution of conflicts not performed well across the world	A matter of 'make or break' trust, connected to risk management	Changes of public policy in legal, administrative, and financial systems in healthcare	Conflict of interest Payment system Medical uncertainty
	Clinical practice guidelines	To transform generic medical/dental knowledge into patients' practical benefits	To justify/determine healthcare practices and guide the standard of 'reasonable care'	More emphasis should be put on the dissemination and encouragement of guidelines in clinical practices	Evidence-based guidelines Treatment priority in planning
	Administration of healthcare service	Trust directly/indirectly draws on every moment throughout healthcare service	The overall administrative operation needs to be based on trust	Ethics of marketing healthcare services, tackling sensationally negative coverage by mass media, and encouraging continuity of care	Continuity of care Dental service advertisement and promotion
	Physical environment	Patients' psychological status is affected by the physical environment	Privacy engendering physical setting contributes to confidentiality in trustworthiness	Infection control to prevent adverse events and display hygienic protocol Sensory adaptive dental environment for dental anxiety	Privacy and confidentiality in healthcare settings Less-anxious ambience
Deterrence/ calculus-based trust	Paternalism Scare tactics	Outdated for the role of a clinician as a guardian Exploiting information asymmetry	May induce involuntary and hegemonic trust	Predicated on the biomedical model and disease-centred care Appears on calculative and inequitable basis	Hierarchical relationship Dental information asymmetry Victim blaming

Appendix S1. Initial literature search strategy

Initial review question(s)

What are relevant concepts to trust in dentist-patient relationships (DPR)?

How are the relevant concepts related to trust in DPR and one another?

Database search strategy performed on MedLine via OvidSP (on 26/11/2018)

Order	Search terms	Results	Concepts
1	Trust.mp. or TRUST/	27294	
2	(mistrust$ or distrust$ or entrust$ or trust$).mp.	41806	
3	1 or 2	41806	Trust
4	Dentist-patient relationships.mp. or Dentist-Patient Relations/	8054	
5	Dentistry.mp or Dentistry/	80284	
6	Dental treatment.mp or Dental Care/	25012	
7	4 or 5 or 6	104293	Dental context
8	3 and 7	471	
9	Limit 8 to (English language and humans)	411	

Database searched

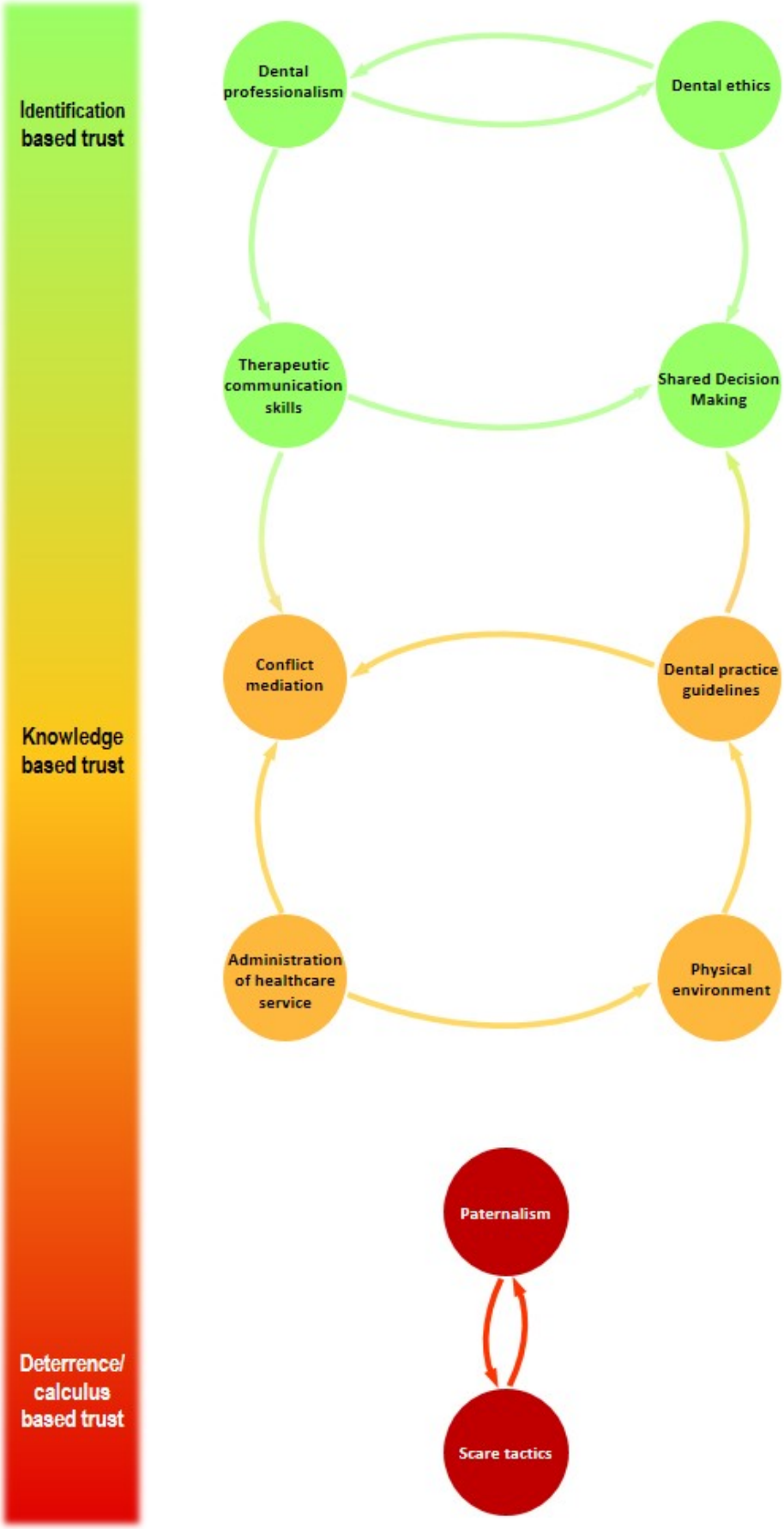
The systematic strategy for literature search was performed in OvidSP Medline for its extensive coverage of biomedical references and organised structure of subject headings in relevancy. As this paper is a mapping review for more inclusive coverage with relevant concepts to the topic, the initial structured search was intended to be a starting point for 'pearl growing'. From the initial search result, citation chaining and purposively targeted papers were pursued through further relevance-driven search. Hence a single database was accessed in the beginning and the rest was sought for by enlarging the literature pool following 'one-thing-leads-to-another' guidance.

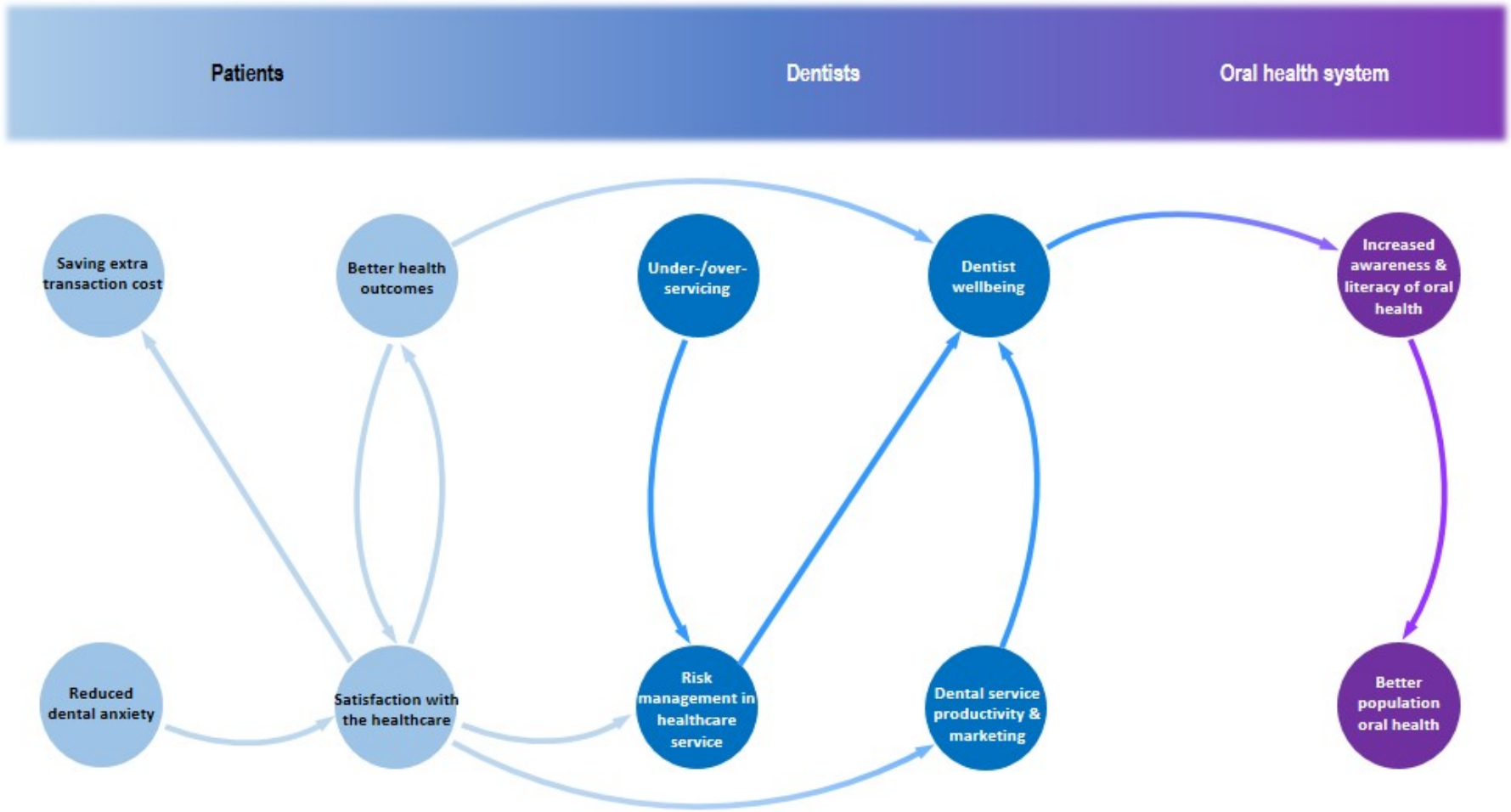
Inclusion/exclusion criteria

1. Inclusion: The articles dealing with patients' trust in dentists were included with priority. In addition, less context-specific literature was adopted at the discretion of pragmatic utility according to commonality (e.g. communication skills to improve trust in physician-patient relationships). Grey literature was also covered and selectively included in the paper so as to reflect as many relevant concepts as presented. Thus one of the inclusion criteria is how close the theme of the literature is towards trust in DPR rather than how rigorously or critically it is analysed for an argument.

2. Exclusion: The topic of trust in dentist-patient *relationship* excluded a different scope of trust in institution and/or system otherwise specified with interpersonal trust. As for a similar issue of categorical heterogeneity, less relevant subfields of bioethics were not included aside from medical ethics, clinical ethics or public health ethics (e.g. research ethics or animal ethics). Accessibility to literature set limits to English language publications and articles with full text available.

Appendix S2. Simplified system maps




Patients
Dentists
Oral health system
Saving extra transaction cost
Better health outcomes
Under-/over-servicing
Dentist wellbeing
Increased awareness & literacy of oral health
Reduced dental anxiety
Satisfaction with the healthcare
Risk management in healthcare service
Dental service productivity & marketing
Better population oral health

Chapter 5: Empirical study 1

Statement of Authorship

Statement of Authorship

Title of Paper	Dentist-patient relationships and oral health impact in Australian adults
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Principal Author

Name of Principal Author (Candidate)	Youngha Song		
Contribution to the Paper	Initial conceptualisation, data preparation and analysis, writing and critically revising the manuscript, performing the duty as corresponding author		
Overall percentage (%)	75%		
Certification:	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.		
Signature		Date	24 Jun 2020

Co-Author Contributions

By signing the Statement of Authorship, each author certifies that:

i. the candidate's stated contribution to the publication is accurate (as detailed above);
ii. permission is granted for the candidate in include the publication in the thesis; and
iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

Name of Co-Author	Liana Luzzi		
Contribution to the Paper	Supervised the development of the methodology and critically reviewed/revised the draft manuscript		
Signature		Date	01/07/2020

Name of Co-Author	Sergio Chrisopoulos		
Contribution to the Paper	Contributed to the interpretation of the results and critically reviewed/revised the draft manuscript		
Signature		Date	29/06/2020

Name of Co-Author	David Brennan		
Contribution to the Paper	Supervised the development of the methodology, contributed to the interpretation of the results, and critically reviewed/revised the draft manuscript		
Signature		Date	10 July 2020

Please cut and paste additional co-author panels here as required.

Linkage to the body of work

This first empirical study tested the hypothesis that better dentist-patient relationship (DPR) variables are associated with higher oral health-related quality of life (OHRQoL). The main finding of the study – favourable DPR variables are associated with better OHRQoL – provides a justified premise for further analyses of the thesis topic. Moreover, by including diverse covariates associated with oral health outcomes in individual and clustered block entry, the comparison of each predictor was enabled and subsequent research questions were answered. For this reason, this paper establishes the groundwork of further empirical studies by confirming the adjusted positive association between DPR and OHRQoL, as hypothesised in the general aim of the thesis.

Highlights

- The study found that favourable DPR variables, mainly higher satisfaction and less dental fear were positively associated with better OHRQoL independently from the presence of potential confounders.
- Trust in DPR showed inconsistent associations with OHRQoL according to different entries in the model, provided two hypothetical explanations: conceptual postulation of trust on health outcomes and mediation effects of trust.
- Further studies are warranted to investigate the mechanism of the causality and mediation/moderation of DPR variables on oral health outcomes.

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ORIGINAL ARTICLE

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Dentist-patient relationships and oral health impact in Australian adults

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Abstract

Objectives: Dentist-patient relationships (DPRs) are a key component in clinical encounters with potential benefits for oral health outcomes. This study aimed to investigate whether better DPR variables are associated with higher oral health-related quality of life (OHRQoL).

Methods: A total of 12 245 adults aged 18 years or over were randomly sampled from South Australia in 2015-2016. Data were collected from self-complete questionnaires and analysed as a cross-sectional design. The outcome variable was the Oral Health Impact Profile (OHIP-14). Explanatory DPR variables included trust in dentists, satisfaction with dental care, and dental fear. Covariates comprising oral health behaviours, dental services, demographics, and socioeconomic status were included as potential confounding variables. Bivariate correlation analyses and multivariable linear regression were performed for the associations among explanatory, outcome variables and other covariates.

Results: Response data were analysed from 4220 participants (response rate = 41.9%). Unadjusted mean total scores of DPR variables and OHIP-14 were associated with most of the study participants' characteristics ($P < .05$). Bivariate correlations among DPR variables and OHIP-14 showed a diverse range of coefficients ($|r|$ or $|\rho|$=0.22-0.67). Multivariable regression analyses in both individual/clustered block entry and full model indicated that higher satisfaction and less dental fear (B = −0.039 and 0.316, respectively in the full model) were associated with lower OHIP-14 after adjusting for possible confounders ($P < .01$).

Conclusions: This study found that favourable DPR variables, mainly greater satisfaction and less dental fear are positively associated with better OHRQoL. Further studies are warranted to investigate the causality and mediation/moderation of DPR variables on oral health outcomes.

KEYWORDS
community dentistry, dentist-patient relations, health-related quality of life, South Australia

1 | INTRODUCTION

The clinical encounter between clinician and patient remains a key component of healthcare despite comprehensive and drastic changes in medical systems and techniques.[1] To achieve patient-centred care, it is crucial to establish a good clinician-patient relationship at the centre of actual encounters.[2] Also in clinical dentistry, the dentist-patient relationship (DPR) generally "covers (nearly) all aspects of care" and a favourable DPR "increases the quality of care".[3] The theoretical framework of 'social dentistry' at the individual level supports better relationship-based actions,[4] which the Wilson and Cleary model conceives are social and psychological factors for health-related quality of life.[5] There are a few decisive attributes suggested for the construct of DPR,[6] including but not limited to patients' trust in clinicians,[7,8] satisfaction with care,[9,10] dental fear,[11] therapeutic communication,[6,12] and involvement in clinical decision-making.[13,14]

Potential benefits from better DPR may accrue for both participants in the relationship – the dental professional and patient.[3] Inter alia, better 'ultimate' health outcomes, namely improved biomedical indices or well-being, are the primary rationale for favourable relationships beyond intermediate outcomes, such as improved adherence to care or health self-efficacy.[12] In particular, subjective health outcomes appear to be more highly correlated with the attributes of clinician-patient relationships than objective ones.[15] For example, oral health-related quality of life (OHRQoL) – an important measure of dental patient-reported outcomes[16] – has a positive association with items of DPR in older people,[8] and trust and decision-making preferences in diabetic patients.[17]

However, there are a limited number of studies in which predictors of DPR variables have been thoroughly explored for their association with oral health outcomes in the general population. These studies are commonly restricted to a single variable for intermediate outcomes such as dental fear to predict dental avoidance and problem-oriented dental visiting.[18] Also, in these studies the attributes of DPR themselves are often focused on as an outcome such as attitudes of a dental professional to determine satisfaction with dental care.[19] Factors from patients' experience in the relationship with dentists have not been sufficiently studied for the association with patient-centred outcomes.[8] Compared with socioeconomic determinants highlighted to tackle a social gradient of public oral health in community dentistry, a healing relationship[2] should also balance the 'power' imbalance in dental encounters[1] to enable patient-centred care. More practically, equitable and participatory relationships can support and encourage shared decision-making[14]—one of the major components in patient-centred dental care.

Based on the gap of previous research findings, the aim of the study was to investigate the association between DPR variables and an oral health outcome. More specifically, we aimed to test the hypothesis that better DPR are associated with improved OHRQoL. In order to test the proposition, the research question was asked: Are DPR variables positively associated with OHRQoL before and after adjusting for confounding variables? Two subordinate queries were also investigated sequentially: Are scores of DPR variables and OHRQoL different according to the study participants' characteristics? How are demographic, socioeconomic, DPR, and OHRQoL variables correlated with each other? The answers to these can inform a better understanding about the role of DPR as a potential determinant of oral health.

2 | METHODS

A total of 12 245 adults aged 18 years or over living in South Australia were randomly sampled from the Electoral Roll, a comprehensive sampling frame for the age group as voting is compulsory in Australia. Sampling for this research was from the baseline of a wider longitudinal study, which aimed at changes of oral health outcomes according to different pathways of dental care.[20] The sample size was calculated for the expected effect size of oral health outcomes in the original study[20] and estimated response rate from the up-to-date national oral health survey.[21] Data were collected by mailed self-complete questionnaires with a primary approach letter and up to four follow-up mailings until the response in 2015-2016. Among respondents, those with the number of missing values >20% in either multi-item scales were excluded due to the limited data quality. The outcome variable was the Oral Health Impact Profile (OHIP-14) to assess OHRQoL. OHIP-14 is a 14-item battery measuring perceived oral health impact on well-being and quality of life in the preceding 12 months.[22] Each response item is coded on a Likert scale (from 0 = never to 4 = very often) and the summed score of OHIP-14 (ranging from 0 to 56; Cronbach's α = .93 in the current study) has demonstrated validity, reliability and precision with higher scores meaning poorer OHRQoL.[23]

Explanatory variables included trust in dentists, satisfaction with dental care, and dental fear representing DPR attributes. Trust in dentists was assessed using the Dentist Trust Scale (DTS) which comprises 11 items on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree) reflecting four dimensions of patients' trust: fidelity, competence, honesty, and global trust.[24] DTS was applied from a modification of the original 'trust in physicians' scale as both trust scales have satisfactory psychometric properties.[24,25] The Dental Care Satisfaction scale (DCS) was adopted to measure satisfaction with care received at the last dental visit. DCS uses a 9-item, 5-point Likert scale with the same coding as DTS, assessing four dimensions: context, content, outcome, and cost.[26] The 31-item full scale was developed with revision[26] and has been employed in national oral health surveys of the Australian population as a full set[27] or the current short version.[21] Items with negative statements were included in both DTS and DCS to prevent acquiescence bias and reversely coded for the consistency of response. Also, both scales were computed to produce summed scores as continuous variables in the analyses (ranging from 11 to 55 in DTS, and 9 to 45 in DCS; Cronbach's α = .92 and .84 in the current study, respectively), with higher scores indicating higher trust/satisfaction. Dental fear was measured using a single item of global rating with a 5-point Likert

scale by asking if they feel afraid when going to the dentist (1 = not at all to 5 = extremely afraid).[28]

Other covariates were included to control for potential confounding in four blocks of variables: oral health behaviours, dental services, demographic, and socioeconomic status (SES). The first two were putative confounders deemed to be associated with both explanatory and outcome variables in the study. Oral health behaviours included smoking status (classified as "smoker" or "non-smoker") and the frequency of tooth brushing (coded as "once per day or less" or "more than once per day"). Dental service variables were the time since the last dental visit ("12 months or over" or "within the last 12 months"), dental service sector as the site of the last dental visit ("public" or "private"), and perceived dental needs ("yes" or "no"). The latter two blocks were included to control for the effect of demographics and social determinants on oral health. Demographic variables included sex and age, and SES variables included household income (in Australian dollars) and highest education level. Age, income, and education were categorized into groups/levels as 12 age groups by 5 years from "18-24" to "≥75", 10 income brackets by $20 000 from "less than $20 000" to "more than $180 000", and six ordinal education levels being "No schooling completed", "Completed primary school", "Some high school", "Completed high school", "Vocational training", or "University degree/Tertiary qualification". Additionally, for descriptive statistics and unadjusted associations, di-/tri-chotomized coding of demographic/SES variables was applied (sex as "male" or "female"; income "<$80 000" or "≥$80 000"; education "≤Year 12 or certificate" or "diploma/degree"; and age "18-39", "40-59", or "≥60").

Due to the non-normal distribution of the summed OHIP-14 score with a floor effect, non-parametric tests and a square-root transformation[29] was employed when the outcome variable was modelled. In the beginning of analyses, descriptive statistics were presented from statistical significance tests using Student's *t* test, ANOVA and their corresponding non-parametric tests. Additionally, bivariate correlation analyses were performed to assess associations among explanatory, outcome variables and covariates using Pearson's and Spearman's rank correlation coefficients. The answer to the research question and hypothesis test were conducted with multivariable linear regression with the square-root transformed total score of OHIP-14 in different models of variable entry. Variables were entered progressively into the model in five individual block entry steps (DPR and four confounding variable blocks), two clustered block entry steps (dental/oral health cluster and demographic/SES cluster), and a full model, to compare changes of regression coefficients and variance explained. The sequential entry of blocks and comparison with a full model has been adopted in a similar context of an empirical study and demonstrated its practical application to assess plausible mediation effects among variables.[30] Missing values in multi-item scales ≤ 20% were imputed using the expectation-maximization algorithm with an iterative maximum likelihood estimation. Data were weighted to the age by sex distribution according to the 2015 Estimated Resident Population from the Australian Bureau of Statistics. All statistical analyses were performed with SPSS, version 25 (IBM Corp.) with $P < .05$ adopted as the threshold for statistical significance.

This study was approved by the Human Research Ethics Committee of the University of Adelaide (H-288-2011) and all procedures performed in the study were in accordance with the Helsinki declaration.

3 | RESULTS

Response data for the study were analysed from a total of 4220 adults after excluding 274 participants based on the missing value criteria. The adjusted response rate was 41.9% allowing for the invalid delivery of mailed questionnaires. Given the chance of response bias by the difference from the initial random sampling, a comparison of study participants with the general population in South Australia was carried out (Table S1). The weighted composition of study participants was similar to the population but presented minor differences with higher percentages of younger age group, higher income and education level, and lower of those made their dental visit within the last 12 months and private dental service. The distribution of participants' characteristics is shown in Table S2. The majority of participants in the study were nonsmokers (87.8%), made their last dental visit in the private sector (84.9%), and had no perceived dental needs (83.2%).

Unadjusted mean total scores of DPR variables and OHIP-14 are tabulated according to participants' characteristics (Table S2). The scores were statistically different for most of the attributes ($P < .05$), with the exception of sex and income to DTS; education to DCS; and sex to OHIP-14. All covariates in oral health behaviour (nonsmoking and more frequent tooth brushing; $P < .01$) and dental service blocks (last dental visit within the past 12 months, private dental service, and no dental needs; $P < .05$) were consistently associated with higher trust and satisfaction, less dental fear, and lower oral health impact. The largest differences in each DPR variable and OHIP-14 were observed in characteristics of the dental service block: last dental visit for DTS (difference 3.7) and DCS (3.5), and perceived dental needs for dental fear (0.4) and OHIP-14 (8.3).

Bivariate correlations among continuous and ordinal variables were analysed with coefficients shown in Table 1. Except for age as categorized groups which had inconsistent patterns, correlations between SES characteristics and explanatory/outcome variables were in accordance with the same direction as indicated in Table S2. However, their absolute values of effect size were mostly smaller than 0.10, not least income and education with DPR variables. The highest correlation was between DTS and DCS in a positive manner ($r = .67$). Other correlations among DPR variables were relatively low in the direction of high trust and satisfaction with low dental fear ($r = -0.27$ and $r = -0.25$, respectively).

Unadjusted and adjusted associations of DPR variables and other covariates with the square root of the total OHIP-14 score were analysed using linear regression in Table 2. Variables in the DPR block were significantly associated with the transformed OHIP-14 score

TABLE 1 Bivariate correlation coefficients among explanatory, confounding and outcome variables

	Age	Income	Education	DTS	DCS	Dental fear	OHIP-14
Age	1						
Income	−0.24	1					
Education	−0.20	0.32	1				
DTS	0.14	0.03	−0.05	1			
DCS	0.13	0.08	0.01	0.67	1		
Dental fear	−0.02	−0.10	−0.07	−0.27	−0.25	1	
OHIP-14	0.02	−0.21	−0.10	−0.22	−0.26	0.29	1

Note: DCS, summed Dental Care Satisfaction score; DTS, summed Dentist Trust Scale score; OHIP-14, summed Oral Health Impact Profile-14 score; ordinal levels for education; Spearman's rank correlation coefficient ρ for OHIP-14 and education; Pearson's correlation coefficient r for the other variables; all correlation coefficients presented without statistical significance for the focus on effect size and direction.

across all three adjusted models ($P < .05$) except trust being statistical significant only in the full model. Most coefficients in the demographic block showed nonsignificance aside from age with a small effect size in the individual block entry. The other covariate not significantly associated with the outcome variable was last dental visit in the individual block entry. Among five blocks individually entered in the analysis, the dental service block showed the highest block R^2 (14.6%) followed by DPR variables (13.6%). Whereas, the SES (5.8%) and oral health behaviour (3.7%) blocks accounted for relatively low variance in the outcome variable. In particular, the demographic block appeared with the lowest amount of block R^2 (0.2%; $P = .020$). When entered in cluster, the dental/oral health cluster (DPR, oral health behaviour, and dental service blocks *en masse*) explained over four times as much of the variance in transformed OHIP-14 score (25.1%) as did the demographic/SES cluster (5.9%). In the full model after controlling for covariates, all variables entered in the regression analysis accounted for 27.4% of the total variance in the outcome variable with two nonsignificant demographic covariates, age ($P = .06$) and sex ($P = .48$).

4 | DISCUSSION

This study showed that variables in DPR were associated with OHRQoL independently from the presence of potential confounders. Especially, favourable DPR attributes of higher satisfaction with dental care and less dental fear were consistently associated with less oral health impact. Moreover, by including dental/oral health-related covariates and clustering them in the analyses, we could compare changes of regression coefficients and variance explained among each individual and clustered block entry with the full model. In addition, mean total scores of DPR variables and OHIP-14 were different across most of the study participants' characteristics. Also, bivariate correlations among DPR variables and OHIP-14 were presented with different levels of coefficients.

When DPR variables are compared with the results from previous studies, few differences are observed for participants' characteristics. For socio-demographic traits, major explicit trends of total score of all three DPR variables remain similar in this study. For example, the older, the more likely to feel trust/satisfaction[26,31]; females feel more fearful than males[28] with small variations. In particular, participants who visited a dental practice over 12 months ago and currently have dental needs appear to consistently report lower trust/satisfaction and higher dental fear.[24,26,32] Bivariate correlations seen in Table 1 are also in accordance with previous findings, such as a positive association between trust and satisfaction, and fear being negatively associated with trust[24] and satisfaction.[33] Especially, the correlation coefficient $\rho = .61$ between trust and satisfaction from a previous study[31] is commensurate with $r = .67$ from Table 1. It is also worth noting that OHRQoL scores were associated with SES variables in both bivariate analyses and adjusted full model, which is in agreement with the findings from the study of a similar framework.[30]

There are some studies where health outcomes were explored for the causality/association with certain isolated clinician-patient relationship variables. Lee et al[17] presented the contribution of trust to improving health outcomes on diabetic patients in a longitudinal study and a meta-analysis also reported a positive correlation between them.[15] To provide more dental contexts, dental fear is hypothetically and empirically associated with poor oral health via dental avoidance in the 'vicious cycle'[18,28] and dental anxiety management can improve OHRQoL outcomes.[11] For dental patients with occlusal splints, the more satisfied with their provider, the higher OHRQoL they are likely to report.[34] One of few studies about the associations between comprehensive DPR variables and OHRQoL, Muirhead et al[8] found unmet needs for dental treatment, and a lack of trust and confidence in their dentist are significantly associated with poor OHRQoL among older people in the UK. However, differently from the previous results for the association with OHRQoL, this study shows an incongruent finding in that trust is not associated with OHRQoL in individual/clustered block entries compared with other DPR variables. In the full model, trust appears to become statistical significant with a relatively small effect size, which may have been adjusted by the inclusion of demographic/SES covariates.

Two hypothetical explanations are possible for the conflicting result of trust in the study: conceptual postulation of trust on health

TABLE 2 Unadjusted and adjusted associations of explanatory and confounding variables with the square root of total OHIP-14 score by individual/clustered block entry and full model

	Unadjusted associations	Individual block entry	Clustered block entry	Full model	
	Coeff. Mean (SE)	B (SE)	B (SE)	B (SE)	β
Dentist-patient relationships					
Trust					
Dentist trust scale	−0.218**	−0.002 (0.004)	−0.006 (0.004)	−0.009* (0.004)	−0.042
Satisfaction					
Dental care satisfaction	−0.275**	−0.052** (0.005)	−0.039** (0.005)	−0.039** (0.005)	−0.154
Fear					
Dental fear	0.305**	0.405** (0.024)	0.336** (0.023)	0.316** (0.024)	0.196
Block R^2		13.6% **			
Oral health behaviours					
Smoking					
Nonsmoker	1.79** (0.03)	−0.845** (0.078)	−0.561** (0.070)	−0.521** (0.072)	−0.103
Smoker	2.68 (0.09)	Ref.	Ref.	Ref.	
Tooth brushing					
More than once per day	1.73** (0.04)	−0.269** (0.051)	−0.133** (0.046)	−0.125** (0.048)	−0.038
Once per day or less	2.05 (0.04)	Ref.	Ref.	Ref.	
Block R^2		3.7% **			
Dental services					
Last dental visit					
<12 mo	1.81** (0.03)	−0.039 (0.050)	0.241** (0.049)	0.278** (0.050)	0.083
≥12 mo	2.03 (0.04)	Ref.	Ref.	Ref.	
Dental service sector					
Private	1.77** (0.03)	−0.615** (0.069)	−0.488** (0.065)	−−0.357** (0.069)	−0.077
Public	2.60 (0.07)	Ref.	Ref.	Ref.	
Perceived dental needs					
Yes	3.19** (0.07)	1.502** (0.065)	1.232** (0.062)	1.178** (0.063)	0.266
No	1.62 (0.03)	Ref.	Ref.	Ref.	
Block R^2		14.6% **			
Clustered block R^2			25.1% **		
Demographic					
Age					
Age groups	0.036*	0.017* (0.007)	−0.015 (0.008)	0.013 (0.007)	0.028
Sex					
Female	1.94 (0.04)	0.079 (0.051)	0.033 (0.052)	0.034 (0.048)	0.010
Male	1.86 (0.04)	Ref.	Ref.	Ref.	
Block R^2		0.2% *			
Socioeconomic					
Income					
Income groups	−0.236**	−0.140** (0.011)	−0.143** (0.011)	−0.085** (0.010)	−0.134

(Continues)

TABLE 2 (Continued)

	Unadjusted associations	Individual block entry	Clustered block entry	Full model	
	Coeff. Mean (SE)	B (SE)	B (SE)	B (SE)	β
Education					
Ordinal education levels	−0.102**	−0.071** (0.022)	−0.078** (0.023)	−0.041* (0.020)	−0.030
Block R^2		5.8% **			
Clustered block R^2			5.9% **		
Full model R^2				27.4% **	

Note: Outcome variable, square root of the total OHIP-14 score; Coeff. in unadjusted associations, Spearman's rank correlation coefficient ρ for education and Pearson's correlation coefficient r for the other variables; B, unstandardized coefficient from multivariable linear regression; β, standardized coefficient from multivariable linear regression; SE, Standard Error of the mean; Ref., reference group in the variable.

*($P < .05$).

**($P < .01$).

outcomes and mediation effects of trust. Firstly, trust in healthcare generally refers to the expectation of *future* behaviour whereas satisfaction with care focuses on the evaluation of the healthcare service based on *past* experiences.[7] In the questionnaire of the study, both DCS (satisfaction with the *last* dental visit) and OHIP-14 (in the *preceding* 12 months) were asked in the past/present perfect tense as per the scale protocol (Questionnaire S1 in Appendix S1). If both an explanatory and an outcome variable are predicated on the perception of previous dental care/conditions, they are more likely to be associated with each other than other variables with time difference/lag such as 'priming' of context effects.[35] Thus trust in dentists may need to be analysed for the association with more future-oriented health outcomes. For example, adherence/continuity of healthcare services,[9] uptake of preventive dental service, and longitudinal changes in OHRQoL can apply to the case. More relationship-based outcomes are also suggested considering 'emotional components' in trust[7] and more relevance of trust to relationships than satisfaction,[31] such as preference in shared decision-making and incidence of complaints in dental practice.[36] The other is that trust may be mediated by other DPR variables in the association with OHRQoL. Potential mediation can be supported by hierarchical linear regression results. The significant coefficient of trust with the square root of total OHIP-14 score as a sole predictor in regression became nonsignificant after adding satisfaction and fear in the model (from $P < .01$ to $P = .57$). Moreover, from R^2 changes in the sequential entry of DPR variables to the regression, DTS shows small or negligible amounts of contribution to DCS, dental fear, and both (ΔR^2 = 0.2%, 2.0% and < 0.1%, respectively) in accounting for the variance of the outcome variable (Table S3). Despite the limitation of a cross-sectional survey, trust may need to be explored in mediation analyses as conditions of mediating effects are sufficiently supported.[37]

In the paradigm shift to patient-centred care with the biopsychosocial model from the previous disease-centred with the biomedical model, the clinician-patient relationship is a pivotal element.[1] The assessment of the quality of care should be based on continuous therapeutic relationships,[2] and dentistry is not the exception, particularly for the promotion of value-based oral health care.[16] For example, satisfaction for improving the quality of dental care[10] and trust for better acceptability of dental care[38] are advised. Useful instruments and frameworks to establish good DPR have been suggested and their implementation encouraged.[39] However, DPR has not been comprehensively investigated for better oral health outcomes[8] in contrast to psychosocial variables to OHRQoL,[30] which are proximal to DPR as both are perceptions of social relationships and contexts. Determinants of oral health outcomes should be sought from DPR in clinical dentistry as social determinants have been considered in relation to the inequity of population oral health.

This study has a few limitations. Only associations between covariates, not causal relationships, were found in the analyses for the inherent shortcoming of the cross-sectional design. In addition, some important DPR variables were missing as putative predictors on OHRQoL. Aside from trust, satisfaction, and dental fear that were included in the study, other factors such as effective communication in clinical encounters[6] and patients' involvement in shared decision-making[13,14] are considered to be crucial in DPR. Regarding the scale for dental fear, a single global item might not represent valid and reliable characteristics as a DPR variable, despite its consistent use in a series of national surveys.[28] Looking at linear regression analyses closely, substantial collinearity between DTS and DCS (r = 0.67) may destabilize the model with a loss of precision. However, tolerances for DTS and DCS in the full model (both 0.52) are not down to the level of serious concern (below 0.5).[40] The previous discussion about nonsignificance of trust for further studies can also justify the inclusion of both variables. For more rigorous psychometric properties in the multivariable model, convergent/discriminatory validity of both trust and satisfaction scales in DPR may need to be investigated.

In spite of the limitations pointed out, this study has a strength to understand DPR by adopting validated psychometric scales for trust and satisfaction. Moreover, a large number of participants covering a broad spectrum of demographics can add to its generalizability of findings compared with other more specific characteristic-based study samples. Even though the study was conducted on Australian adults, the implications may resonate to more general contexts considering the universality of DPR[3] and a global issue of trust erosion in health care.[41] For further studies, not only for adults, but children participants are also to be analysed as the findings of this paper are out of context for them with inapplicable OHRQoL scales and DPR frameworks. As is given above, in-depth analyses are encouraged to implement a prospective longitudinal design for causality among covariates and investigate DPR variables as mediators/moderators including psychosocial variables if necessary.

5 | CONCLUSION

For the hypothesis and research question, better DPR, specifically higher satisfaction and lower dental fear, are consistently associated with better OHRQoL, indicating less oral health impact. Trust, however, was associated only in the full model with a relatively small effect size. In addition, mean total scores of DPR variables and OHIP-14 were associated with most of the study participants' characteristics, and a diverse range of bivariate correlation coefficients was noted among them. This study has the practical implication that DPR variables may need to be pursued not only as 'end goals' of clinical practices but also 'functional values' for OHRQoL. As the hypothesis of positive association between DPR and OHRQoL was tested, further studies exploring the mechanism of DPR on oral health outcomes and devising strategies for how to improve DPR are warranted.

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CONFLICT OF INTERESTS

The authors have no competing interests to declare.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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Appendix Table S1. Comparison of study participants' characteristics with population data

	Data from 2016 Census[1]	Data from the national dental survey[2]	Distribution (95% CI)
Sociodemographic			
Age (%)			
18–39	33.4¶		37.7 (36.3-39.2)
40–59	34.7		34.2 (32.8-35.6)
≥60	31.8		28.1 (26.8-29.5)
Sex (%)			
Female	50.7		51.0 (49.5-52.5)
Male	49.3		49.0 (47.5-50.5)
Income			
<$80,000	60.2†		55.3 (53.7-56.9)
≥$80,000	39.8		44.7 (43.1-46.2)
Education (%)			
≤Year 12 or certificate	70.0		58.8 (57.3-60.3)
Diploma/degree	30.0		41.2 (39.7-42.7)
Dental services			
Last dental visit (%)			
<12months		62.1§	59.4 (57.9-60.9)
Dental service pathway (%)			
Private		88.5§	84.9 (83.8-86.0)

¶ Age 20-39; † <$78,000 (<$1,500/week); § dentate people aged 15 and over

[1] 2016 Census: South Australia (from the Australian Bureau of Statistics https://quickstats.censusdata.abs.gov.au/census_services/getproduct/census/2016/quickstat/4)

[2] AIHW: Chrisopoulos S, Harford JE & Ellershaw A 2016. Oral health and dental care in Australia: key facts and figures 2015. Cat. no. DEN 229. Canberra: AIHW.

Appendix Table S2. Descriptive statistics and unadjusted mean total scores of DPR variables and OHIP-14 by participants' characteristics

	Distribution	Dentist Trust Scale	Dental Care Satisfaction	Dental fear	OHIP-14
	n (valid %)	Mean (SE)	Mean (SE)	Mean (SE)	Mean (SE)
Demographic					
Age		**	**	**	**
18–39	1597 (37.7)	40.1 (0.19)	35.0 (0.17)	1.8 (0.03)	5.5 (0.19)
40–59	1448 (34.2)	39.7 (0.21)	35.3 (0.17)	2.0 (0.03)	7.1 (0.26)
≥60	1190 (28.1)	43.2 (0.24)	37.3 (0.19)	1.8 (0.03)	6.6 (0.26)
Sex			**	**	
Female	2161 (51.0)	40.9 (0.18)	36.0 (0.14)	2.0 (0.02)	6.7 (0.20)
Male	2075 (49.0)	40.8 (0.17)	35.5 (0.14)	1.7 (0.02)	6.0 (0.18)
Socioeconomic					
Income			**	**	**
<$80,000	2145 (55.3)	40.7 (0.18)	35.4 (0.15)	1.9 (0.02)	7.9 (0.22)
≥$80,000	1733 (44.7)	40.9 (0.19)	36.1 (0.15)	1.8 (0.02)	4.5 (0.15)
Education		**		**	**
≤Year 12 or certificate	2463 (58.8)	41.2 (0.17)	35.7 (0.14)	1.9 (0.02)	7.1 (0.19)
Diploma/degree	1726 (41.2)	40.3 (0.19)	35.8 (0.15)	1.8 (0.02)	5.3 (0.18)
Oral health behaviours					
Smoking		**	**	**	**
Non-smoker	3698 (87.8)	41.0 (0.13)	36.0 (0.11)	1.9 (0.02)	5.7 (0.13)
Smoker	513 (12.2)	39.2 (0.38)	34.3 (0.32)	2.0 (0.05)	11.1 (0.56)
Tooth brushing		**	**	**	**
More than once per day	2153 (51.8)	41.4 (0.17)	36.4 (0.14)	1.8 (0.02)	5.6 (0.18)
Once per day or less	2001 (48.2)	40.2 (0.18)	35.2 (0.15)	1.9 (0.02)	7.0 (0.20)
Dental services					
Last dental visit		**	**	**	**
<12months	2513 (59.4)	42.3 (0.15)	37.2 (0.12)	1.8 (0.02)	5.8 (0.16)
≥12months	1716 (40.6)	38.6 (0.20)	33.7 (0.16)	2.1 (0.03)	7.1 (0.23)
Dental service sector		*	**	**	**
Private	3533 (84.9)	41.0 (0.14)	36.2 (0.11)	1.8 (0.02)	5.6 (0.13)
Public	627 (15.1)	40.1 (0.34)	33.7 (0.28)	2.1 (0.05)	10.1 (0.46)
Perceived dental needs		**	**	**	**
No	3458 (83.2)	41.2 (0.14)	36.2 (0.11)	1.8 (0.02)	4.8 (0.12)
Yes	698 (16.8)	39.2 (0.32)	33.8 (0.27)	2.2 (0.05)	13.1 (0.44)
Total		40.8 (0.13)	35.8 (0.10)	1.9 (0.02)	6.4 (0.14)

All data were weighted; DPR, dentist-patient relationships; OHIP-14, summed Oral Health Impact Profile-14 score; SE, Standard Error of the mean; * ($p<0.05$); ** ($p<0.01$); Kruskal-Wallis test for OHIP-14 and ANOVA for the other variables in 'Age' factor; Mann-Whitney U test for OHIP-14 and Student *t*-test for the other variables in the other factors

Appendix Table S3. R squares from hierarchical linear regression models by entering each DPR variable to square root of total OHIP-14 score

Model	A		B		C		D		E		F	
	Predictors	R square	Predictors	R square	Predictors	R square	Predictors	R square	Predictors	R square	Predictors	R square
1	DTS **	0.048	DCS **	0.076	DTS **	0.048	Fear **	0.093	DCS **	0.076	Fear **	0.093
2	DCS **	0.078	DTS **	0.078	Fear **	0.113	DTS **	0.113	Fear **	0.136	DCS **	0.136
3	Fear **	0.136	Fear **	0.136	DCS **	0.136	DCS **	0.136	DTS ^{NS}	0.136	DTS ^{NS}	0.136

OHIP-14, Oral Health Impact Profile-14; DTS, Dentist Trust Scale; DCS, Dental Care Satisfaction; fear, dental fear; Predictors added sequentially to the previous model; ** ($p<0.01$); NS, non-significant

Appendix Questionnaire S1. Oral Health Impact Profile, Dentist Trust Scale, Dental Care Satisfaction

Oral Health Impact Profile-14

HOW OFTEN during the PAST 12 MONTHS	Never	Hardly ever	Occasionally	Fairly often	Very often
1. Have you had trouble pronouncing any words because of problems with your teeth, mouth or dentures?	0	1	2	3	4
2. Have you felt that your sense of taste has worsened because of problems with your teeth, mouth or dentures?	0	1	2	3	4
3. Have you had painful aching in your mouth?	0	1	2	3	4
4. Have you found it uncomfortable to eat any foods because of problems with your teeth, mouth or dentures?	0	1	2	3	4
5. Have you been self-conscious because of your teeth, mouth or dentures?	0	1	2	3	4
6. Have you felt tense because of problems with your teeth, mouth or dentures?	0	1	2	3	4
7. Has your diet been unsatisfactory because of problems with your teeth, mouth or dentures?	0	1	2	3	4
8. Have you had to interrupt meals because of problems with your teeth, mouth or dentures?	0	1	2	3	4
9. Have you found it difficult to relax because of problems with your teeth, mouth or dentures?	0	1	2	3	4
10. Have you been a bit embarrassed because of problems with your teeth, mouth or dentures?	0	1	2	3	4
11. Have you been a bit irritable with other people because of problems with your teeth, mouth or dentures?	0	1	2	3	4
12. Have you had difficulty doing your usual jobs because of problems with your teeth, mouth or dentures?	0	1	2	3	4
13. Have you felt that life in general was less satisfying because of problems with your teeth, mouth and dentures?	0	1	2	3	4
14. Have you been totally unable to function because of problems with your teeth, mouth or dentures?	0	1	2	3	4

Dentist Trust Scale

These questions relate to Dentist Trust. In general...	Strongly disagree				Strongly agree
1. Dentists care about their patients' health just as much or more as their patients do.	1	2	3	4	5
2. Sometimes dentists care more about what is best for them, than about patients' dental needs.	1	2	3	4	5
3. Dentists are extremely thorough and careful.	1	2	3	4	5
4. You completely trust dentists decisions about which dental treatments are best.	1	2	3	4	5
5. Dentists think only about what is best for their patients.	1	2	3	4	5
6. Dentists are totally honest in telling their patients about all the different treatment options available for their conditions.	1	2	3	4	5
7. Sometimes dentists do not pay full attention to what patients are trying to tell them.	1	2	3	4	5
8. Dentists always use their very best skills and effort on behalf of their patients.	1	2	3	4	5
9. You have no worries about putting your oral health in the hands of the dentist.	1	2	3	4	5
10. A dentist would never mislead you about anything.	1	2	3	4	5
11. All in all, you trust dentists completely.	1	2	3	4	5

Dentist Care Satisfaction

These questions relate to your LAST DENTAL VISIT.	Strongly disagree				Strongly agree
1. I was satisfied with the dental care I received.	1	2	3	4	5
2. I would like to have had more explanation of my dental treatment options.	1	2	3	4	5
3. The dental surgery had everything needed to provide my dental care.	1	2	3	4	5
4. The dental care I received did not improve my dental health.	1	2	3	4	5
5. I was able to make the dental visit as promptly as I felt was necessary.	1	2	3	4	5
6. The dental professional explained whether there were any patient costs and how much, before beginning the treatment.	1	2	3	4	5
7. The dental professional I saw explained well what treatment was needed.	1	2	3	4	5
8. I am confident that I received good dental care at my last visit.	1	2	3	4	5
9. There are things about dental care I received that could have been better.	1	2	3	4	5

Chapter 6: Empirical study 2

Statement of Authorship

Statement of Authorship

Title of Paper	Are trust and satisfaction similar in dental care settings?
Publication Status	☑ Published ☐ Accepted for Publication ☐ Submitted for Publication ☐ Unpublished and Unsubmitted w ork w ritten in manuscript style
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Principal Author

Name of Principal Author (Candidate)	Youngha Song
Contribution to the Paper	Initial conceptualisation, data preparation and analysis, writing and critically revising the manuscript, performing the duty as corresponding author
Overall percentage (%)	80%
Certification:	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.
Signature	Date: 24 Jun 2020

Co-Author Contributions

By signing the Statement of Authorship, each author certifies that:

i. the candidate's stated contribution to the publication is accurate (as detailed above);
ii. permission is granted for the candidate in include the publication in the thesis; and
iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

Name of Co-Author	Liana Luzzi
Contribution to the Paper	Supervised the development of the methodology and critically reviewed/revised the draft manuscript
Signature	Date: 01/07/2020

Name of Co-Author	Sergio Chrisopoulos
Contribution to the Paper	Contributed to the interpretation of the results and critically reviewed/revised the draft manuscript
Signature	Date: 29/06/2020

Name of Co-Author	David Brennan
Contribution to the Paper	Supervised the development of the methodology, contributed to the interpretation of the results, and critically reviewed/revised the draft manuscript
Signature	Date: 10 July 2020

Please cut and paste additional co-author panels here as required.

Linkage to the body of work

Even though trust and satisfaction are acknowledged to be salient in clinician-patient relationships, similarity and difference of the constructs have not been empirically attempted beyond the conceptual suggestion. This empirical study compares trust and satisfaction in dental care settings with regard to factor structure in advance of extensive causal modelling. The rationale of the study was to clarify the operationalisation of important dentist-patient relationship variables for better psychometric properties. The finding of the paper – both constructs are unidimensionally different but highly correlated simultaneously – can address the potential issue of collinearity raised in empirical study 1 and support their application in further studies on dentist-patient relationships.

Highlights

- Trust and satisfaction in dental care settings were unidimensionally different yet highly correlated factors concurrently, beyond the conceptual difference suggested from the previous literature.
- Exploratory factor analysis, cluster analysis, and confirmatory factor analysis confirmed the factor solution of trust and satisfaction, resulting in the final model of two correlated but distinct factors with minor modifications.
- Demonstrating the discriminant and complementary functions of trust and satisfaction in dental care settings can justify the rationale to apply both constructs together in further studies for dentist-patient relationships.

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ORIGINAL ARTICLE

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Are trust and satisfaction similar in dental care settings?

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Abstract

Objectives: Trust and satisfaction in dental care settings are salient constructs to operationalize the concept of dentist-patient relationships (DPR). This study aimed to compare the similarity of both constructs with regard to factor structure and revise the scales for better psychometric properties.

Methods: Data analysed in the study were collected in self-complete questionnaires from a random sample of 4011 adults living in South Australia. Trust and satisfaction were assessed using the Dentist Trust Scale and the Dental Care Satisfaction scale. Items in the scales were initially examined with a split-half sample in exploratory factor analysis and cluster analysis. Factor structures of different model designs were tested on the other half sample in confirmatory factor analysis. The final model was cross-validated on the first half sample for structural invariance.

Results: Exploratory factor analysis revealed a three-factor structure consisting of 'trust', 'satisfaction' and 'distrust/dissatisfaction' (60.2% of the variance explained; Cronbach's α = 0.94, 0.81, 0.73, respectively). Cluster analysis supported the factor solution with the same three major clusters except for a single-item independent branch of the 'cost' domain from the satisfaction scale. The final model was designed with two correlated but distinct factors, 'trust' and 'satisfaction', with the modification of one inter-item covariance and deleting the least associated item (GFI = 0.96, CFI = 0.98, RMSEA = 0.06). The stability of the final model was achieved through cross-validation (P = .143, ΔCFI < 0.001).

Conclusions: Trust and satisfaction in dental care settings are unidimensionally different yet highly correlated factors concurrently. Demonstrating the discriminant and complementary functions of both constructs can justify the rationale to apply them together in further studies for DPR.

KEYWORDS
dentist-patient relations, patient satisfaction, psychometrics, South Australia, trust

1 | INTRODUCTION

A therapeutic relationship between clinician and patient is at the centre of healthcare encounters.[1] Either in face-to-face visits or technology-based interactive communication, continuous healing relationships should constitute one of the important criteria for the quality of health care.[2] Clinical encounters in dentistry are also fundamentally based on good dentist-patient relationships (DPR),[3] considering the often highly anxious and invasive nature of the dental practice. Despite its centrality in health care, however,

clinician-patient relationships have primarily been described in the nonempirical literature such as normative guides/statements and opinion pieces.[4] Better understanding of the relationship for quality of care is encouraged in the light of continual changes and increasing complexity of the healthcare system.[2]

The concept of clinician-patient relationships has been noted to be hard to operationalize for its multidimensionality and compartmentalization.[4] Nevertheless, conceptual and theoretical models from the literature suggest a few relevant constructs[4] including but not limited to trust,[5,6] satisfaction,[3,7] dental fear/anxiety,[8] communication[9] and autonomy/involvement in decision making.[10] Among them, trust and satisfaction in healthcare contexts, both salient to comprising healing relationships, have been compared and discussed for their contiguous attributes in previous studies.[5,11] From the development and validation of psychometric scales, each construct was demonstrated with conceptual sub-domains/dimensions. Trust in dentists was conceived in four domains (fidelity, competence, honesty and global trust) under a unidimensional construct of general trust.[12] In contrast, the Dental Satisfaction Questionnaire (DSQ), one of the commonly used satisfaction scales with dental care, presents seven factors among items introduced from four conceptual dimensions (context, content, outcome and cost).[13] Notwithstanding those individual psychometric properties analysed, the distinction between trust and satisfaction has not been attempted concurrently except for the conceptual difference with the former as 'an expectation of *future* behaviour' and the latter 'looks backward, based on *past* experience'.[5] There remains a need to clarify the similarity of both constructs as a preliminary work before proceeding with further studies for DPR.[14]

Driven by the gap of conceptual understanding, firstly, this study aimed to compare the constructs of trust and satisfaction in dental care settings with regard to factor structure in the scales. For the second aim, findings from the initial factor solution were employed in search of the best model to revise both scales to better quantify the concept of DPR.

2 | METHODS

A random sample of total 12 245 adults aged 18 years or over living in South Australia was drawn from the Electoral Roll in Australia. Sampled adults were sent self-complete questionnaires with a primary approach letter via postal mail, followed by up to four reminders to encourage response in 2015-2016. Informed consent was implied by participants completing and returning the survey forms. Ethical approval was obtained from the Human Research Ethics Committee of the University of Adelaide (H-288-2011).

Data items for the study were from the Dentist Trust Scale (DTS) and the Dental Care Satisfaction scale (DCS). DTS was adopted to assess trust in dentists with 11 items reflecting four domains aforementioned.[12] The items were modified to dental contexts from the original 'trust in physicians' scale[15] by changing the term 'physicians' to 'dentists'.[12] Both trust scales had satisfactory psychometric properties through validation.[12,15] Satisfaction with care at the last dental visit was measured using DCS with a shortened battery of 9 items representing four conceptual dimensions from the 31-item full scale of DSQ.[13] The scale has been employed in the Australian national oral health surveys in either the full[16] or short version[17] of DSQ. Both DTS and DCS were rated on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). Negatively worded items were included in both scales to prevent acquiescence bias[18] and reverse-coded for consistency of response. Detailed item descriptions in the questionnaires for the study can be found in the supplementary material (Table S1).

The collected data were prepared for statistical analyses in the procedure of data screening. For missing values, respondents with the number of missing items >20% in either scale (≥3 items in DTS and/or ≥2 items in DCS missing) were excluded for the limited data quality. Among remaining participants, those with an identical endorsement of category for all items in either scale were also excluded as unengaged responses. Missing values of 20% or less in both scales were imputed using the expectation-maximization algorithm—an iterative procedure of producing maximum likelihood estimates based on the covariance matrix.[19] No outliers were observed. Data weighting was not applied as the study aimed at the structural validity of psychometric scales, rather than population estimates of the variables.

We performed two stages of statistical analyses for the factor structure with half-split random samples, so-called exploratory and confirmatory procedures.[20] Firstly, an exploration of factor solution was sought with subsample A using exploratory factor analysis (EFA) and cluster analysis. Next, confirmatory factor analysis (CFA) was implemented with the other half subsample B to cross-validate the results from the 'precursor'.[20] For the assumption of factor analyses, univariate normality and multivariate normality were tested in advance. Univariate normality for each item was assumed in accordance with practical recommendations (skewness < 2.0 and kurtosis < 7.0).[21] However, as all models analysed in CFA showed multivariate non-normality based on Mardia's coefficients, bootstrapping with maximum likelihood method of sampling 500 times was applied in CFA.[22]

All samples were examined in descriptive and item analyses with frequency tables and classic psychometric indicators. Subsample A was explored in EFA using principal components to maximize the variance with Kaiser's K1 rule (factors with eigenvalue > 1.0 retained) and scree plot for factor extraction.[23] Both orthogonal (Varimax) and oblique (Direct oblimin) axis rotations were applied for robust results of factor structure and loadings. The same subsample was also tested in hierarchical cluster analysis to compare the factor structure by clustering items. The classification of items was performed using Ward's method to minimize the variance between members within the cluster.[24] The structural hierarchy of cluster analysis was visually displayed on a dendrogram consisting of branches in a tree format. With the exploration of factor solution, subsample B was tested in CFA for the comparison of model designs between the conceptual 'a priori theory-driven models' and 'post

hoc exploratory models'.[25] Goodness-of-fit indices[26] in each default model were scrutinized, and alterations in design were introduced in pursuit of acceptable model fit and construct validity/reliability.[27] Lastly, the final model from subsample B was applied to subsample A to assess the stability of the model with structural invariance through cross-validation.[28] All statistical analyses were performed using SPSS, version 25.0 (IBM Corp) with the exception of CFA using AMOS 25.0. P-value < 0.05 was adopted as the threshold for statistical significance.

3 | RESULTS

Data for the study were collected from 4011 adults after excluding undelivered questionnaire mails, low quality and unengaged responses in data preparation. The adjusted valid response rate was 39.8%. Participants' sociodemographic characteristics were compared with population census data allowing for the possible response bias from the initial random sampling (Table S2). Respondents in the study showed a similar composition to that of population data with minor differences (more female, older and higher education level of participants). Response distribution of each item and bivariate correlations among items and total score were tabulated from item analyses (Table S1 and S3). Mean item scores in DTS and DCS ranged from 3.46 to 4.03, and 3.38 to 4.36, respectively. No explicit ceiling or floor effect was observed throughout the scales but items in DCS indicated more ratings of 'strongly agree' with six items below −1.0 for skewness and two over 2.0 for kurtosis compared to no items outside of the range in DTS. Response distribution on items DTS10 and DTS11 was almost identical with the highest correlation coefficient of 0.99. Items DTS2 and DTS7, both reverse-coded, were in the lowest corrected item-total correlation (0.49 and 0.40, respectively) with low levels of inter-item correlation (all Pearson's *r* coefficients below .40 except for one item), whereas the lowest item-total correlation in DCS was shown on item DCS6 as .32 with low correlations with other items (below .3 except for two items). Internal consistency of both scales was measured in all samples with Cronbach's α 0.92 for DTS and 0.83 for DCS.

Factor extraction and the highest factor loadings after oblique axis rotation on subsample A (N = 2003) from EFA are presented in Table 1. Sampling adequacy was assessed and satisfied with Kaiser-Meyer-Olkin measure (0.94) and Bartlett's test of sphericity ($P < .01$). The principal components produced three factors with the initial eigenvalue greater than 1.0, collectively accounting for 60.2% of the variance. Three factors are composed of nine items on 'trust' for factor 1 (all DTS items), six on 'satisfaction' for factor 2 (all DCS items) and five on 'distrust/dissatisfaction' for factor 3 (all reverse-coded items). A moderate level of inter-factor correlations was measured, from 0.29 between factor 2 and 3 to 0.48 between factor 1 and 2 (not shown in Table). As factors were noted being correlated, results with an oblique axis rotation are tabulated but an orthogonal rotation was also performed, leading to the same factor structure. Communalities of two items in 'satisfaction' factor and three in 'distrust/dissatisfaction' factor showed lower than 0.5 but all of them were higher than an acceptable cut-off value of 0.3.[29] All items loaded on each factor with greater than 0.5 of factor loadings aside from item DTS2 on 'distrust/dissatisfaction' factor with 0.468. Additionally, DTS2 was the sole item with a cross-loading of higher than 0.3 on a different 'trust' factor (0.384). Each factor demonstrated a good to excellent level of internal consistency, Cronbach's α with 0.94 for 'trust', 0.81 for 'satisfaction' and 0.73 for 'distrust/dissatisfaction'.

Cluster analysis with subsample A illustrated the structural hierarchy on a dendrogram (Figure S1). In general, the structure in clustering was in accordance with the three-factor solution from EFA with the exception of an isolated single-item branch, DCS6. From the bottom of the tree diagram, the first bifurcation was made splitting into the main trunk and the 'satisfaction' cluster. Then, the major stem was divided into three-pronged branches, 'trust', 'distrust/dissatisfaction' and DCS6 one-item cluster representing the 'cost' domain. Towards the top of the dendrogram, items DTS10 and DTS11 were placed in the closest distance with the most homogeneity. In the same 'distrust/dissatisfaction' cluster, two items in DTS and three DCS were gathered separately.

A series of models with different designs on subsample B (N = 2008) were examined in CFA outlining the summary of goodness-of-fit indices in Table 2. Models 1 and 2 are theory-driven designs with the inclusion of conceptual dimensions in each scale for the former and without them for the latter. Models 3 and 4 are derived from the previous exploration with a three-factor structure including the 'distrust/dissatisfaction' factor and two factors only ('trust' and 'satisfaction') without it, respectively. Diagrams of models tested in CFA are shown in Figure S2 in the supplementary material. Since all four default models indicated poor model fits, modifications were attempted to meet the fit indices following a comprehensive assessment of item analysis and modification indices. A newly added covariance between error terms of items DTS10 and DTS11, as the most sensible and least contrived modification, improved the fit of all default models except for model 1, close to the adequate level (goodness-of-fit index > 0.95, comparative fit index (CFI) > 0.95 and root mean square error of approximation < 0.07).[26] Among them, the modified model 4 (model 4_01) was selected as a candidate for a final model in pursuit of parsimony based on Akaike information criteria with a lower value indicating a better fit. A second modification of deleting item DCS6 was adopted in the candidate model to achieve criteria for convergent/discriminant validity and reliability in CFA (average variance extracted (AVE)≥0.50, composite reliability (CR) ≥ 0.70, AVE_i and AVE_j > square of the correlation between the factors *i* and *j*).[27] The final model (model 4_02) satisfied the criteria on AVE (0.60, 0.56), CR (0.93 and 0.86 for 'trust' and 'satisfaction', respectively) and AVE being greater than the square of the correlation between factors ($r^2 = .51$). Cronbach's α of the factors in the final model showed 0.93 for 'trust' and 0.84 for 'satisfaction' on subsample B. As factors in the final model were highly correlated with each other ($r = .71$), a model designed with a single common factor instead of

TABLE 1 Factor extraction and factor loading table of exploratory factor analysis

Principal components			Rotated factor loadings					
Factor	Eigenvalue	Variance (%)	Item label	Item description	1	2	3	h^2
1	9.05	45.3	DTS10	Dentists would never mislead you	0.914			0.756
2	1.73	8.6	DTS11	You trust dentists completely	0.912			0.756
3	1.26	6.3	DTS5	Dentists think only what is best for patients	0.813			0.648
4	0.97	4.8	DTS4	You trust dentists decisions about treatments	0.801			0.719
5	0.78	3.9	DTS6	Dentists are honest about treatment options	0.794			0.706
6	0.72	3.6	DTS9	You have no worries about the dentist	0.738			0.647
7	0.65	3.3	DTS8	Dentist use best skills and effort	0.728			0.666
8	0.61	3.1	DTS3	Dentists are thorough and careful	0.683			0.590
9	0.59	2.9	DTS1	Dentists care as much as patients do	0.637			0.533
10	0.53	2.7	DCS8	Good dental care received at my last visit		0.721		0.778
11	0.47	2.4	DCS7	Explained well what treatment was needed		0.718		0.710
12	0.45	2.3	DCS1	Satisfaction with the dental care received		0.632		0.704
13	0.43	2.1	DCS3	Dental surgery had everything for dental care		0.617		0.553
14	0.39	1.9	DCS5	Dental visit made as promptly as necessary		0.576		0.373
15	0.33	1.7	DCS6	Explained costs before beginning treatment		0.557		0.330
16	0.32	1.6	DCS2*	Would like more explanation of treatment options			0.744	0.547
17	0.31	1.5	DCS9*	The dental care I received could have been better			0.663	0.591
18	0.24	1.2	DCS4*	Dental care did not improve my dental health			0.630	0.497
19	0.17	0.9	DTS7*	Dentists do not pay full attention to patients			0.588	0.489
20	0.01	0.0	DTS2*	Dentists sometimes care more about them			0.468	0.444
				Rotation sums of squared loadings	8.04	5.35	4.30	
				Cronbach's α	0.937	0.809	0.734	

Note: Analysis performed on subsample A; factor loadings from pattern matrix after Direct oblimin rotation with Kaiser Normalization; DCS, Dental Care Satisfaction; DTS, Dentist Trust Scale; * reverse-coded items; h^2, communality

two separate factors was tested (model 4_03) but failed to meet adequate fit indices. All items in the final model loaded on each factor with standardized regression weights greater than 0.6 ($P < .01$) and squared multiple correlations of 0.4 excepting item DCS5 with 0.49 and 0.24, respectively (Figure 1). With the final model, multiple-group CFA was performed on subsample A for cross-validation. Both configural and measurement models achieved acceptable model fit indices with no significant structural variance observed ($P = .143$, $\Delta CFI < 0.001$).[30]

4 | DISCUSSION

This study tested the similarity of trust and satisfaction in dental care settings as constructs for the concept of DPR through structural validation. By exploring items in both psychometric scales for the initial factor structure and confirming it by comparison with models of different designs, we could identify the final model of factor solution. The model indicates that two separate yet highly correlated factors induced from exploratory and confirmatory analyses are the most explicative and parsimonious design for trust and satisfaction in DPR.

The factor structure produced from EFA and cluster analysis simultaneously supports unidimensionality of both constructs as convergent validity and their distinctive nature with discriminant validity. Even though both scales were developed with conceptual domains/dimensions,[12,13] a single factor for each trust and satisfaction implies that they are recognized as global and overarching constructs with relevant aspects collectively combined. The unidimensionality is confirmed in concord with the validation results of DTS[12] and its original scale[15] for trust. However, satisfaction appears differently from the previous multiple factors in DSQ[13] for the reduced number of items in DCS. Nevertheless, a critical review of satisfaction questionnaires suggests that most satisfaction instruments with adequate internal consistency can be considered to be unidimensional.[31] For a comprehensive understanding of DPR, these two unidimensional constructs can function as reciprocal complements justified by the divided factor structure beyond the conceptual

TABLE 2 Goodness-of-fit indices in models with different factor structures and tests of structural invariance for cross-validation

Model	χ^2	*df*	χ^2/df	*P*-value	GFI	CFI	RMSEA [90% CI]	AIC
Model 1	5750.64	162	35.50	<.001	0.673	0.805	0.131 [0.128, 0.134]	5846.64
Model 1_01[a]	5173.27	161	32.13	<.001	0.711	0.825	0.125 [0.122, 0.127]	5271.27
Model 2	8543.93	169	50.56	<.001	0.801	0.708	0.157 [0.154, 0.160]	8625.93
Model 2_01[a]	1687.78	168	10.05	<.001	0.914	0.947	0.067 [0.064, 0.070]	1771.78
Model 3	8146.32	167	48.78	<.001	0.814	0.722	0.154 [0.151, 0.157]	8232.32
Model 3_01[a]	1299.78	166	7.83	<.001	0.936	0.960	0.058 [0.055, 0.061]	1387.78
Model 4	7634.44	89	85.78	<.001	0.785	0.701	0.206 [0.202, 0.209]	7696.44
Model 4_01[a]	799.72	88	9.09	<.001	0.948	0.972	0.063 [0.059, 0.068]	863.72
Model 4_02[b]	587.95	75	7.84	<.001	0.959	0.979	0.058 [0.054, 0.063]	647.95
Model 4_03[c]	2477.49	76	32.60	<.001	0.813	0.903	0.125 [0.121, 0.130]	2535.49
Structural invariance[d]								
Configural model	1140.42	150	7.60	<.001	0.961	0.980	0.041 [0.038, 0.043]	
Measurement model	1157.61	162	7.15	<.001	0.960	0.980	0.039 [0.037, 0.041]	
Comparison test[e]	17.19	12		.143		<0.001		

Note: Final model in boldface (Model 4_02) analysed on subsample B.

Abbreviations: AIC, Akaike's information criterion; CFI, comparative fit index; *df*, degree of freedom; GFI, goodness-of-fit index; RMSEA, root mean square error of approximation.

[a]Models with the first modification, covariance between errors of items DTS10 and DTS11 allowed;

[b]Model with the second modification, item DCS6 deleted;

[c]Tested for a single factor structure with a first-order common factor;

[d]Cross-validation of the final model with subsample A;

[e]Difference of χ^2, *df*, and CFI.

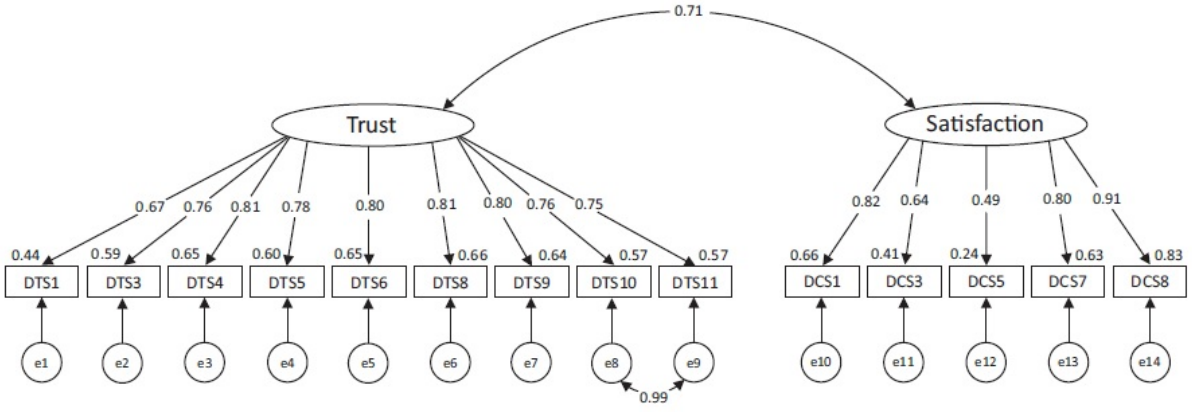

FIGURE 1 Diagram of the final model in confirmatory factor analysis. Final model (Model 4_02) analysed on subsample B; *P*-value < .01 for all standardized regression weights and correlations on arrow lines; squared multiple correlations on arrowheads; DTS, Dentist Trust Scale; DCS, Dental Care Satisfaction

differences proposed.[5] Therefore, the inclusion of both 'similar yet different' constructs in future studies is warranted for broadening the domain of DPR.

A third factor consisting of only reverse-coded items was established in EFA and reproduced in cluster analysis. Not only from the exploration of factor solution, but results in the item analysis in Table S1 and S3 also endorse the difference of reverse-coded items from the others with low levels of mean scores, item-total, and inter-item correlations. Previous literature has reported that items of positive and negative statements in a psychometric scale are frequently analysed into a factor structure reflecting different factors according to the direction of wording.[18,32-34] There are two

contrary interpretations about a method factor of reverse-worded items: 'substantively irrelevant method effects' as *artifactors*[32] and meaningful attributes of interest as a *response style*.[33] To elicit the property of a third factor based on the debatable argument lies beyond the scope of the present study, thus both models with and without the 'distrust/dissatisfaction' factor were examined in CFA. However, reversely worded items to prevent acquiescence bias might have not functioned as intended resulting in a questionable factor structure.[18,34]

Certain items showed distinctive characteristics of response hinting at modifications in CFA. Firstly, items DTS10 and DTS11 were responded virtually the same. The distribution of item response had a negligible difference between them with a very high bivariate correlation coefficient close to 1.0. Therefore, they were drawn in the nearest stretch on the dendrogram and suggested to be correlated with each other for the adequate model fit in CFA in the first place. As they acted in an identical manner, the deletion of either item was also attempted but not adopted as the contents of each item were from different conceptual dimensions (DTS10 in 'honesty' and DTS11 in 'global' trust).[12] However, given Cronbach's α of DTS and 'trust' factor over 0.90, the possible redundancy of items may need to be considered.[35] Next, item DCS6 from the 'cost' domain was on the obtrusively lower level of item-total and inter-item correlations with the lowest mean item score. The incommensurate feature of item DCS6 was also manifested by the lowest amount of communality in EFA and a protruded branch isolated from the three major clusters in cluster analysis. From the previous factor analysis on DSQ, item DCS6 was grouped into the 'conceptually unrelated items' notwithstanding being conceived for the 'cost' domain along with analogous items.[13] For this reason, item DCS6 was removed as the second modification of CFA for the adequate validity/reliability criteria and the deletion satisfied them as a minimal adjustment. This may imply that item DCS6 representing the 'cost' domain is more of financial access to dental service than a relationship-associated factor for the concept of DPR.

Some limitations are worth noting in this study. There remains a chance of method biases from self-complete questionnaires, such as common method variance with single-source data.[36] Also, a relatively low response rate can raise a concern of response bias, which may necessitate caution in the interpretation of results. In particular, the uniformity of responses on items DTS10 and DTS11, despite their different contents and statements, alludes to potential acquiescence bias as they were presented together at the end of the DTS questionnaire. Another limitation is the absence of comparative correlates for constructs. This study is solely predicated on covariance/correlation matrix-based mathematical factor structure; thus, theoretical framework may need to be construed supplementarily for comparative validity with other putatively correlated items. For example, the acceptance of dental care[11] and the tendency to excuse[37] for trust can be introduced in the questionnaire along with the fulfilment of healthcare needs/expectations[7] for satisfaction. Also, a sub-optimal number of items for each dimension (model 1 in Figure S2) might have restrained the model fit of conceptual design in the factor structure (three or more items recommended for a solid factor).[38] Besides, dimensions analysed in the study were inherently limited to those in the established scales with a possible chance of missing important traits such as empathy[11] and responsiveness.[11,31] Those limitations aside, this study investigated structural validity of both constructs thoroughly and rigorously from the initial exploration to the confirmation of factor solution. Moreover, cross-validation with split-half samples could reinforce the stability of the final model with structural invariance. To address methodological shortcomings and expand the scope of understanding DPR, further studies are encouraged to consider alternative analyses for validation and inclusion of more comprehensive constructs in DPR. For example, multitrait-multimethod matrix to deal with common method variance[36] and exploratory structural equation modelling to prevent the misspecification from zero cross-loading assumptions in factor structure[39] may be beneficial. In addition to measuring the constructs as outcomes, different aspects of DPR may need to be reflected in further studies such as the process of establishing/maintaining trust and satisfaction.[6]

5 | CONCLUSION

The constructs of trust and satisfaction are unidimensionally different yet highly correlated factors in dental care settings concurrently, beyond the conceptual proposition. By adapting and modifying the initial factor structure, the final model suggests the revision of both scales for better psychometric properties. These findings are practically applicable in that the use of both constructs in revised formats is justified in further studies for the in-depth analysis of DPR.

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CONFLICT OF INTEREST

The authors have no competing interests to declare.

AUTHOR CONTRIBUTION

YS contributed to the conception of the article, data analysis, interpretation of results and drafting manuscript. SC contributed to data acquisition and interpretation of results. LL and DSB contributed to the study design, interpretation of results and critical revision of the manuscript. All authors have read and approved the content of the manuscript.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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Appendix Table S1. Distribution of item responses in DTS and DCS

Item	Item description			Response frequencies (%)						
		Mean	SD	1	2	3	4	5	Skewness	Kurtosis
DTS										
DTS1	Dentist care about their patient' health just as much or more as their patients do.	3.90	0.95	1.7	4.6	26.4	36.4	30.9	-0.61	0.01
DTS2*	Sometimes dentists care more about what is best for them, than about patients' dental needs.	3.50	1.17	5.6	15.5	26.4	28.7	23.8	-0.36	-0.77
DTS3	Dentists are extremely thorough and careful.	3.94	0.89	0.9	4.6	23.6	41.3	29.6	-0.59	0.01
DTS4	You completely trust dentists decisions about which dental treatments are best.	3.80	1.02	2.2	8.9	23.3	37.6	30.0	-0.62	-0.19
DTS5	Dentists think only about what is best for their patients.	3.65	0.99	2.6	8.8	30.4	37.3	20.8	-0.45	-0.18
DTS6	Dentists are totally honest in telling their patients about all the different treatment options available for their conditions.	3.76	1.01	2.6	8.0	26.1	37.1	26.2	-0.58	-0.13
DTS7*	Sometimes dentists do not pay full attention to what patients are trying to tell them.	3.46	1.15	4.7	17.5	26.5	29.2	22.0	-0.29	-0.82
DTS8	Dentists always use their very best skills and effort on behalf of their patients.	4.01	0.86	0.9	3.0	21.4	43.0	31.6	-0.68	0.33
DTS9	You have no worries about putting your oral health in the hands of the dentist.	4.03	0.96	1.9	5.2	17.7	38.6	36.7	-0.93	0.55
DTS10	A dentist would never mislead you about anything.	3.54	1.03	3.3	10.7	33.9	32.4	19.7	-0.33	-0.37
DTS11	All in all, you trust dentists completely.	3.55	1.02	3.3	10.6	33.7	32.7	19.7	-0.34	-0.36
DCS										
DCS1	I was satisfied with the dental care I received.	4.29	0.90	1.5	3.6	10.1	33.5	51.2	-1.41	1.89
DCS2*	I would like to have had more explanation of my dental treatment options.	3.63	1.25	7.1	13.0	21.2	27.1	31.5	-0.56	-0.73
DCS3	The dental surgery had everything needed to provide my dental care.	4.36	0.86	1.2	2.6	10.4	30.4	55.3	-1.47	2.16
DCS4*	The dental care I received did not improve my dental health.	4.12	1.13	4.4	6.7	11.8	26.8	50.3	-1.25	0.71
DCS5	I was able to make the dental visit as promptly as I felt was necessary.	4.01	1.08	3.6	6.7	16.0	32.0	41.6	-1.03	0.40
DCS6	The dental professional explained whether there were any patient costs and how much, before beginning the treatment.	3.38	1.42	14.1	16.3	17.7	21.9	30.1	-0.35	-1.21
DCS7	The dental professional I saw explained well what treatment was needed.	4.22	0.91	1.4	3.6	13.3	35.0	46.6	-1.19	1.23
DCS8	I am confident that I received good dental care at my last visit.	4.31	0.88	1.6	2.8	10.1	34.0	51.5	-1.46	2.22
DCS9*	There are things about dental care I received that could have been better.	3.78	1.24	6.3	12.0	15.9	26.7	37.1	-0.76	-0.50

Analysis performed on all samples; DTS, Dentist Trust Scale; DCS, Dental Care Satisfaction; * reverse coded items; SD, standard deviation; directions of response categories towards 1 (strongly disagree) and 5 (strongly agree)

Appendix Table S2. Study participants' sociodemographic characteristics in percentage and comparison with population data

	Data from 2016 Census[(1)]	Distribution in the study (95% CI)
Sex		
Female	50.7	56.6 (55.0-58.1)
Male	49.3	43.4 (41.9-45.0)
Age		
18–39	33.4[¶]	21.7 (20.5-23.0)
40–59	34.7	39.0 (37.5-40.5)
≥60	31.8	39.3 (37.8-40.8)
Income (annual household in AUD)		
<$80,000	60.2[§]	58.1 (56.5-59.7)
≥$80,000	39.8	41.9 (40.3-43.5)
Education		
≤Year 12 or certificate	70.0	59.9 (58.4-61.4)
Diploma/degree	30.0	40.1 (38.6-41.6)

Analysis performed on all samples; [¶] Age 20-39; [§] <$78,000 (<$1,500/week)

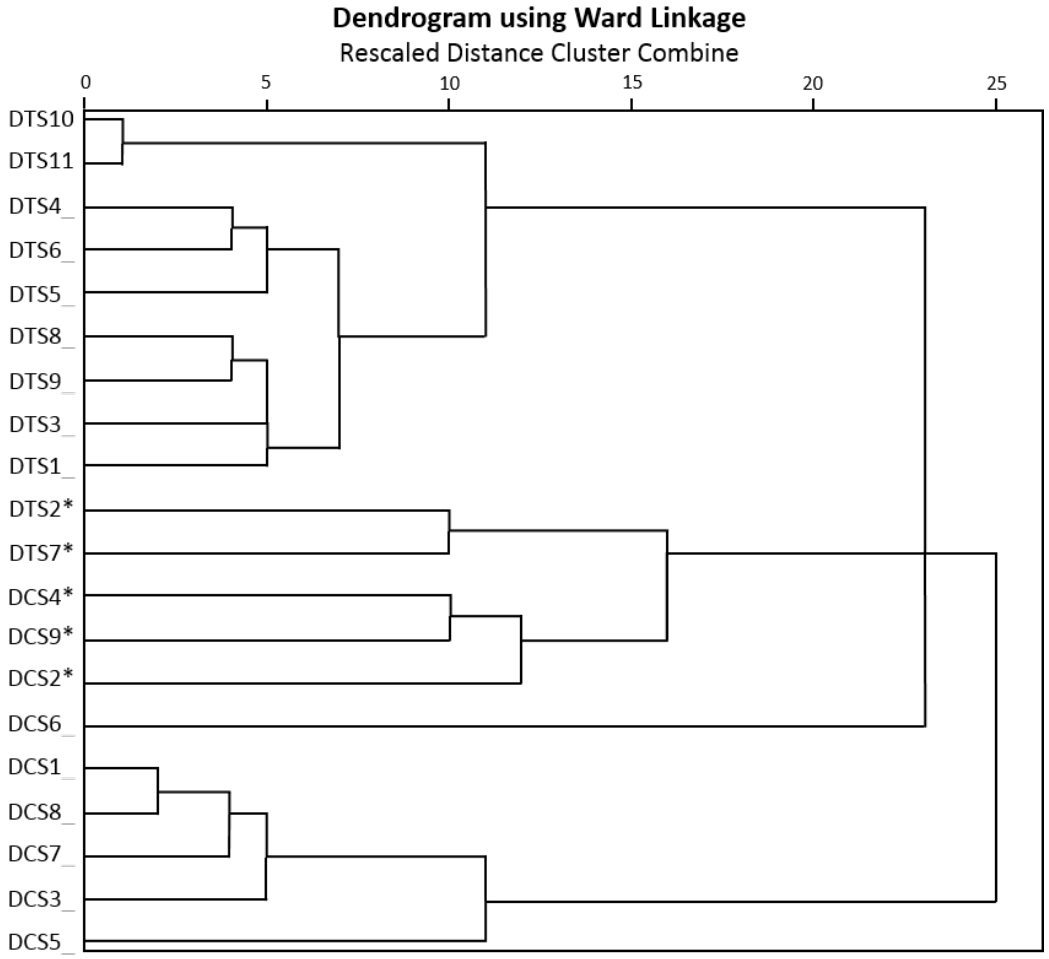
[(1)] 2016 Census: South Australia (from the Australian Bureau of Statistics https://quickstats.censusdata.abs.gov.au/census_services/getproduct/census/2016/quickstat/4)

Appendix Table S3. Bivariate correlations among items and total score in DTS and DCS

Item			DTS											DCS							
	DTS†	DCS†	T1	T2*	T3	T4	T5	T6	T7*	T8	T9	T10	T11	S1	S2*	S3	S4*	S5	S6	S7	S8
T1	.64		-																		
T2*	.49		.34	-																	
T3	.71		.57	.34	-																
T4	.78		.53	.41	.66	-															
T5	.74		.55	.39	.58	.66	-														
T6	.77		.52	.38	.60	.70	.66	-													
T7*	.40		.26	.39	.30	.31	.27	.33	-												
T8	.75		.57	.35	.63	.64	.61	.66	.29	-											
T9	.74		.53	.35	.59	.67	.58	.62	.30	.68	-										
T10	.78		.50	.38	.54	.62	.61	.65	.31	.61	.62	-									
T11	.78		.50	.38	.54	.62	.61	.65	.31	.61	.62	.99	-								
S1		.71	.45	.31	.49	.51	.43	.48	.28	.49	.50	.42	.42	-							
S2*		.47	.26	.31	.27	.29	.23	.29	.31	.26	.27	.25	.26	.36	-						
S3		.59	.38	.25	.41	.41	.38	.39	.23	.45	.44	.36	.36	.58	.29	-					
S4*		.51	.28	.28	.32	.32	.27	.29	.27	.32	.33	.28	.28	.46	.39	.39	-				
S5		.44	.30	.20	.30	.31	.29	.30	.17	.32	.29	.28	.29	.38	.24	.38	.20	-			
S6		.32	.21	.14	.23	.24	.23	.25	.09	.23	.22	.25	.25	.24	.12	.18	.14	.22	-		
S7		.73	.44	.29	.46	.47	.43	.48	.25	.48	.46	.44	.44	.60	.35	.51	.38	.42	.47	-	
S8		.76	.47	.31	.49	.50	.44	.49	.28	.51	.52	.45	.45	.77	.36	.58	.44	.42	.32	.74	-
S9*		.59	.34	.35	.37	.36	.32	.36	.34	.36	.36	.33	.33	.52	.48	.40	.46	.26	.18	.43	.52

Analysis performed on all samples; p-value <0.01 for all inter-item correlations (Pearson *r* correlation coefficients); † Corrected item-total correlation; DTS, Dentist Trust Scale; Ti, DTS i^{th} item; DCS, Dental Care Satisfaction; Si, DCS i^{th} item; * reverse-coded items

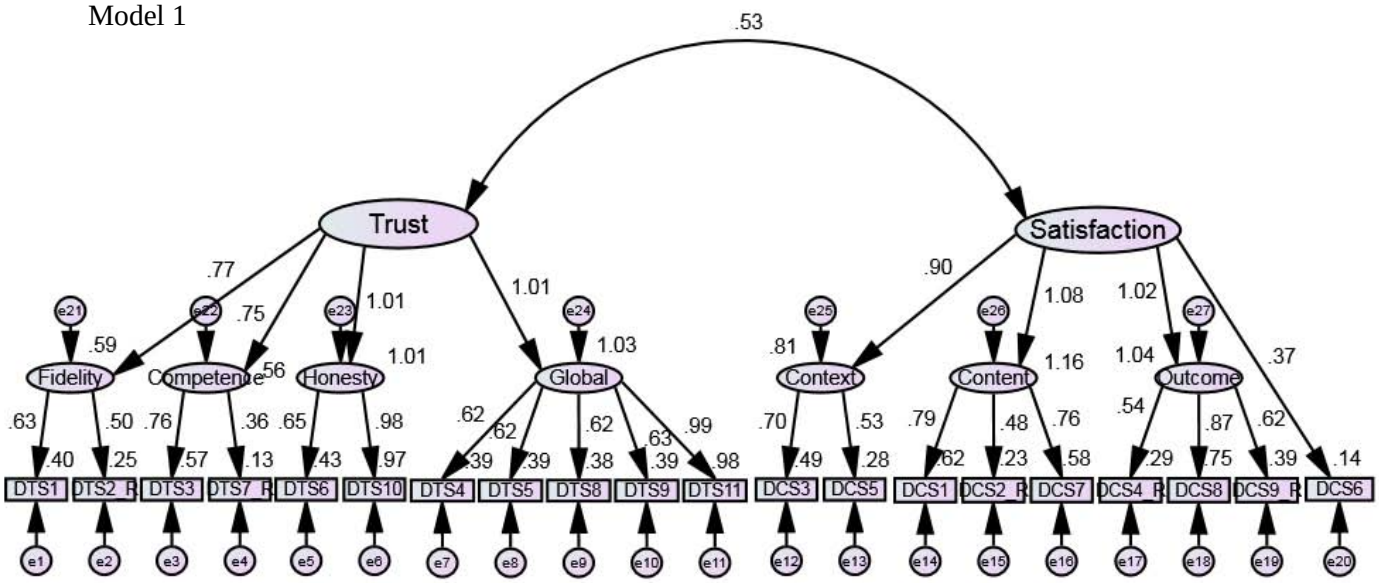
Appendix Figure S1. Structural hierarchy of items in DTS and DCS on dendrogram from cluster analysis



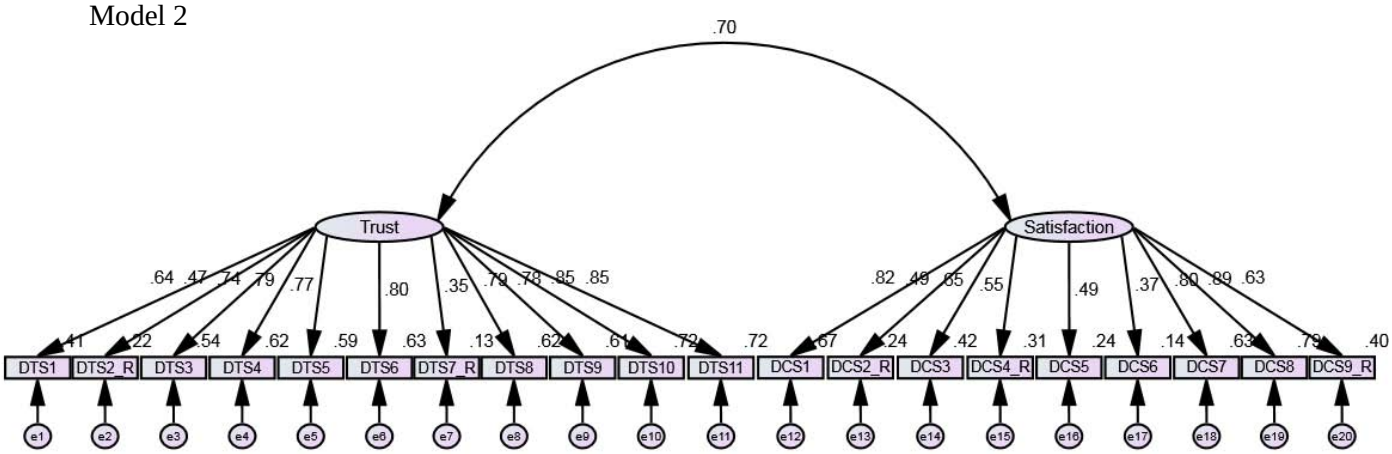
Analysis performed on subsample A; DTS, Dentist Trust Scale; DCS, Dental Care Satisfaction; * reverse-coded items

Appendix Figure S2. Diagrams of models tested in confirmatory factor analysis

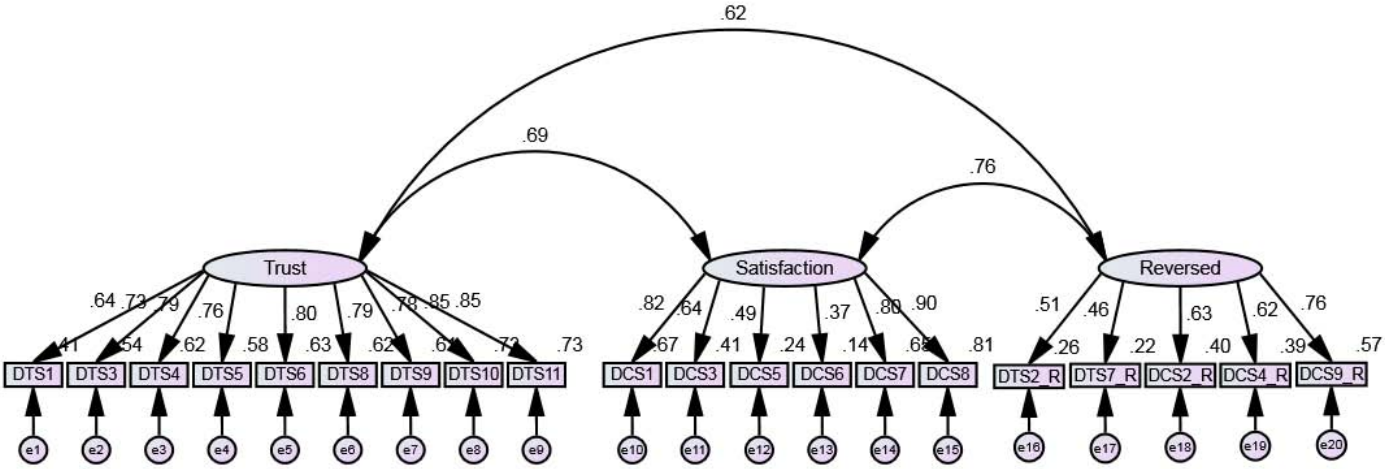
Model 1



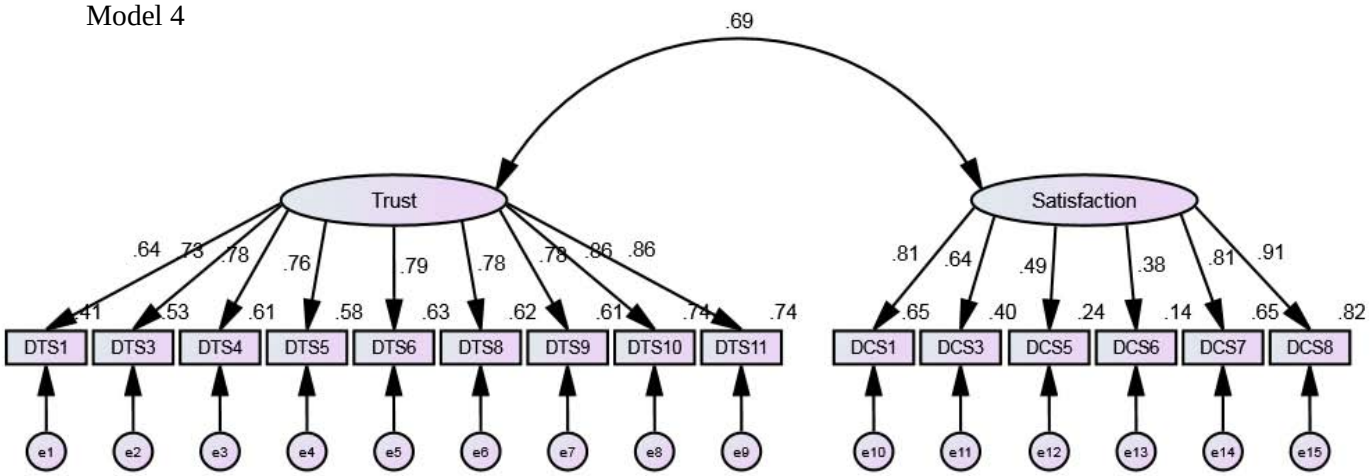
Model 2



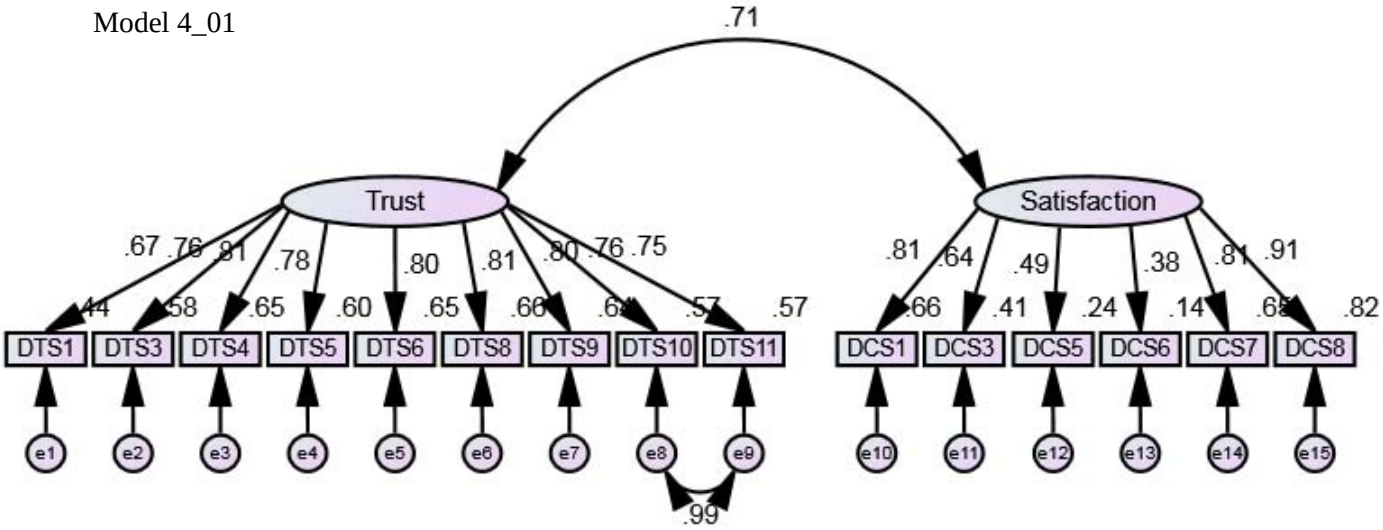
Model 3



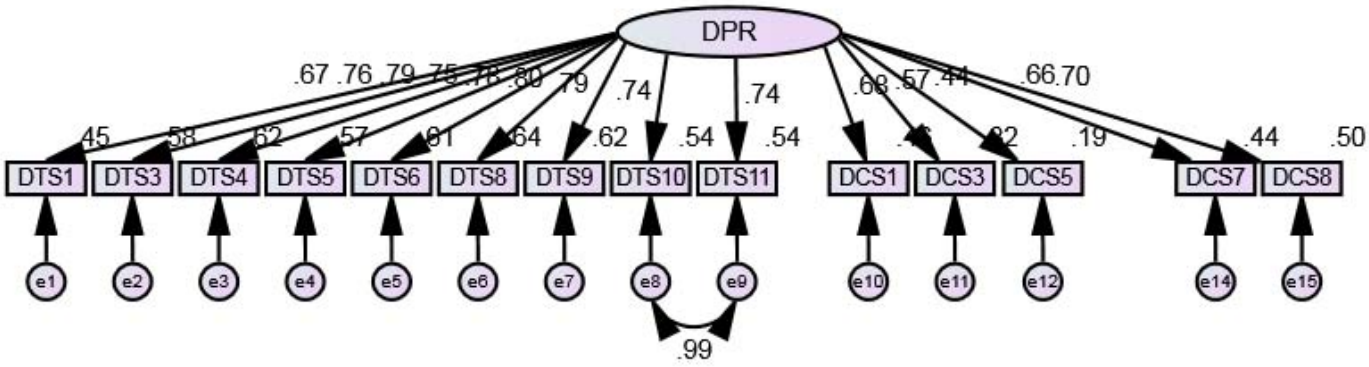
Model 4



Model 4_01



Model 4_03



Chapter 7: Empirical study 3

Statement of Authorship

Statement of Authorship

Title of Paper	Psychosocial factors, dentist-patient relationships, and oral health impact: A structural equation modelling approach
Publication Status	☐ Published ☐ Accepted for Publication ☐ Submitted for Publication ☑ Unpublished and Unsubmitted work written in manuscript style
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Principal Author

Name of Principal Author (Candidate)	Youngha Song
Contribution to the Paper	Initial conceptualisation, data collection/preparation and analysis, writing and critically revising the manuscript, performing the duty as corresponding author
Overall percentage (%)	85%
Certification:	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.
Signature	Date: 24 Jun 2020

Co-Author Contributions

By signing the Statement of Authorship, each author certifies that:

i. the candidate's stated contribution to the publication is accurate (as detailed above);
ii. permission is granted for the candidate in include the publication in the thesis; and
iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

Name of Co-Author	Liana Luzzi
Contribution to the Paper	Supervised the development of the methodology and critically reviewed/revised the draft manuscript
Signature	Date: 01/07/2020

Name of Co-Author	David Brennan
Contribution to the Paper	Supervised the development of the methodology, contributed to the interpretation of the results, and critically reviewed/revised the draft manuscript
Signature	Date: 10 July 2020

Please cut and paste additional co-author panels here as required.

Linkage to the body of work

This final empirical study extends the understanding of the thesis topic in two ways: causal modelling beyond simple associations and a wider framework including psychosocial factors. The conceptual model was organised by the adjusted association found in the previous study and from potential relationships among psychosocial factors, dentist-patient relationship variables, and oral health-related quality of life in the literature review. The hypothesis of possible mediation in dentist-patient relationships from empirical study 1 and findings of factor structure from study 2 were integrated into this causal model for the comprehensive analysis. By analysing direct/indirect effects in the broad framework of 'distal-to-proximal' determinants, dentist-patient relationships can contribute to reinforcing and interpreting the biopsychosocial model of oral health.

Highlights

- Psychosocial factors and dentist-patient relationship variables were associated with oral health impact in both direct and indirect paths from the hypothesised conceptual model.
- The two-step approach in the structural equation modelling guided modifications of the initial model to the final model including mediation of variables to the outcome.
- The framework of ‘distal-to-proximal’ actions based on the Wilson and Cleary model and social dentistry was empirically warranted from psychosocial factors via dentist-patient relationship variables to oral health-related quality of life.

Title: Psychosocial factors, dentist-patient relationships, and oral health impact: A structural equation modelling approach

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Abstract

Objectives: Psychosocial factors and dentist-patient relationships (DPR) have been empirically and normatively suggested to be associated with oral health outcomes. This study aimed to examine and verify the conceptual model comprising hypothesised relationships among psychosocial factors, DPR variables, and oral health-related quality of life (OHRQoL).

Methods: A total of 12,245 adults aged 18 years or over living in South Australia were randomly sampled for the study. Data were collected from self-complete questionnaires in 2015-2016. The outcome variable of oral health impact was used to measure OHRQoL. Psychosocial domain consisted of psychological well-being, social support, and health self-efficacy. DPR domain included trust in dentists, satisfaction with dental care, and dental fear. The initial hypothesised model was tested with a two-step approach in structural equation modelling to achieve adequate fit indices in the final model.

Results: Data were analysed from 3,767 respondents after the screening/preparing process (adjusted valid response rate 37.4%). Confirmatory factor analyses produced acceptable measurement models of each latent variable from each psychometric scale with modifications (GFI=0.95, CFI=0.98, RMSEA=0.04 in the full measurement model). The final structural model indicated that well-being, self-efficacy, and satisfaction were negatively associated with oral health impact (β= –0.12, –0.07, –0.14, respectively) whereas fear was positively associated (β=0.19). Among intermediates, support was positively associated with satisfaction within a small effect size (β=0.06) as compared to self-efficacy with trust (β=0.22). The invariance of the final model was confirmed through cross-validation and multi-group analyses on participants' SES and dental service characteristics except for the variable of 'last dental visit'.

Conclusions: Psychosocial factors and DPR variables were associated with oral health impact in both direct and indirect paths. The framework of ‘distal-to-proximal’ actions is empirically supported from psychosocial factors via DPR variables to OHRQoL.

Keywords: oral health; psychosocial; dentist-patient relations; health-related quality of life; South Australia

Introduction

The focus of epidemiology has been expanded and shifted to social and cultural aspects on the risk of disease from the traditional perspective of the biomedical model (Weiss and Lonnquist 2017). At the centre of social epidemiology are social determinants of health such as psychosocial, economic, political, and environmental factors (Watt 2007). Among others, psychosocial characteristics have been explored for their close relationships to general and oral health outcomes along with socioeconomic status (SES) (Brennan et al. 2019b; Watt 2007). There are a disparate array of variables consisting of the psychosocial factor, which are suggested to be correlated with general/oral health. For example, research has investigated the associations of psychological well-being, social support, health self-efficacy, and perceived stress with oral health outcomes (Armfield et al. 2013; Brennan et al. 2019a; Brennan and Spencer 2012; Brennan et al. 2019b; Sanders et al. 2007).

As a social relationship-based determinant of oral health, dentist-patient relationships (DPR) are one of the key components in the biopsychosocial model in dentistry (Bedos et al. 2018; Song et al. 2020c; Yamalik 2005). The importance of DPR is also acknowledged in the assessment of quality of care and patient-centred care (Committee on Quality of Health Care in America 2001), let alone oral health outcomes (Song et al. 2020c). Considering the context of clinical encounters, DPR should be integrated into the whole process of dental care

(Yamalik 2005), coordinating the delivery of actual dental service. Despite the difficulty operationalising the concept of DPR (Hoff and Collinson 2017), a few relevant constructs are proposed to assess its multidimensionality such as trust in dentists, satisfaction with dental care, dental fear, therapeutic communication, and involvement in clinical decision making (Hoff and Collinson 2017; Muirhead et al. 2014; Song et al. 2020a; Song et al. 2020b; Yamalik 2005).

With the rationale of analysing the role of psychosocial factors and DPR variables for oral health outcomes, however, analysis of potential linkages between the two concepts has not been attempted. In order to conceive a plausible mechanism for the health outcome, the Wilson and Cleary model (Wilson and Cleary 1995), and 'social dentistry' model (Bedos et al. 2018) can provide helpful theoretical frameworks. The former conceptualises the function of psychological characteristics on health-related quality of life in both individual and social/environmental levels (Wilson and Cleary 1995). The proposed functional relationships are organised in the framework of actions suggested by the latter, for their interconnectedness across three levels: macro (society), meso (community), and micro (individual and family) levels (Bedos et al. 2018). In other words, the distal and general domain (psychosocial factors) is hypothesised to result in oral health outcomes through the proximal and dentistry-specific domain (DPR variables). For example, social support and trust as a determinant for health, purported from the social capital theory (Islam et al. 2006), can be hypothesised to result in oral health-related quality of life (OHRQoL) via trust in dentists, one of the more proximal variables for the outcome. The initial model tested in this study was established on the basis of the 'distal-to-proximal' framework with the components of each domain found from the literature review.

In this regard, the aim of the study was to examine and verify the conceptual model comprising hypothesised relationships among psychosocial factors, DPR variables, and the

oral health outcome. The broad framework of associations among domains and specific direct/indirect effects among variables were to be investigated to assess the hypotheses. For more general and rigorous results, the final model was to be cross-validated and tested for the stability of the model with invariance.

Methods

Ethics approval for this study was granted by the Human Research Ethics Committee of the University of Adelaide (H-288-2011). All procedures in the study were performed in accordance with the Helsinki declaration for ethical standards. Informed consent was implied if participants completed and returned the questionnaires mailed to them.

This cross-sectional data were from the baseline of a wider prospective cohort study, which aimed at the influence of different dental care pathways on changes of oral health outcomes (Australian Research Centre for Population Oral Health 2018). A total of 12,245 adults aged 18 years or over living in South Australia were recruited at random from the Electoral Roll in Australia in 2015-2016. Data were collated from self-complete questionnaires by the invitees with a primary approach letter and up to four reminders to encourage response. The sample size was initially calculated from the expected effect size for the original study and considered to be sufficient for the analysis tool in this study (Wolf et al. 2013).

All the variables in the analyses were from multi-item psychometric scales except for a single item of global rating for dental fear. Responses on each item were coded on a 5-point Likert scale from 1=strongly disagree to 5=strongly agree except the Oral Health Impact Profile (OHIP-14) with 0=never to 4=very often. Items with a negative statement were included in some scales to prevent acquiescence bias and reverse-coded for consistency of response such as from 1 to 5 in the corresponding sequence. Higher scores on a scale indicated better

psychosocial and DPR values aside from higher dental fear and oral health impact. The outcome variable was assessed using OHIP-14 representing OHRQoL. The OHIP-14 is a 14-item battery of patient-reported oral health outcome, capturing perceived oral health impact (Slade 1997). OHIP-14 has demonstrated acceptable psychometric properties and widely served as an oral health-specific measure of quality of life (Cronbach's α=0.94 for all samples in this study) (Brennan 2013).

The psychosocial domain for the study included psychological well-being, social support, and health self-efficacy. Psychological well-being was quantified using the Satisfaction with Life Scale (SWL), which comprises five items reflecting subjective global life satisfaction as a single factor (α=0.89) (Diener et al. 1985). Although well-being itself may be considered an outcome variable equated to quality of life, we adopted it as a predictor with a focus on its psychosocial role as a 'frame of reference' to conceive/interpret OHRQoL. Social support was measured using the Multidimensional Scale of Perceived Social Support (PSS) with 12 items loaded on three factors of family, friends, and significant other (α=0.94) (Dahlem et al. 1991). Health self-efficacy was assessed using the Perceived Health Competence Scale (PHC), combining outcome and behavioural expectancies from eight items including four reverse-coded items (α=0.84) (Smith et al. 1995).

We selected trust in dentists, satisfaction with dental care, and dental fear as potential representatives for the DPR domain (Song et al. 2020c). Trust in dentists was assessed using the Dentist Trust Scale (DTS) validated as a single factor structure with 11 items including three reverse-coded items (α=0.92) (Armfield et al. 2017). The dental care satisfaction scale (DCS) was used to measure satisfaction with care received at the last dental visit, a short form of nine items including four reversely coded out of a 31-item full scale (α=0.83) (Stewart and Spencer 2005). Dental fear was rated by asking a single question: "Do you feel

afraid or distressed when going to the dentist?" (1=not at all to 5=extremely afraid), which has been consistently used in national-level surveys in Australia (Armfield et al. 2009).

Before performing statistical analyses, the collected data were prepared by sorting out the low quality of responses and unengaged cases. Respondents with the number of missing items in either scale >20% and/or identical responses to all items on either scale including reverse-coded items were excluded on the criteria. The imputation of missing values for the items of 20% or less in psychometric scales was conducted by the expectation-maximisation algorithm with an iterative maximum likelihood estimation. All samples obtained through the process were randomly split in half for analysing the model with the one and cross-validating with the other.

The initial conceptual model is drawn in Figure 1. Each domain rests on the diagram in a balanced juxtaposition to represent the outline of the 'distal-to-proximal' framework. Hypotheses of paths to be tested are delineated in the model as straight arrow lines with +/– signs to indicate positive/negative associations among variables. As we are interested in exploring a vast range of effects and pathways rather than specific estimates of exposures for the population, structural equation modelling (SEM) is advised for the purpose (VanderWeele 2012). In particular, we employed the two-step approach in SEM to develop/modify the conceptual model (Anderson and Gerbing 1988). Firstly, confirmatory factor analyses (CFA) were performed on subsample A to test the validity of measurement models in each domain and an all-inclusive full model. Following the result of CFA, the structural model hypothesised in Figure 1 was tested for the final causal model. In addition to the two steps, the final model from subsample A was subjected to further invariance tests of cross-validation with subsample B and multi-group analyses across different groups with participants' characteristics (SES and dental service variables) relevant to OHRQoL.

An adequate level of fit indices for measurement and structural models were suggested to be goodness of fit index >0.95, comparative fit index (CFI) >0.95, and root mean square error of approximation (RMSEA) <0.07 (Hooper et al. 2008). Models were considered to be invariant if the difference of CFI and RMSEA were <0.01 and <0.015, respectively (Chen 2007). SPSS and AMOS (Versions 25.0., IBM Corp., Chicago, IL, USA) were used for all statistical analyses. A p-value <0.05 was adopted to be statistically significant.

Results

Data for the analyses were from 3,767 respondents after excluding 727 participants based on the screening criteria (adjusted valid response rate 37.4%). Sociodemographic and oral health-related characteristics of study participants are presented in Table 1. As compared with the population data shown in supplementary Table S1, the study sample had a higher composition of female (56.0% vs. 50.7%), older age group (≥60-year-olds of 37.4% vs. 31.8%), and post-secondary education (diploma/degree of 40.0% vs. 30.0%). There was no statistical difference of the characteristics in Table 1 between two half subsamples. Mean scores of psychometric scales ranged from 0.47 (SD 0.63) for OHIP to 4.10 (SD 0.85) for PSS. Most of each item and sum scores in the scale were within the limit of univariate normality (kurtosis <7, skewness <2 (Curran et al. 1996)) except OHIP being highly right-skewed. As multivariate normality could not be assumed from Mardia's Kurtosis coefficients, bootstrapping with maximum likelihood method of 2,000 times sampling was applied in all SEM analyses (Byrne 2010).

Model fit indices from CFA on subsample A (N=1,882) in each domain and full measurement model are tabulated in Table 2. All initial models conceived by the original psychometric scales showed unacceptably poor fits from CFA. Thus we modified them one-

at-a-time according to the following principles: mathematical guidance of low factor loadings and modification indices, theoretical consideration for less relevant items of the latent variable, and invariant item functioning between subsamples. The final full measurement model is drawn in Figure S1. The model satisfied acceptable fit indices for each and every domain (upper section in Table 2) and validity/reliability criteria for CFA (Table S2). All standardised factor loadings in the model were greater than 0.50 with statistical significance ($p<0.01$). The final measurement model was tested for common method bias (CMB) using the unmeasured latent factor technique (Jordan and Troth 2020), which showed differences of standardised regression weights >0.20 (all in SWL items). Hence we adopted the Single-common-method-factor approach (Podsakoff et al. 2003) for CMB-adjusted values by producing imputed composite scores and applying them to path analysis for the structural model.

The initial structural model hypothesised as Figure 1 indicated a poor fit to the data (Table 2). Modification of the model was also performed with the addition/deletion of paths based on theoretical substantiality and statistical significance one by one until reaching the final model with acceptable fit indices (CFI=0.99, RMSEA=0.036). Figure 2 presents the final structural model in path analysis with all statistical significant coefficients ($p<0.01$). From the psychosocial domain, well-being and health self-efficacy were negatively associated with oral health impact ($\beta= -0.12$ and -0.07, respectively). Satisfaction with dental care was negatively ($\beta= -0.14$) and dental fear positively ($\beta=0.19$) associated with the outcome as direct effects from the DPR domain. Among intermediates between two domains, support was positively associated with satisfaction, having a small effect size ($\beta=0.06$) as compared to self-efficacy with trust ($\beta=0.22$). Within the DPR domain, trust was associated with satisfaction and fear in different positive/negative directions but with the largest effect sizes ($\beta=0.75$ and -0.26, respectively). For endogenous variables, the final model explained 9% of

the variance in oral health impact; 56%, 7%, and 5% in satisfaction, fear, and trust, respectively.

Invariance test results of the final model with cross-validation and multi-group analyses are presented in the lower section of Table 2. The final model was cross-validated on subsample B (N=1,885) with configural, measurement, and structural invariances confirmed. Different groups with all of the participants' SES and dental service characteristics (shown in Table 1) also produced adequate fit indices for model invariances (Table S3) except the variable of 'last dental visit' for the structural invariance (ΔCFI=0.014 in Table 2).

Discussion

This study tested the hypothesised conceptual model and devised the final model for the effects of psychosocial factors and DPR variables on oral health impact. The two-step approach in SEM guided modifications of the initial model to the final model with path coefficients for direct and indirect effects including mediation of variables to the outcome.

In the first step of SEM, CFA led to measurement models with satisfactory fit indices, consisting of each latent variable from each psychometric scale. The results were similar to the findings of previous structural validation between DTS and DCS with minor variations from different approaches (Song et al. 2020b). Reverse-coded items were deleted for low factor loadings from multi-item scales for the acceptable model fit in the first place. Further modifications were predicated on the exclusion of thematically less relevant items and the addition of covariance between analogous items. Those principles were consistently found in CFA for the psychosocial domain, not least PHC as all items reversely worded were dropped and highly correlated items either deleted or drawn with covariance.

The main concept of the framework, 'distal-to-proximal' associations are supported by the final structural model. Psychosocial factors presented with indirect effects on oral health impact via DPR variables as mediators, along with their unique contributions of direct effects. The rationale of the 'proximity' concept can be also countenanced by the larger effect sizes of DPR variables – the more proximal domain to the outcome. The total effects of DPR variables (|β| from 0.14 to 0.19 in Table S4) were much larger than that of more distal psychosocial factors (|β| from 0.01 to 0.12). This mechanism is demonstrated within the same DPR domain as well. DTS, as for the *general* dental context (e.g. trust in general dentists), was entirely mediated by DCS and dental fear, as from *specific* clinical settings (e.g. satisfaction with the dental care at the last visit and fear with a descriptive/evocative question of clinical practice) (Song et al. 2020c). Therefore the theory-based framework suggested in the introduction is empirically verified.

For detailed tests of hypotheses and paths of variables, all differences from the initial conceptual model were observed in the psychosocial domain. SWL was directly associated with OHIP, losing the hypothesised paths to DCS and DTS. The association of PSS was with DCS instead of DTS as initially presumed. PHC had an additional association with DTS in company with a direct effect on OHIP. Positive/negative directions of the paths were all as expected in the hypotheses with better psychosocial and DPR variables leading to lower dental fear and oral health impact. Individual total effects of predictors on the outcome were also in agreement with the findings from the literature review (Armfield et al. 2013; Brennan et al. 2019a; Brennan et al. 2019b; Mehrstedt et al. 2007; Muirhead et al. 2014; Song et al. 2020c). SWL and PHC were significantly and substantially associated with OHIP (β= –0.12 and –0.10 in Table S4) whereas PSS associated in a significant yet negligible amount (β= –0.01) similar to weak or non-significant results from previous studies (Armfield et al. 2013; Brennan et al. 2019a; Brennan et al. 2019b). DCS and dental fear directly accounted for a

considerable amount of variance in OHIP (β= –0.14 and 0.19, respectively), while DTS contributed as only indirect effects. The mediation of trust by satisfaction has already been hypothesised (Song et al. 2020c) and reported for the effect on the compliance (Kim et al. 2004) and loyalty (Platonova et al. 2008) to their physician. Despite its solely indirect association, DTS had a comparable size of the total effect on OHIP (β= –0.15), which warrants the importance of trust for OHRQoL along with satisfaction and fear.

Multi-group analyses of the final model achieved consistent model invariances across different groups of participants' characteristics aside from the variable of 'last dental visit'. The characteristics in the tests were selected considering the substantial role of SES as determinants of health (Armfield et al. 2013; Brennan et al. 2019b; Watt 2007) and dental service variables for oral health-specific outcomes (Armfield et al. 2013; Brennan et al. 2019b; Muirhead et al. 2014; Song et al. 2020c). For those who made their last dental visit ≥12 months ago, paths with statistical significance in difference showed higher coefficients together with similarly greater β in four paths out of the remaining six (Table S5). Inasmuch as two thirds (65.0% in subsample A) of those with the last visit less than 12 months were for regular check-ups, non-regular dental patients are likely to put more weight on psychosocial and DPR variables for OHRQoL.

There are some limitations to be noted in the study. Firstly, the causality in the final model needs to be interpreted with caution due to the nature of cross-sectional data. For example, the causal effect of well-being on OHRQoL can be interpreted in reverse as those with oral health impact/conditions tend to feel lower satisfaction with life, as is reported (Brennan et al. 2008). Secondly, a few important variables as either predictors or confounders were missing in the causal diagram. Not only positive traits, but negative aspects of psychosocial factors are also supposed to be related with oral health outcomes such as psychological stress (Brennan et al. 2019a; Brennan et al. 2019b; Sanders et al. 2007). In the DPR domain,

communication and patients' involvement in clinical encounters are considered to be essential (Committee on Quality of Health Care in America 2001; Hoff and Collinson 2017) other than those included. Even though invariance tests were performed on SES characteristics, income and education may need to be incorporated as functional components in the model for their potential confounding. Next, modified psychometric scales for each latent variable in CFA may represent slightly different or more specific constructs compared with pre-validated original scales. For example, modified oral health impact may not comprehensively represent the outcome by losing some dimensions conceived in the original OHIP-14. In this regard, parcelling or total summed score of items in path analysis can be supplementarily considered for robust results. Finally, data collected entirely from self-complete questionnaires are inherently subject to method biases on empirical studies. In spite of our effort with imputed composite scores to minimise the consequence of CMB, acquiescence bias and social desirability bias might have influenced the results.

The findings of the study provide practical implications. The final model endorses that psychological values in social and clinical environments be encouraged for better oral health outcomes beyond the emphasis on clinical compliance and behavioural changes. Even as social determinants of health, subjective psychosocial factors need to be actively engaged in health promotion as well as objective variables in SES for the social gradient in health (Brennan et al. 2019b). This can be vindicated by the universality of psychosocial values applicable to extensive social milieu as the underlying concept of the common risk factor approach (Sheiham and Watt 2000), not limited to oral and general health. Further studies are advised for the establishment of rigorous causality in a longitudinal design and the general application of the findings to different/diverse outcomes of relevant fields.

Conclusion

This study found psychosocial factors and DPR variables are associated with oral health impact in both direct and indirect paths. The framework of ‘distal-to-proximal’ actions is empirically supported from psychosocial factors via DPR variables to OHRQoL. The theoretical biopsychosocial model of health is practically encouraged for better health promotion, not least self-reported health outcomes with the importance of subjective psychosocial determinants.

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FIGURE 1. Initial hypothesised conceptual model

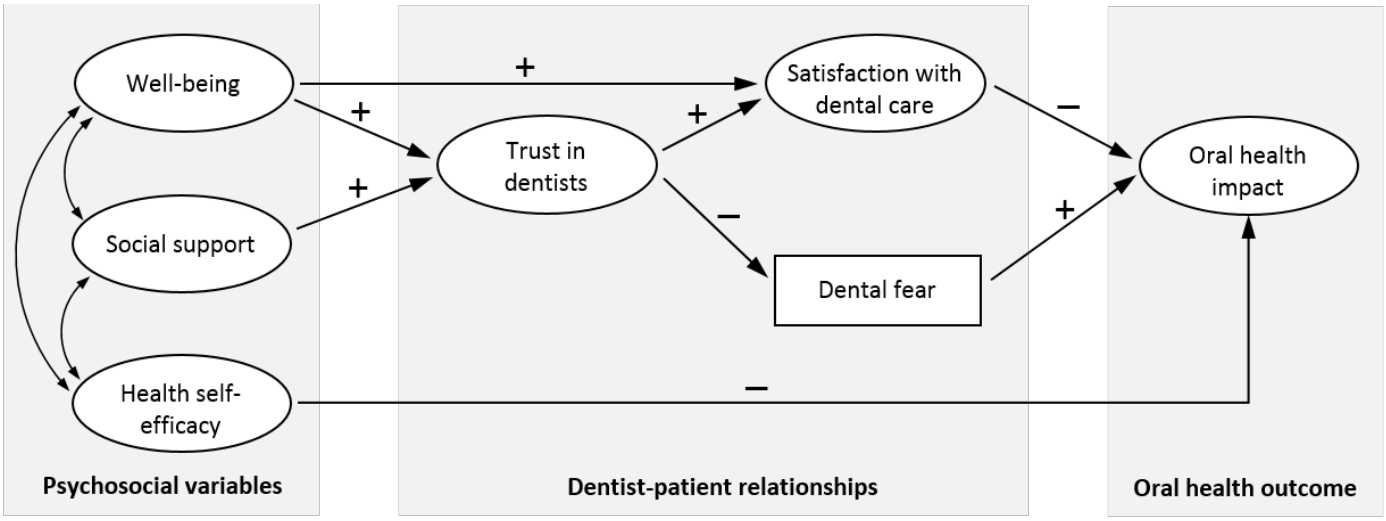


TABLE 1. Sociodemographic and oral health-related characteristics of study participants

Characteristics	Subsample A	Subsample B
	N (valid %)	N (valid %)
Demographics		
Sex		
Female	1054 (56.0)	1079 (57.2)
Male	828 (44.0)	806 (42.8)
Age		
18–39	403 (21.4)	428 (22.7)
40–59	775 (41.2)	712 (37.8)
≥60	704 (37.4)	745 (39.5)
Socioeconomic status		
Income[a]		
<$80,000	990 (57.1)	1012 (58.0)
≥$80,000	744 (42.9)	734 (42.0)
Education		
≤Year 12 or certificate	1118 (60.0)	1101 (59.1)
Diploma/degree	746 (40.0)	762 (40.9)
Oral health behaviours		
Smoking		
Non-smoker	1655 (88.3)	1667 (88.8)
Smoker	219 (11.7)	211 (11.2)
Tooth brushing		
More than once per day	991 (53.9)	1015 (54.9)
Once per day or less	849 (46.1)	835 (45.1)
Dental services		
Last dental visit		
<12months	1161 (61.8)	1207 (64.1)
≥12months	718 (38.2)	677 (35.9)
Dental service sector[b]		
Private	1624 (87.2)	1618 (87.6)
Public	238 (12.8)	229 (12.4)
Perceived dental needs		
No	1526 (82.7)	1541 (83.4)
Yes	319 (17.3)	306 (16.6)

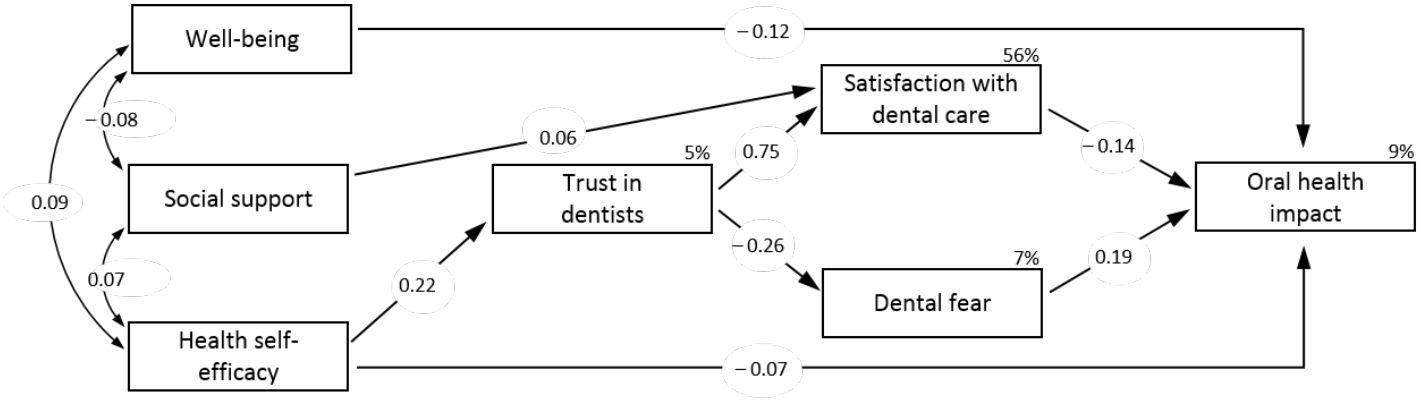
[a] Annual income in Australian dollars; [b] based on the site of the last dental visit

TABLE 2. Model fit indices of structural equation modelling and measurement/structural invariance for cross-validation and multi-group analysis for last dental visit

Model/Invariance	χ^2	d.f.	χ^2/d.f.	GFI	CFI	RMSEA [90% CI]
Measurement model[a]						
Psychosocial variables	439.73	71	6.19	0.967	0.981	0.053 [0.048, 0.057]
DPR variables	571.27	75	7.62	0.959	0.981	0.059 [0.055, 0.064]
OHIP-14	53.95	8	6.74	0.991	0.994	0.055 [0.042, 0.070]
Full measurement model	1649.54	507	3.25	0.951	0.979	0.035 [0.033, 0.036]
Structural model[b]						
Initial hypothesised model	167.94	10	16.79	0.975	0.922	0.092 [0.080, 0.104]
Final model	34.31	10	3.43	0.995	0.988	0.036 [0.023, 0.049]
Cross-validation[c]						
Configural invariance	3411.99	1014	3.37	0.949	0.978	0.025 [0.024, 0.026]
Measurement invariance[d]	3452.19	1042	3.31	0.949	0.977	0.025 [0.024, 0.026]
Comparison test[f]	40.20	28			0.001	<0.001
Configural invariance	151.01	20	7.55	0.988	0.966	0.042 [0.036, 0.048]
Structural invariance[e]	183.40	28	6.55	0.986	0.960	0.038 [0.033, 0.044]
Comparison test[f]	32.39	8			0.006	0.004
Multi-group for last dental visit[g]						
Configural invariance	3363.53	1014	3.32	0.949	0.978	0.025 [0.024, 0.026]
Measurement invariance[d]	3447.04	1042	3.31	0.948	0.977	0.025 [0.024, 0.026]
Comparison test[f]	83.50	28			0.001	<0.001
Configural invariance	176.36	20	8.82	0.986	0.958	0.046 [0.040, 0.052]
Structural invariance[e]	234.21	28	8.37	0.982	0.944	0.044 [0.039, 0.050]
Comparison test[f]	57.85	8			0.014	0.002

d.f., degree of freedom; GFI, goodness of fit index; CFI, comparative fit index; RMSEA, root mean square error of approximation; [a] Final models from confirmatory factor analysis with subsample A; [b] Path analysis model with subsample A; [c] Cross-validation of the final model with subsample B; [d] Factor loadings constrained equal; [e] Factor loadings and path coefficients constrained equal; [f] Difference of χ^2, d.f., CFI, and RMSEA; [g] Comparison by multi-group analysis for the time since the last dental visit (within or over 12 months) from all samples

FIGURE 2. Final structural equation model



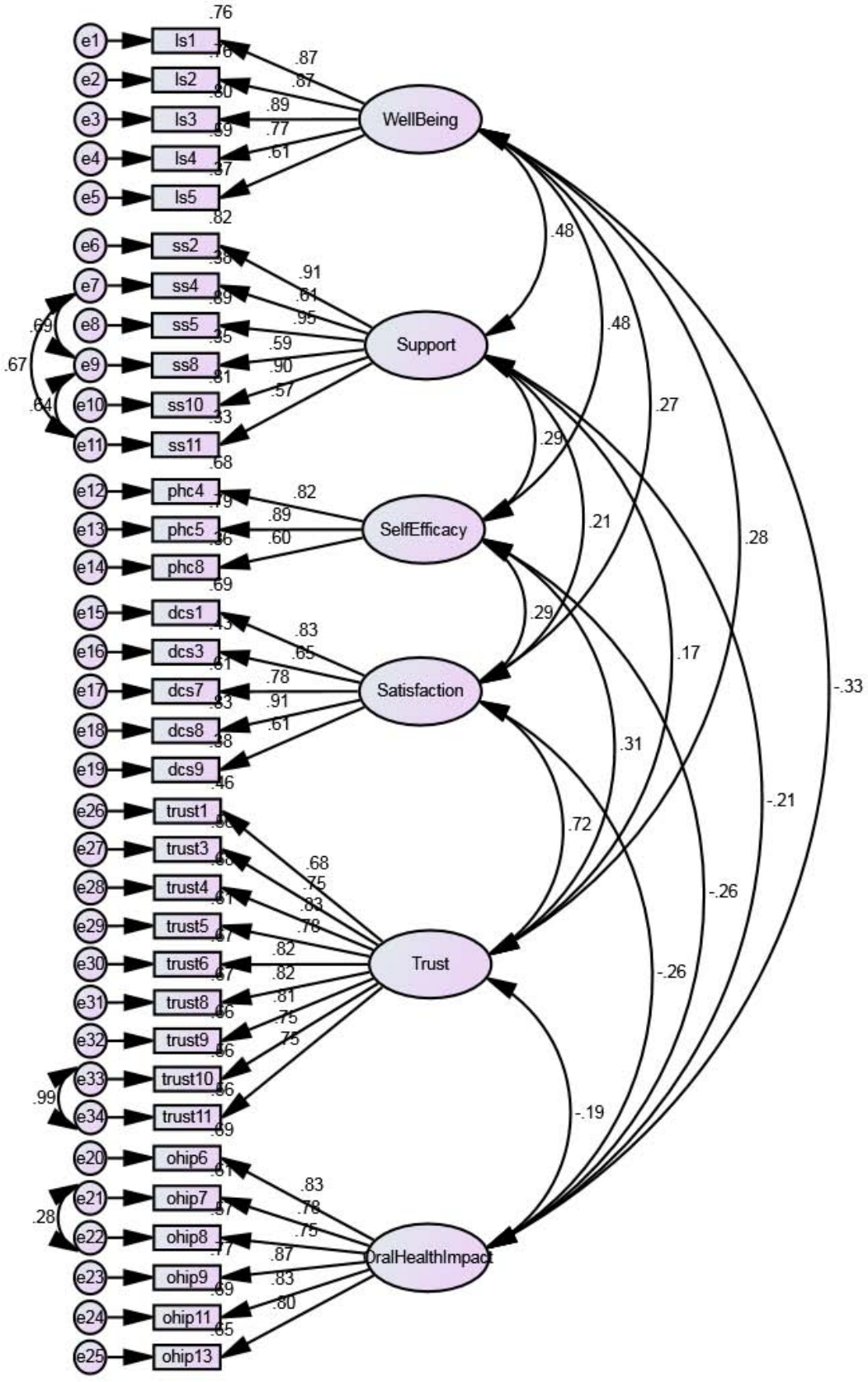
Path analysis with imputed composite scores (error terms not presented); p-value <0.01 for all standardised regression weights and correlations on arrow lines; squared multiple correlations on top right edge of each endogenous variable

Appendix Table S1. Study participants' sociodemographic characteristics in percentage and comparison with population data

	Data from 2016 Census[a]	Distribution in the study[b] (95% CI)
Sex		
Female	50.7	56.0 (53.8-58.2)
Male	49.3	44.0 (41.8-46.2)
Age		
18–39	33.4[¶]	21.4 (19.6-23.3)
40–59	34.7	41.2 (39.0-43.4)
≥60	31.8	37.4 (35.2-39.6)
Income (annual household in AUD)		
<$80,000	60.2[§]	57.1 (54.8-59.4)
≥$80,000	39.8	42.9 (40.6-45.2)
Education		
≤Year 12 or certificate	70.0	60.0 (57.7-62.2)
Diploma/degree	30.0	40.0 (37.8-42.3)

[a] 2016 Census: South Australia (from the Australian Bureau of Statistics https://quickstats.censusdata.abs.gov.au/census_services/getproduct/census/2016/quickstat/4); [b] Characteristics of study participants in subsample A; [¶] Age 20-39; [§] <$78,000 (<$1,500/week)

Appendix Figure S1. Full measurement model of confirmatory factor analysis



p-value <0.01 for all standardised regression weights and correlations on arrow lines; squared multiple correlations on arrow heads; ls, Satisfaction With Life Scale; ss, Perceived Social Stress; phc, Perceived Health Competence Scale; dcs, Dental Care Satisfaction; trust, Dentist Trust Scale; ohip, Oral Health Impact Profile

Appendix Table S2. Validity and reliability of full model in confirmatory factor analysis

	SWL	PSS	PHC	DTS	DCS	OHIP	AVE	CR	N	α
SWL	**0.811**						0.657	0.904	5	0.895
PSS	0.482	**0.773**					0.597	0.895	6	0.903
PHC	0.476	0.287	**0.779**				0.607	0.819	3	0.802
DTS	0.280	0.174	0.307	**0.777**			0.603	0.932	9	0.934
DCS	0.272	0.206	0.291	0.724	**0.766**		0.587	0.874	5	0.855
OHIP	-0.331	-0.206	-0.256	-0.194	-0.257	**0.813**	0.661	0.921	6	0.920

Correlations between factors with root square of AVE as boldface; SWL, Satisfaction With Life Scale; PSS, Perceived Social Stress; PHC, Perceived Health Competence Scale; DTS, Dentist Trust Scale; DCS, Dental Care Satisfaction; OHIP, Oral Health Impact Profile; AVE, Average Variance Extracted; CR, Composite Reliability; N, number of items; α, Cronbach's α

Appendix Table S3. Invariance tests from multi-group analyses

Model	χ^2	d.f.	CMIN/d.f.	GFI	CFI	RMSEA [90% CI]
Multi-group for Income						
Configural invariance	3158.58	1014	3.12	.949	.978	.025 [.024, .026]
Measurement invariance	3351.82	1042	3.22	.946	.976	.025 [.024, .026]
Comparison test	193.24	28			.002	<.001
Configural invariance	157.51	20	7.88	.987	.962	.044 [.038, .051]
Structural invariance	184.36	28	6.58	.984	.957	.040 [.035, .046]
Comparison test	26.85	8			.005	.004
Multi-group for Education						
Configural invariance	3310.86	1014	3.27	.950	.978	.025 [.024, .026]
Measurement invariance	3437.42	1042	3.30	.948	.977	.025 [.024, .026]
Comparison test	126.56	28			.001	<.001
Configural invariance	173.19	20	8.66	.986	.961	.045 [.039, .052]
Structural invariance	180.14	28	6.43	.986	.961	.038 [.033, .044]
Comparison test	6.96	8			<.001	.007
Multi-group for Dental service sector						
Configural invariance	3324.09	1014	3.28	.950	.978	.025 [.024, .026]
Measurement invariance	3376.27	1042	3.24	.949	.978	.025 [.024, .026]
Comparison test	52.18	28			<.001	<.001
Configural invariance	179.97	20	9.00	.986	.959	.046 [.040, .053]
Structural invariance	196.78	28	7.03	.985	.957	.040 [.035, .046]
Comparison test	16.81	8			.002	.006
Multi-group for Dental needs						
Configural invariance	3241.31	1014	3.20	.951	.978	.024 [.023, .025]
Measurement invariance	3303.11	1042	3.17	.950	.978	.024 [.023, .025]
Comparison test	61.80	28			<.001	<.001
Configural invariance	170.84	20	8.54	.987	.959	.045 [.039, .052]
Structural invariance	204.99	28	7.32	.984	.952	.041 [.036, .047]
Comparison test	34.15	8			.007	.004

d.f., degree of freedom; GFI, goodness of fit index; CFI, comparative fit index; RMSEA, root mean square error of approximation

Comparison by multi-group analysis for the variable of participants' characteristic from all samples; Measurement invariance, Factor loadings constrained equal; Structural invariance, Factor loadings and path coefficients constrained equal; Comparison test, Difference of χ^2, d.f., CFI, and RMSEA

Appendix Table S4. Total, direct, and indirect effect with standardised estimates in the final path analysis model

		SWL	PSS	PHC	DTS	Fear	DCS
DTS							
	Total			0.223 (0.025)			
	Direct			0.223 (0.025)			
	Indirect						
Fear							
	Total			-0.058 (0.008)	-0.258 (0.024)		
	Direct				-0.258(0.024)		
	Indirect			-0.058 (0.008)			
DCS							
	Total		0.055 (0.016)	0.167 (0.019)	0.749 (0.013)		
	Direct		0.055 (0.016)		0.749 (0.013)		
	Indirect			0.167 (0.019)			
OHIP							
	Total	-0.119 (0.024)	-0.008 (0.003)	-0.099 (0.028)	-0.150 (0.021)	0.185 (0.029)	-0.136 (0.027)
	Direct	-0.119 (0.024)		-0.066 (0.027)		0.185 (0.029)	-0.136 (0.027)
	Indirect		-0.008 (0.003)	-0.033 (0.006)	-0.150 (0.021)		

p-value <0.01 for all standardised estimates; Bootstrapped standard errors in parentheses; SWL, Satisfaction With Life Scale; PSS, Perceived Social Stress; PHC, Perceived Health Competence Scale; DTS, Dentist Trust Scale; DCS, Dental Care Satisfaction; OHIP, Oral Health Impact Profile

Appendix Table S5. Standardised path coefficients from multi-group analysis for the characteristic of 'last dental visit'

			< 12 months		≥ 12 months		
			β	P value	β	P value	z-score
PHC	→	DTS	.171	<0.001	.184	<0.001	0.613
DTS	→	DCS	.708	<0.001	.755	<0.001	**6.687**
DTS	→	fear	-.210	<0.001	-.211	<0.001	-0.652
PSS	→	DCS	.042	0.004	.038	0.029	0.150
fear	→	OHIP	.190	<0.001	.164	<0.001	-0.903
DCS	→	OHIP	-.124	<0.001	-.168	<0.001	-1.067
PHC	→	OHIP	-.038	0.056	-.070	0.006	-1.182
SWL	→	OHIP	-.111	<0.001	-.201	<0.001	**-3.038**

β, standardised regression weights from multi-group analysis for the time since the last dental visit (within or over 12 months) from all samples; z-score, significant differences are marked in bold face (p<0.01); SWL, Satisfaction With Life Scale; PSS, Perceived Social Stress; PHC, Perceived Health Competence Scale; DTS, Dentist Trust Scale; DCS, Dental Care Satisfaction; OHIP, Oral Health Impact Profile

Chapter 8: General discussion and conclusion

This chapter presents overall findings and discussion of the thesis from four stand-alone papers dealing with the common theme of dentist-patient relationships in the structure of the following headings: summary of findings, general discussion, limitations and strengths of the study, study implications and future research, and conclusions.

Summary of findings

The aim of the thesis was to examine associations of diverse variables in dentist-patient relationships (DPR) with oral health-related quality of life (OHRQoL). In order to achieve the aim, the reverse/inverted funnel approach and sequential hypotheses of the study were introduced throughout the series of articles, from a specific construct of trust in DPR to the inclusion of a wider framework with psychosocial factors. This section succinctly provides the essential findings at a glance from each paper included in the thesis.

The mapping review for the relevant concepts of trust in DPR covered the topic in three frameworks: the continuum of studying trust; beneficiaries of trust utilisation; and a transformational model of trust development. From the system maps drawn in the review, a multidisciplinary approach was advised for the interconnectedness of relevant concepts in trust in DPR. The two core values represented from trust in DPR were patient-centred care and quality of care. Empirical evidence, however, was insufficient to support trust in DPR with mostly normative and imperative propositions from the previous literature.

The first empirical study indicated that better DPR variables were associated with favourable OHRQoL independently from the putative covariates. In particular, lower oral health impact was consistently associated with higher satisfaction with dental care and lower dental fear. Additionally, unadjusted mean scores of DPR variables and OHIP-14 were distributed

differently in accordance with study participants' characteristics. Different levels of bivariate correlation coefficients were found between DPR variables and OHIP-14.

In empirical study 2, the investigation into the similarity between the contiguous constructs of trust and satisfaction in dental care settings supports both the convergent validity of each latent variable and the discriminant validity of their distinctive nature. From the validation procedure, trust and satisfaction in DPR were considered to be unidimensionally separate but highly correlated factors concurrently. The factor solution from exploratory and confirmatory analyses presented the revision of psychometric scales for better structural validity.

The final empirical study tested the hypothesised conceptual model for the association between DPR variables and OHRQoL in a more expansive scope. The final model derived from the two-step approach in structural equation modelling showed psychosocial factors and DPR variables were associated with OHRQoL in both direct and indirect effects including mediation of variables. Starting from psychosocial factors via DPR variables to the OHRQoL, the 'distal-to-proximal' framework for oral health impact was empirically substantiated by the final model.

General Discussion

The discussion of the thesis consists of three thematic findings from the overall thesis and four individual discussion points from each article included. The general thematic findings are: answers to core research questions of the thesis aim; the operationalisation of DPR variables for examination of mediation effects and structural validity; and underlying concepts relevant to the thesis topic. Following the overall findings, the mapping review and three empirical studies provide interpretations and considerations of the results, which are committed to each individual paper.

The core research questions asked throughout the thesis were “Are better dentist-patient relationships associated with improved oral health-related quality of life?” and “If so, how are the variables in dentist-patient relationships positively associated with the oral health outcome?” The first question was conceived and hypothesised from the mapping review where relevant concepts and their associations were drawn in system maps for trust in dental contexts, a representative construct of DPR. Empirical studies 1 and 3 found positive associations between DPR variables and OHRQoL with raising and testing of the hypothesis of mediation effects among variables. As a prerequisite for the second question, trust and satisfaction were validated for factor structure with the population data in empirical study 2, beyond conceptual suggestions. The finding that trust and satisfaction were unidimensionally different yet mutually complementary functions was applied to the hypothesised causal model along with psychosocial factors in empirical study 3. The conceptual model was modified resulting in both direct and indirect effects among variables of domains in a refined final model. Therefore the rationale of the thesis purported in Chapter 1 Introduction was warranted by the collective findings with empirical analyses, contextual consideration on dental encounters, and expansive exploration in the model.

The operationalisation of dentist-patient relationships has been reported to be hard because of its multidimensionality and compartmentalisation (Hoff and Collinson 2017). However, for the purpose of empirical analyses in the thesis, three constructs of trust, satisfaction, and fear/anxiety in dental care settings were employed from self-complete questionnaires. Especially trust and satisfaction in DPR were further studied to clarify their potential collinearity and mediation effects. Through the exploratory and confirmatory analyses, the factor structure with both psychometric scales supported the convergent validity of each latent variable and discriminant validity for their distinctive nature at the same time. With the factor solution acquired from empirical study 2, structural equation modelling in empirical study 3 verified the hypothesis of mediation effects raised from empirical study 1. In the final model of structural equation modelling, trust in dentists was entirely mediated by satisfaction with dental care and dental fear for oral health impact. Despite trust being solely indirectly associated, the total effect of trust on OHRQOL was as large as that of satisfaction and dental fear. In this regard, trust should be considered essential in DPR for oral health outcomes.

Some of the relevant concepts reviewed in Chapter 1 Introduction were commonly found across the thesis as underlying values. The major premise for the conception of the thesis was the biopsychosocial model of oral health and it was consistently introduced by each and every article included. The biopsychosocial model was reflected in the affiliated disciplines such as medical sociology, social epidemiology, and social medicine/dentistry. As those disciplines suggest, the model was translated and applied to useful frameworks for the analyses of empirical articles such as the adoption of the Wilson and Cleary model of health-related quality of life. To provide more clinical encounter contexts, patient-centred care in the quality of care was continuously induced from the findings of the study in company with the practical significance of patient-reported health outcomes. However, as the thesis was focused on the association of DPR with oral health outcomes, different normative models in

physician-patient relationships and the conceptual model of dental encounters were not explored in-depth in the thesis. Based on the findings of the thesis, more comprehensive analyses and experimental designs of DPR are encouraged in further studies for the establishment and measurement of the relationship.

The mapping review for the relevant concepts of trust in DPR suggests the need to take a multidisciplinary approach to address the lack of empirical evidence for the topic. Across the review process for the system maps, an extensive and disparate range of relevant disciplines were discovered. To name a few, the concepts were found in medical/dental sociology; dental professionalism and ethics; public oral health system and policy; psychological aspects of clinical encounters; dental education and training; clinical decision making; medico-/dento-legal liability and conflict mediation; evidence-based dental practice; health economic evaluation for better resource management; marketing and administration of dental practice; and environmental design in dental care settings. Based on the nature of interconnectedness as an eclectic mixture, a multidisciplinary approach is advised and has already been acknowledged (Lewicki et al. 2006). The recommendations for the restoration of better physician-patient trust (Tucker et al. 2016) may be helpful in a similar context of dental care settings. Despite the extensive scale and scope of the topic in the review, there was a limited amount of empirical evidence available from the literature search. Most of the entangled interactions among relevant concepts in the system maps were from normative and imperative suggestions in conceptual healthcare frameworks rather than empirical findings supported by rigorous analytic results, not to mention the need to include more dental contexts. Therefore, further studies are advised to reinforce the structural deficiency in the system maps with an interdisciplinary perspective with more practical and empirical data.

The first empirical study showed a similar pattern of DPR variables in terms of distributions and bivariate correlations, reported in the previous studies. Few differences were noted in the

distribution of DPR variables according to participants' characteristics. The trend of total scores in psychometric scales for DPR variables according to demographic and socioeconomic status was in line with previous findings. For example, older people are likely to report higher trust/satisfaction, and females and those in lower SES seem to feel more fearful in dental clinical encounters (Armfield 2013; Armfield et al. 2017; Stewart and Spencer 2005). Particularly, 'last dental visit' and 'perceived dental needs' in the dental service cluster were explicitly associated with all of the DPR variables in the study (Armfield et al. 2017; Armfield 2010; Stewart and Spencer 2005). Among the three DPR variables, the positive association between trust and satisfaction, and both their negative associations with dental fear (Armfield et al. 2017; Armfield et al. 2014) were also reaffirmed. Another analogous pattern was found between DPR variables and health outcomes. Previously patients with higher trust and satisfaction were more likely to report better health outcomes with clinical indicators of diabetes (Lee and Lin 2011) and OHRQoL from occlusal splint treatment in dental contexts (Inglehart et al. 2014). In particular, dental fear has been hypothetically and empirically correlated with poor oral health outcomes in the 'vicious cycle' (Armfield 2013; Armfield et al. 2009). However, trust in dentists was not consistently associated with OHRQoL in this study, which raised two possible explanations: conceptual postulation of trust for *future* expectations and mediation effects of trust. Those hypotheses were further examined and verified in the subsequent empirical analyses, structural validity in study 2 and structural equation modelling in study 3.

The factor structure in psychometric scales of trust and satisfaction was validated in empirical study 2. Aside from the convergent and discriminant validity of the factor solution aforementioned, two additional findings are worth noting, a third factor and item analysis results. Exploratory factor analysis and cluster analysis demonstrated the presence of a third factor consisting of only reverse-coded items regardless of the original scale source. The

factor was also reported by previous studies in that items with negative statements are frequently formed together in a different factor for the direction of wording (DiStefano and Motl 2006; Locker et al. 2007; Marsh 1996; Van Sonderen et al. 2013). Either a method effect as an *artifactor* (Marsh 1996) or a meaningful attribute as a *response style* (DiStefano and Motl 2006), items with negatively worded statements might not have functioned as intended to prevent acquiescence bias, resulting in a questionable factor (Locker et al. 2007; Van Sonderen et al. 2013). Also, specific items in the psychometric scale showed distinctive patterns in item analyses. Two of the trust scale items were answered almost the same with the bivariate correlation coefficient close to 1.0 in spite of their origin from different conceptual domains (Armfield et al. 2017). A single item from the cost domain in the satisfaction scale presented an obtrusively different feature from the others (Stewart and Spencer 2005), suggesting a modification for better psychometric properties. The factor structure established in the study was re-tested and re-affirmed extensively by structural equation modelling in empirical study 3.

In the final empirical study, the conceptual framework of 'distal-to-proximal' associations was verified by the final model. Having been conceived from the Wilson and Clear model (Wilson and Cleary 1995) and social dentistry (Bedos et al. 2018), psychosocial factors provided both direct contributions to and indirect effects via DPR variables on oral health impact. Not only was the inter-domain causal model supported, but within the intra-domain of DPR, the concept of 'proximity' was reflected among trust, satisfaction, and dental fear by their contextual applications. Thus the overall theoretical framework is justified with minor modifications of hypothetical paths in the model. For more robust study findings, the final model was applied to cross-validation and invariance tests across different groups of participants' characteristics. Multi-group analyses for the invariance indicated the robustness of the results in the final model except for the variable of 'last dental visit'. Considering the

portion of regular check-ups for the purpose of the last dental visit, non-regular dental patients are more likely to be affected by psychosocial factors and DPR variables for oral health impact.

Limitations and strengths of the study

This thesis has some limitations to provide caution in the interpretation of the study findings. The mapping review has two aspects of limitations: inherent weakness in methodology and some important topics missing on trust in DPR. For the purpose of extensively covering relevant topics on trust in DPR, the review adopted a pragmatic approach. Even though a systematic searching protocol was employed for the initial screening of the review, most associations of the concepts in the system maps were acquired through an *ad hoc* approach such as citation chaining and hand searching. While the approach was effectively applied to drawing comprehensive system maps for the theme, the methodology may not be as rigorous or robust as to reproduce the findings reported. The other issue is missing topics in the review by limiting the scope to *patients'* perspective in a *naïve* and *interpersonal* approach. As trust is considered to involve mutual interactions, the dentists' viewpoint also needs to be taken into account for balanced relationships. Given the nature of trust being dynamic and complex, simply building up trust in DPR is only one naïve way to deal with the topic, setting aside diverse features of establishing trust such as maintenance (Lewicki et al. 2006), restoration (Öztürk and Noorderhaven 2018), and negotiation of trust (Skirbekk 2009). The interpersonal approach can miss other crucial attributes of trustworthiness including social determinants of trust and technical competency in clinical encounters (Thom et al. 2004).

In the empirical studies, common limitations and those proper to each article should be acknowledged. Firstly, three common limitations are noted: cross-sectional design of the study, methodological biases from self-complete questionnaires, and missing some important variables in DPR. Despite comprehensive analyses among disparate variables, only associations – not necessarily causality – were found by the inherent drawback of the cross-sectional data, even in the causal model of structural equation modelling. Data analysed in the

empirical studies were entirely from self-complete questionnaires by the respondents invited. Therefore, the chance of method biases still remains in the analyses such as common method variance, response bias, acquiescence bias, and social desirability bias. Considering the difficulty operationalising concepts of DPR and psychosocial factors, variables tested in the analyses may not be sufficiently representative or exhaustive in the framework. Not only those included, but other important traits/attributes should contribute to the empirical verification of conceptual models. Next, each article has some limitations pertaining to individual analysis. In empirical study 1, a high correlation coefficient (r=0.67) between trust and satisfaction may raise an issue of possible collinearity. However the inclusion of both variables was justified by the following study with structural validity and an acceptable level of tolerance (Hair et al. 1998). The second empirical study was only performed on the premise of covariance/correlation matrix-based mathematical analyses, thus the additional introduction of comparative correlates can complementarily support the validity of findings. In empirical study 3, putative confounders in the causal model were not employed as functional components but tested only in multi-group analyses for invariance across different characteristics.

Notwithstanding the limitations pointed out above, this thesis has strengths to efficaciously achieve the aim and objectives proposed in Chapter 2. From the beginning of the thesis, better understanding the complexity and interdisciplinary nature of trust in DPR was enabled with the introduction of visual system maps, a graphic aid rather than narrative descriptions. The maps can provide the outline of relevant concepts in DPR and guide future hypothesis settings for conceptual and/or empirical frameworks. For the variables adopted in the empirical studies, they are drawn from well-validated psychometric scales or commonly accepted questionnaires in the previous literature. Therefore the validity and reliability of the constructs could be initially assumed aside from the factor structure between trust and

satisfaction in DPR. The variables were collected from a relatively large sample representing the study population, which favours the generalisability and universality of the study findings applicable to other contexts. In addition, thorough and rigorous analytic methods provide support to the validity of the study findings. For example, cross-validation, the exploration-confirmation process and multi-group analyses in empirical studies 2 and 3 could strengthen the stability of factor structure and invariance of the final model.

Study implications and future research

The findings of the study can suggest practical implications for both clinical dentistry and dental public health. So far, in clinical dental encounters, better DPR have been encouraged mainly as normative values or imperatives. However, studies included in the thesis found out more practical benefits for improved oral health outcomes and detailed framework among different constructs relevant to DPR. The conceptual model offered in the Chapter 1 literature review has become more specified by the study findings with the concepts of patient-centred care and patient-reported health outcomes. For dental public health, studies in the thesis contribute to translating the conceptual framework of the biopsychosocial model of oral health into empirical applications at different levels of social relationships. More comprehensively, the analysis starting from the proximal dentist-patient encounters has been expanded to the wider and more distal components, psychosocial factors, for oral health outcomes. The implication of the thesis became possible by applying three levels of actions in social dentistry to the analytic methodology in the reverse/inverted funnel approach and sequential hypotheses.

As the studies in the thesis are bound to have some limitations for the findings, future research should address the shortcomings identified in both study design and research topic. To establish causal inferences in the study, longitudinal and experimental designs are advised rather than the analysis of cross-sectional data. On the study design, novel or meticulous approaches may be required to prevent method biases raised in the limitation section, such as the use of a multitrait-multimethod matrix for common method variance (Podsakoff et al. 2003) and exploratory structural equation modelling for the issue of cross-loading in factor structure (Asparouhov and Muthén 2009). Analyses in the study design also need to combine methods in social science and applied medical/health discipline according to research

contexts such as Actor-Partner Interdependence Model and Social Relation Analysis (Kenny 1994; Kenny et al. 2006). Regarding the scope of the research topic, this thesis, as the title indicates, focused mainly on the benefit of better DPR for the utilisation/justification of the topic. Now that the rationale of better DPR is warranted by the findings of the thesis, further studies are encouraged to explore the measurement (how to evaluate DPR comprehensively) and development (how to improve DPR efficaciously) of DPR. The framework found in the mapping review – a continuum of three labels with utilisation, measurement, and establishment of DPR – remains further tasks as the first step was only taken.

Conclusions

In general conclusion, this thesis examined the associations of variables in DPR with OHRQoL in the presence of putative confounders and a wider framework of the biopsychosocial model. Based on the reverse/inverted funnel approach, the thesis started from a specific construct of trust in DPR and covered the structural validity of analogous variables in DPR following sequential hypotheses. Better DPRs were associated with more favourable OHRQoL in both direct and indirect paths along with psychosocial factors. Trust and satisfaction, two representative variables in DPR, have a factor structure with both convergent and discriminant validity that can be used together for further studies of DPR.

The specific conclusions from each study were:

1. The mapping review found that a multidisciplinary approach was advised for the study of trust in DPR from its interconnectedness among relevant concepts. The common underlying values from the review were patient-centred care and quality of care. Even though trust was acknowledged with its centrality in medical/dental contexts, empirical evidence was insufficient with primarily normative suggestions hitherto.
2. Better DPR, mainly higher satisfaction and less dental fear, were associated with favourable OHRQoL, presenting lower oral health impact. The significant association was consistently established between better DPR and less oral health impact after adjusting for putatively confounding variables.
3. The analyses on factor structure showed that the constructs of trust and satisfaction in dental care settings were unidimensionally different but highly correlated factors concurrently, beyond the conceptual proposition. The final model from the structural

validity assessment suggested the revision of both scales for better psychometric properties with modifications of the initial factor solution.

4. The final empirical study supported the conceptual framework of ‘distal-to-proximal’ actions from psychosocial factors via DPR variables to OHRQoL. From the empirical findings, the biopsychosocial model of oral health as theoretically conceived can be practically applied to improve health promotion with support for favourable psychosocial factors and better DPR variables.

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Thesis appendices

Appendix 1. DCOHs questionnaire

THE UNIVERSITY of ADELAIDE

AUSTRALIAN RESEARCH CENTRE FOR POPULATION ORAL HEALTH
SCHOOL OF DENTISTRY

DENTAL CARE AND ORAL HEALTH STUDY

The purpose of this study is to answer fundamental questions on what works best in relation to the provision of dental care. The study involves collection of responses to a questionnaire from a sample of Australian adults aged over 18 years. The questionnaire will take about **20 minutes** to complete.

Why participate?

1. The study provides evidence to a National Strategic Plan Priority Area on health systems development.
2. This is a major study that tracks your health outcomes and dental care over time.
3. Results of the study will be available on a project website (more information provided at end of this survey).

How to complete the survey?

1. Please use a DARK pen to write your answers.
2. Please use BLOCK LETTERS.
3. Responses can be provided by:
   - Marking with a CROSS (eg. [X])
   - Circling a number (eg. (1))
   - Writing the response (eg. MOBILE DENTAL CLINIC)

Instructions are also provided at the beginning of each question.

4. There are three parts to the survey:
   PART A asks questions about oral health.
   PART B asks questions about general health.
   PART C asks questions about your background, education and work.
5. Answer all questions, unless otherwise indicated.

Your feedback is strictly confidential

1. Results will be reported as group profiles only.
2. Individual identity will not be revealed.

Any queries

Dental care and oral health study
Health Services Research Unit
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Conducted by:

Health Services Research Unit
Australian Research Centre for Population Oral Health (ARCPOH)
School of Dentistry, The University of Adelaide

Please return the completed questionnaire as soon as possible in the reply paid envelope provided

PART A contains questions about your oral health status, dental visits, dental insurance, financial burden due to dental care, impact of oral health on your daily life and issues related to your satisfaction with dental care and the dental system in Australia. Instructions on how to answer each question are provided at beginning of the question.

1 Tooth brushing habits [Please mark with a CROSS or WRITE your answer, where required]

A. In the last week, how many times did you brush your teeth? _____ (times) → **If NIL go to Question 1 D now**

B. If you said you brushed your teeth at least once a week, how long on average do you spend on brushing your teeth?

- ☐ Less than one minute
- ☐ About one minute
- ☐ About 1½ minutes
- ☐ About 2 minutes
- ☐ About 2½ minutes
- ☐ About 3 minutes
- ☐ More than 3 minutes

C. In the last week, how many times did you use an electric tooth brush? _____ (times)

D. In the last week, how many times did you use dental floss? _____ (times)

E. In the last week, how many times did you use a mouth rinse/wash? _____ (times)

F. If you used a mouth rinse or mouth wash, write the name of the product you used here: _____

2 Number of teeth [Please mark with a CROSS or WRITE your answer, where required]

A. Do you have any of your own natural teeth?

- ☐ Yes, I have some or all of my natural teeth
- ☐ No, I have none of my natural teeth → **If NO go to Question 3 now**

B. There are 16 teeth, including wisdom teeth, in the UPPER jaw. How many of these 16 teeth do you have in your upper jaw? *Do not count false teeth. If you have no teeth in your upper jaw write 'nil'.*

I have _____ (number) of teeth in my UPPER jaw.

C. There are 16 teeth, including wisdom teeth, in the LOWER jaw. How many of these 16 teeth do you have in your lower jaw? *Do not count false teeth. If you have no teeth in your lower jaw write 'nil'.*

I have _____ (number) of teeth in my LOWER jaw.

3 Dentures [Please mark with a CROSS]

Dentures are artificial teeth that can be removed.

A. Do you wear a denture in your UPPER jaw? ☐ Yes ☐ No

B. Do you wear a denture in your LOWER jaw? ☐ Yes ☐ No

4 Oral and general health [Please mark with a CROSS]

A. How would you rate your dental health? ☐ Excellent ☐ Very good ☐ Good ☐ Poor ☐ Very poor

B. How would you rate your general health? ☐ Excellent ☐ Very good ☐ Good ☐ Poor ☐ Very poor

5 Dental visits [Please mark with a CROSS or WRITE your answer, where required]

A. When was your last visit to a dental professional?
(Includes dentist, dental specialist, oral health therapist, dental hygienist, dental therapist, dental technician, denturist or dental prosthetist)

- ☐ Less than 12 months ago
- ☐ One to less than two years ago
- ☐ Two to less than five years ago
- ☐ Five to less than ten years ago
- ☐ Ten years or more
- ☐ Never attended → **Go to Question 6**

B. What was the main reason for your last dental visit?

- ☐ Examination or check-up
- ☐ Treatment (not for relief or pain)
- ☐ Emergency/relief of pain

C. How often do you usually seek care from a dental professional?
(Includes dentist, dental specialist, oral health therapist, dental hygienist, dental therapist, dental technician, denturist or dental prosthetist)

- ☐ More than two times a year
- ☐ Two times a year
- ☐ Once a year
- ☐ Once every two years
- ☐ Less often than once every two years

D. Where did you go for your last dental visit?

- ☐ Private dental practice
- ☐ Public dental clinic (including dental hospital, community clinic)

E. Please write the name of the suburb or postcode of the clinic where you made your last dental visit ?

_____ suburb OR ☐☐☐☐ postcode

F. Overall, how many...

		In the last 12 months	One year to two years ago
1	...dental appointments have you attended.....		
2	...dental examinations have you had.....		
3	...clean and scale procedures have you had.....		
4	...fillings have you had.....		
5	...teeth have you had extracted (removed).....		

G. Have you had any other dental treatment in the last 12 months?
[Cross the relevant box(es)]

- ☐ No other treatment in the last 12 months
- ☐ Professional fluoride application
- ☐ New denture(s) prepared or fixed
- ☐ Oral surgery (besides extraction)
- ☐ Other treatment (please specify) _____
- ☐ Gum treatment (periodontal treatment)
- ☐ Adjustment, reline or rebase denture(s)
- ☐ Orthodontics
- ☐ Crown or bridge treatment

6 Future dental visits [Please mark with a CROSS]

A. Do you need to make a dental visit now? ☐ Yes ☐ No → **If NO go to Question 7 now**

B. What do you need the dental visit for? ☐ Check-up ☐ Treatment (not for relief of pain) ☐ Emergency/relief of pain

C. How soon do you think you need a check-up or treatment?

- ☐ In less than a week
- ☐ From one week to less than a month
- ☐ From one month to less than three months
- ☐ From three months to less than six months
- ☐ Six months or more

7 Financial burden [Please mark with a CROSS or CIRCLE your answer, where required]

A. During the last 12 months, have you avoided or delayed visiting a dental professional because of cost? ☐ Yes ☐ No

B. Has cost prevented you from having any dental treatment that was recommended by a dental professional? ☐ Yes ☐ No

> Did you take up an alternative lower cost option for the treatment that was recommended? ☐ Yes ☐ No

> Which dental treatments were prevented by cost? (Please CROSS as many as applicable)

- ☐ Fillings
- ☐ Extractions
- ☐ Scale and clean
- ☐ Dental implants
- ☐ Gum treatments (periodontal)
- ☐ Dental crown or bridge
- ☐ Root canal
- ☐ Dentures made
- ☐ Orthodontic treatment
- ☐ Cosmetic treatment (eg. bleaching)
- ☐ Replace amalgams with white
- ☐ Others

C. In the last 12 months how much of a financial burden have dental visits been to you? ☐ None ☐ Hardly any ☐ A little ☐ A large burden

D. At most times of the year, how much difficulty would you have paying a **$150 bill** out of your own pocket? ☐ None ☐ Hardly any ☐ A little ☐ A lot

E. Overall, how satisfied are you with your current financial situation?

Totally dissatisfied										*Totally satisfied*
0	1	2	3	4	5	6	7	8	9	10

F. Overall, how satisfied are you with the material standards of your life?

Totally dissatisfied										*Totally satisfied*
0	1	2	3	4	5	6	7	8	9	10

G. Relative to others, how would you rate your financial position?

Worse than most										*Better than most*
0	1	2	3	4	5	6	7	8	9	10

H. Do you hold any of these concession cards?

- ☐ Health Care Card
- ☐ Pensioner Concession Card
- ☐ Commonwealth Seniors Card
- ☐ Other card
- ☐ None of the above
- ☐ Don't know

I. Do you have private health insurance (including hospital or ancillary/extras insurance, excluding Medicare)

☐ Yes, I have private health insurance ☐ No, I do not have private health insurance

> What best describes your private health insurance status?

- ☐ Combined hospital & ancillary/extras cover
- ☐ Hospital cover only
- ☐ Ancillary/extras only cover

8 **Impact of oral health on your daily life**

HOW OFTEN during the PAST YEAR

	Never	Hardly ever	Occasionally	Fairly often	Very often
Please CIRCLE	1	2	3	(4)	5
1. Have you had **trouble pronouncing any words** because of problems with your teeth, mouth or dentures?	1	2	3	4	5
2. Have you felt that your **sense of taste has worsened** because of problems with your teeth, mouth or dentures?	1	2	3	4	5
3. Have you had **painful aching** in your mouth?	1	2	3	4	5
4. Have you found it **uncomfortable to eat any foods** because of problems with your teeth, mouth or dentures?	1	2	3	4	5
5. Have you been **self-conscious** because of your teeth, mouth or dentures?	1	2	3	4	5
6. Have you **felt tense** because of problems with your teeth, mouth or dentures?	1	2	3	4	5
7. Has your **diet been unsatisfactory** because of problems with your teeth, mouth or dentures?	1	2	3	4	5
8. Have you had to **interrupt meals** because of problems with your teeth, mouth or dentures?	1	2	3	4	5
9. Have you found it **difficult to relax** because of problems with your teeth, mouth or dentures?	1	2	3	4	5
10. Have you been **a bit embarrassed** because of problems with your teeth, mouth or dentures?	1	2	3	4	5
11. Have you been **a bit irritable** with other people because of problems with your teeth, mouth or dentures?	1	2	3	4	5
12. Have you had **difficulty doing your usual jobs** because of problems with your teeth, mouth or dentures?	1	2	3	4	5
13. Have you felt that **life in general was less satisfying** because of problems with your teeth, mouth and dentures?	1	2	3	4	5
14. Have you been **totally unable to function** because of problems with your teeth, mouth or dentures?	1	2	3	4	5
15. Have you had **pain** in the face, jaw, temple, in front of ear, or in the ear?	1	2	3	4	5
16. Have you **broken or chipped** a natural tooth?	1	2	3	4	5
17. Have you had **sensitive teeth**, for example due to hot or cold food or drinks?	1	2	3	4	5
18. Have you had any teeth that have become **loose** by themselves without some injury?	1	2	3	4	5
19. Have you had **sore gums**?	1	2	3	4	5

9 Dental fear [Please CROSS the appropriate box]

Do you feel afraid or distressed when going to the dentist?	Not at all ☐	A little afraid or distressed ☐	Moderately afraid or distressed ☐	Very afraid or distressed ☐	Extremely afraid or distressed ☐

10 Dentist trust

These questions relate to Dentist Trust. In general... *Please CIRCLE a number for each statement*

	Strongly disagree				Strongly agree
1. Dentists care about their patients' health just as much or more as their patients do.	1	2	3	4	5
2. Sometimes dentists care more about what is best for them, than about patients dental needs.	1	2	3	4	5
3. Dentists are extremely thorough and careful.	1	2	3	4	5
4. You completely trust dentists decisions about which dental treatments are best.	1	2	3	4	5
5. Dentists think only about what is best for their patients.	1	2	3	4	5
6. Dentists are totally honest in telling their patients about all the different treatment options available for their conditions.	1	2	3	4	5
7. Sometimes dentists do not pay full attention to what patients are trying to tell them.	1	2	3	4	5
8. Dentists always use their very best skills and effort on behalf of their patients.	1	2	3	4	5
9. You have no worries about putting your oral health in the hands of the dentist.	1	2	3	4	5
10. A dentist would never mislead you about anything.	1	2	3	4	5
11. All in all, you trust dentists completely.	1	2	3	4	5

11 Dental care satisfaction

A. Have you ever visited a dentist before? ☐ Yes ☐ No → **If No, Go to Question 12 now**

B. These questions relate to your LAST DENTAL VISIT.

Please CIRCLE a number for each statement

	Strongly disagree				Strongly agree
1. I was satisfied with the dental care I received.	1	2	3	4	5
2. I would like to have had more explanation of my dental treatment options.	1	2	3	4	5
3. The dental surgery had everything needed to provide my dental care.	1	2	3	4	5
4. The dental care I received did not improve my dental health.	1	2	3	4	5
5. I was able to make the dental visit as promptly as I felt was necessary.	1	2	3	4	5
6. The dental professional explained whether there were any patient costs and how much, before beginning the treatment.	1	2	3	4	5
7. The dental professional I saw explained well what treatment was needed.	1	2	3	4	5
8. I am confident that I received good dental care at my last visit.	1	2	3	4	5
9. There are things about dental care I received that could have been better.	1	2	3	4	5

PART B asks questions about your general health and impact of general health on your daily life. Instructions on how to answer each question are provided at beginning of each question.

12 General health information [Please mark with a CROSS or WRITE where required]

A. What is your current HEIGHT? _____ centimetres OR _____/_____ feet / inches

B. What is your current WEIGHT? _____ kilograms OR _____ pounds

C. Do you have any of these chronic medical conditions? [Please CROSS all that apply]

1. Asthma ☐	9. Cataracts ☐	17. Hypothyroidism ☐
2. Chronic bronchitis or emphysema ☐	10. Glaucoma ☐	18. Rheumatic fever ☐
3. Hypertension or high blood pressure ☐	11. Osteoporosis ☐	19. A bleeding problem ☐
4. A heart condition or heart attack ☐	12. Hip fracture ☐	20. Deafness ☐
5. High cholesterol ☐	13. A cancer or malignancy ☐	21. Diagnosed with dementia ☐
6. A stroke or "mini strokes" (TIA) ☐	14. A diagnosed depression ☐	22. Diagnosed with Alzheimer's disease ☐
7. Diabetes ☐	15. Parkinson's disease ☐	23. Artificial joints, heart valves or prosthesis ☐
8. Arthritis ☐	16. Epilepsy ☐	24. Other medical conditions (please specify) ☐ _____

D. **Which of these statements best describe your cigarette smoking status?**

- ☐ I smoke daily → A) On average, I smoke _____ (number) cigarettes per day.
- ☐ I smoke occasionally → A) On average, I smoke _____ (number) cigarettes per day.
- ☐ I do not smoke now but I used to → B) I used to smoke ____(number) cigarettes per day. C) I stopped smoking _____ years ago.
- ☐ I have never smoked

13 Your general health today [Please CROSS one box only for each question]

A. MOBILITY	I have no problems walking about. ☐	I have some problems walking about. ☐	I am confined to bed. ☐
B. SELF CARE (eg. Washing, dressing)	I have no problems with self care. ☐	I have some problems with washing and dressing myself. ☐	I am unable to wash or dress myself. ☐
C. USUAL ACTIVITIES (eg. household work, family, leisure)	I have no problems performing my usual activities. ☐	I have some problems performing my usual activities. ☐	I am unable to perform my usual activities. ☐
D. PAIN/DISCOMFORT	I have no pain or discomfort. ☐	I have moderate pain or discomfort. ☐	I have extreme pain or discomfort. ☐
E. ANXIETY/DEPRESSION	I am not anxious or depressed. ☐	I am moderately anxious or depressed. ☐	I am extremely anxious or depressed. ☐

14 **Life satisfaction, social support and work** [Please CIRCLE a number that best represents your perspective]

A. The following statements seek views on levels of life satisfaction

	Strongly disagree				Strongly agree
1. In most ways my life is close to my ideal.	1	2	3	4	5
2. The conditions of my life are excellent.	1	2	3	4	5
3. I am satisfied with my life.	1	2	3	4	5
4. So far I have acquired the important things I want in my life.	1	2	3	4	5
5. If I could live my life over, I would change almost nothing.	1	2	3	4	5

B. The following statements are about social support.

	Strongly disagree				Strongly agree
1. There is a special person who is around when I am in need.	1	2	3	4	5
2. There is a special person with whom I can share joys and sorrows.	1	2	3	4	5
3. My family really tries to help me.	1	2	3	4	5
4. I get the emotional help and support I need from my family.	1	2	3	4	5
5. I have a special person who is a real source of comfort to me.	1	2	3	4	5
6. My friends really try to help me.	1	2	3	4	5
7. I can count on my friends when things go wrong.	1	2	3	4	5
8. I can talk about my problems with my family.	1	2	3	4	5
9. I have friends with whom I can share my joys and sorrows.	1	2	3	4	5
10. There is a special person in my life who cares about my feelings.	1	2	3	4	5
11. My family is willing to help me make decisions.	1	2	3	4	5
12. I can talk about my problems with my friends.	1	2	3	4	5

C. The following statements are about your work.
Paid work, study and volunteering are considered 'work'.

→ **IFYOU ARE NOT WORKING CURRENTLY GO TO QUESTION 15 NOW**

	Strongly disagree				Strongly agree
1. After work, I am too tired for leisure activities, family time or house chores.	1	2	3	4	5
2. I have so much work to do that it takes away from my personal interests.	1	2	3	4	5
3. My family/friends dislike how often I am preoccupied with work while I am at home.	1	2	3	4	5
4. Work takes up time that I'd like to spend with family or friends.	1	2	3	4	5
5. I am often too tired at work because of the things I have to do at home.	1	2	3	4	5
6. My superiors and peers dislike how often I am preoccupied with my personal life while at work.	1	2	3	4	5
7. My personal demands are so great that they interfere with my work.	1	2	3	4	5
8. My personal life takes up time that I'd like to spend at work.	1	2	3	4	5

15 **General health** [Please CIRCLE a number that best represents your perspective]

A. The following statements are about your general health.

	Strongly disagree				Strongly agree
1. I take responsibility in caring for my health.	1	2	3	4	5
2. No matter how hard I try my health does not turn out the way I would like.	1	2	3	4	5
3. It is difficult for me to find effective solutions to health problems that come my way.	1	2	3	4	5
4. I succeed in the projects I undertake to improve my health.	1	2	3	4	5
5. I am generally able to achieve my goals with respect to health.	1	2	3	4	5
6. I am usually unsuccessful in making changes to things about my health that I don't like.	1	2	3	4	5
7. Generally, my plans for my health don't work out well.	1	2	3	4	5
8. I am able to do things for my health as well as most other people.	1	2	3	4	5

B. The following statements ask questions about stress. While answering Can you please consider " How often during the Past year..."

	Very often	Fairly often	Occasionally	Hardly ever	Never
Please CIRCLE	1	2	3	(4)	5
1. Have you felt upset because of something that happened unexpectedly?	1	2	3	4	5
2. Have you felt unable to control the important things in life?	1	2	3	4	5
3. Have you felt either nervous or stressed?	1	2	3	4	5
4. Have you dealt successfully with irritating life hassles?	1	2	3	4	5
5. Have you effectively coped with important changes in your life?	1	2	3	4	5
6. Have felt confident about your ability to handle your personal problems?	1	2	3	4	5
7. Have you felt things were not going your way?	1	2	3	4	5
8. Have you felt unable to cope with all things that you had to do?	1	2	3	4	5
9. Have you felt able to control irritations in your life?	1	2	3	4	5
10. Have you felt you were on the top of things?	1	2	3	4	5
11. Have you felt angered because of things that happened outside your control?	1	2	3	4	5
12. Have you found yourself thinking about all the things that you have to accomplish?	1	2	3	4	5
13. Have you felt able to control the way you spend your time?	1	2	3	4	5
14. Have you felt difficulties were piling up so high that you could not overcome them?	1	2	3	4	5

16 **Social and health system values** [Please CIRCLE a number that best represents your opinion]

	Strongly disagree				Strongly agree
1. The community is responsible for ensuring everyone is able to receive dental care.	1	2	3	4	5
2. People with similar dental problems should be provided with the same dental care.	1	2	3	4	5

17 Personality traits [Please CIRCLE the number that best represents your answer]

Here are a number of personality traits that may or may not apply to you. Please indicate the extent to which you agree or disagree with each statement. You should rate the extent to which the pair of traits applies to you, even if one characteristic applies more strongly than the other.

I see myself as:	Disagree strongly	Disagree moderately	Disagree a little	Neither agree or disagree	Agree a little	Agree moderately	Agree strongly
1. Extraverted, enthusiastic	1	2	3	4	5	6	7
2. Critical, quarrelsome	1	2	3	4	5	6	7
3. Dependable, self-disciplined	1	2	3	4	5	6	7
4. Anxious, easily upset	1	2	3	4	5	6	7
5. Open to new experiences, complex	1	2	3	4	5	6	7
6. Reserved, quiet	1	2	3	4	5	6	7
7. Sympathetic, warm	1	2	3	4	5	6	7
8. Disorganised, careless	1	2	3	4	5	6	7
9. Calm, emotionally stable	1	2	3	4	5	6	7
10. Conventional, uncreative	1	2	3	4	5	6	7

18 Orientation to life [Please CIRCLE the number that best represents your answer]

Do you usually:	Yes, usually	Yes, sometimes	No
1. Feel that the things that happen to you in your life are hard to understand?	1	2	3
2. See a solution to problems and difficulties that other people find hopeless?	1	2	3
3. Feel that your daily life is a source of personal satisfaction?	1	2	3

19 Wellbeing [Please CIRCLE the number that best represents your answer]

HOW OFTEN during the PAST MONTH:	None of the time	A little of the time	Some of the time	Most of the time	All of the time
1. Did you feel tired out for no good reason?	1	2	3	4	5
2. Did you feel nervous?	1	2	3	4	5
3. Did you feel so nervous that nothing could calm you down?	1	2	3	4	5
4. Did you feel hopeless?	1	2	3	4	5
5. Did you feel restless or fidgety?	1	2	3	4	5
6. Did you feel so restless you could not sit still?	1	2	3	4	5
7. Did you feel depressed?	1	2	3	4	5
8. Did you feel that everything was an effort?	1	2	3	4	5
9. Did you feel so sad that nothing could cheer you up?	1	2	3	4	5
10. Did you feel worthless?	1	2	3	4	5

PART C asks generic questions about your background, education, diet and work. Instructions on how to answer each question are provided at beginning of each question.

20 Diet [Please WRITE an appropriate number or choose from the options provided]

A1. My usual daily serves of fruit: _____(serves) (Number)

A2. My usual daily serves of vegetables: _____(serves) (Number)

B1. Since same time last year, my fruit consumption: ☐ Increased ☐ Decreased ☐ Stayed about the same

B2. Since same time last year, my vegetable consumption: ☐ Increased ☐ Decreased ☐ Stayed about the same

C1. How often is salt used in your household for cooking or preparing food? ☐ Very often ☐ Occasionally ☐ Rarely ☐ Not used

C2. How often is salt added to food at the table? ☐ Very often ☐ Occasionally ☐ Rarely ☐ Not used

21 General information [Please CROSS or WRITE your answer, where required]

A. Please write your YEAR OF BIRTH ☐☐☐☐

B. Please mark your GENDER
☐ Male
☐ Female

C. In which country were you born?
☐ Australia ☐ Other country (please specify) _____
↓
Which year did you migrate to Australia? ☐☐☐☐

D. Are you of Aboriginal or Torres Strait Islander origin?
☐ No ☐ Yes, Torres Strait Islander
☐ Yes, Aboriginal ☐ Yes, Aboriginal & Torres Strait Islander

E. What is the main language you speak at home?
☐ English
☐ Other (please specify) _____

F. What is your current marital status?
☐ Single, never married ☐ Divorced
☐ Married or de facto partnership ☐ Separated
☐ Widowed

G. Do you have children?
☐ Yes
☐ No

If NO go to Question H now

> Please provide the ages of your children starting with your oldest child (in years/months)

1. _____ 3. _____ 5. _____
2. _____ 4. _____ 6. _____

H. What is the HIGHEST level of education you have completed?
☐ No schooling completed ☐ Completed high school
☐ Completed primary school ☐ Vocational training
☐ Some high school ☐ University degree/Tertiary qualification

I. Where did you complete your highest education?
☐ In Australia
☐ In other country (please specify) _____

22 Work related information

A. Are you currently employed?
- ☐ Yes, full time
- ☐ Yes, part-time
- ☐ No, not currently working

B. Please select an option that best describes the work you do?
- ☐ Managers
- ☐ Professionals
- ☐ Technicians and trade workers
- ☐ Community and personal service workers
- ☐ Clerical and administrative workers
- ☐ Sales workers
- ☐ Machinery operators and drivers
- ☐ Labourers

C. Which of the following best describes the position you hold within your business or organisation?
- ☐ Managerial
- ☐ Supervisory
- ☐ Non-management/Non-supervisory

D1. How would you describe your management position?
- ☐ Top
- ☐ Upper
- ☐ Middle
- ☐ Lower

D2. Do you participate in making policy decisions such as products or services delivered, people employed, budgets and so forth?
- ☐ Yes
- ☐ No

D3. As an official part of your job, do you supervise the work of other employees or tell other employees what work to do?
- ☐ Yes
- ☐ No

E. How many people contribute to your household income?
- ☐ Only ME
- ☐ Myself and my PARTNER
- ☐ Myself, my partner and OTHERS (including children, parents)

F. Which category does your total household income (before tax) fall into? Include any salaries, pensions, allowances, benefits etc. from all persons in the household. (Please CROSS one box only)
- ☐ Less than $20,000
- ☐ $20,001 to $40,000
- ☐ $40,001 to $60,000
- ☐ $60,001 to $80,000
- ☐ $80,001 to $100,000
- ☐ $100,001 to $120,000
- ☐ $120,001 to $140,000
- ☐ $140,001 to $160,000
- ☐ $160,001 to $180,000
- ☐ More than $180,000

Please feel free to write here if you have any suggestions/comments:

THE UNIVERSITY of ADELAIDE

TRACK THE STUDY PROGRESS AND RESULTS BY VISITING OUR **WEBSITE:**
www.adelaide.edu.au/arcpoh/dentalcarestudy

If you would like future correspondence by email please provide us with your email address in the box below:

Appendix 2. Ethics approvals

THE UNIVERSITY of ADELAIDE

RESEARCH BRANCH
RESEARCH ETHICS AND COMPLIANCE UNIT

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CRICOS Provider Number 00123M

17 November 2011

Associate Professor D Brennan
School of Dentistry

Dear Associate Professor Brennan

APPROVAL No.: **H-288-2011**
PROJECT TITLE: **Dental health services research for improved oral health outcomes**

I write to advise you that on behalf of the Human Research Ethics Committee I have approved the above project. Please refer to the enclosed endorsement sheet for further details and conditions that may be applicable to this approval.

The ethics expiry date for this project is: 30 November 2012

Participants taking part in the study are to be given a copy of the Information Sheet and the signed Consent Form to retain.

Please note that any changes to the project which might affect its continued ethical acceptability will invalidate the project's approval. In such cases an amended protocol must be submitted to the Committee for further approval.

It is a condition of approval that you **immediately report** anything which might warrant review of ethical approval including:

- serious or unexpected adverse effects on participants
- proposed changes in the protocol; and
- unforeseen events that might affect continued ethical acceptability of the project.

It is also a condition of approval that you inform the Committee, giving reasons, if the project is discontinued before the expected date of completion.

A reporting form is available from the website at http://www.adelaide.edu.au/ethics/human/guidelines/reporting.This may be used to renew ethical approval or report on project status including completion.

Yours sincerely

for PROFESSOR GARRETT CULLITY
Convenor
Human Research Ethics Committee

THE UNIVERSITY of ADELAIDE

RESEARCH BRANCH
OFFICE OF RESEARCH ETHICS, COMPLIANCE AND INTEGRITY

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CRICOS Provider Number 00123M

26 November 2012

Associate Professor D Brennan
School of Dentisrty, University of Adelaide

Dear Associate Professor Brennan

PROJECT NO: H-288-2011
Dental health services research for improved oral health outcomes

Thank you for your report on the above project. I write to advise you that I have endorsed renewal of ethical approval for the study on behalf of the Human Research Ethics Committee.

The expiry date for this project is: 30 November 2015

Where possible, participants taking part in the study should be given a copy of the Information Sheet and the signed Consent Form to retain.

Please note that any changes to the project which might affect its continued ethical acceptability will invalidate the project's approval. In such cases an amended protocol must be submitted to the Committee for further approval. It is a condition of approval that you immediately report anything which might warrant review of ethical approval including (a) serious or unexpected adverse effects on participants (b) proposed changes in the protocol; and (c) unforeseen events that might affect continued ethical acceptability of the project. It is also a condition of approval that you inform the Committee, giving reasons, if the project is discontinued before the expected date of completion.

A reporting form is available from the Committee's website. This may be used to renew ethical approval or report on project status including completion.

Yours sincerely

Dr John Semmler
Acting Convenor
Human Research Ethics Committee

Appendix 3. Two reflective articles for the motif of the thesis

Examinations for overseas-trained dentists in Australia and the UK: formative and summative feedback

Youngha Song[1]

Key points

- Helps understand examinations for overseas-trained dentists in Australia and the UK.
- Provides formative and summative feedback on the examinations from a participant and practitioner's perspective.
- Proposes three suggestions to better evaluate the competency of overseas-trained dentists in Australia and the UK.

Abstract

Examinations for overseas-trained dentists are enforced to qualify for registration to perform dental practices in some countries. Feedback on the examinations in Australia and the UK is presented as formative and summative evaluations from a participant and practitioner's perspective. The formats of both examinations are analysed with the foci of the composition, implementation and standard-setting/standardisation in practical tests. The structures of the examinations are formulated in a different manner, resulting in different pass rates. Some administrative errors and loopholes are identified in the implementation. The issue of reliability is raised for the acceptability of the practical examination. Among components of the examinations, establishing the relationship and communicating with patients is more valued to practitioners trained overseas, along with medical emergency protocols for patients' safety. To better evaluate the competency of overseas-trained dentists in Australia and the UK, three suggestions are proposed. Firstly, the examination governing body should ask for and refer to feedback from actively practising dentists passing through the qualification process. Next, the examinations should redirect the target of competency from dental manikin-based dexterity to a more comprehensive evaluation. Finally, the equivalent level of qualifying competency for the examinations described in official publications may need to be revisited.

Introduction

Dental qualifications are generally recognised within only the home country or certain foreign areas under the valid accreditation of dental education. Thus overseas-trained dentists (OTDs) – qualified in other than the destination country and in which their primary dental education was not performed – need to either pass specific examinations or take further training programmes if seeking registration for dental practice. A few countries enforce the requirement of successful examination results on OTD candidates; these include Australia,[1] the United Kingdom,[2] Canada,[3] and South Korea.[4] Each country has its own dental accreditation authority governing the examinations: the Australian Dental Council (ADC) exam in Australia; the Overseas Registration Examination (ORE) by the General Dental Council in the UK (commissioned to the examination suppliers);[5] the National Dental Examining Board of Canada (NDEB) Equivalency Process in Canada; and the Korea Health Personnel Licensing Examination Institute in South Korea.

The international migration of OTDs has become a global issue, beyond specific agreements or partnerships in a local region.[6] For some high-income countries, the number of qualified OTDs occupies a significant portion of the oral health workforce. For example, one out of four practising dentists in Australia is an OTD,[7] and 1,300 dentists had qualified through ORE between 2007 and 2016 in the UK.[5] In particular, the issue of 'Brexit' may lead to huge ramifications for the examination in the UK – currently primary dental qualifications for practice within the European Economic Area are mutually and automatically recognised across countries. Not only for a country's policy on the dental care system, but for individual candidates, the examinations for OTD are 'high-stakes' attempts at the cost of a considerable amount of resources.[5] Given its importance on both sides, however, there are very few study findings,[7] except for the official publications from the examination governing entity. If any, they are either 'floating' tips from interest groups on the internet or unproven advice from private preparation courses and institutions for the examinations.

This opinion piece is to present personal arguments on the examinations for OTD in Australia and the UK. They are based on anecdotal evidence and 'snapshot' analyses. However, as a former participant in both the ADC examination and the ORE, I happen to occupy a vantage point to reflect on the pitfalls and propose suggestions for improvement. Having been educated up to undergraduate level and practised dentistry for six years in South Korea, I passed through the ADC exam at the second attempt in 2014. Since carrying out dental practices in Australia, I have attempted the ORE twice in 2014 and

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Table 1 Comparison in formats of the ORE, pre-/post-revision of the ADC exam and the NDEB Assessment of Clinical Skills (as of 2019 January, otherwise specified)

	ORE	ADC exam (2018 Jul ~)	ADC exam (2014 Jun ~ 2018 Mar)	NDEB
Application and requirements	Application form with: Clinical experience (1,600 hrs); Evidence of English language	No change	Initial assessment: Evidence of English language (when applying for registration after exam pass)	NDEB Equivalency Process
Knowledge test	Part 1 (for 2 days): Two papers of 3-hour time limit each; Multiple short answer questions	No change	Written examination (for 2 days): Four papers of 2-hour time limit each; 80 multiple choice questions each	Assessment of fundamental knowledge: Two books of 150 multiple choice questions for 3 hrs each. Assessment of clinical judgement: Two books of 60 single/multiple choice questions for total 5 hrs.
Practical and clinical skills test	Part 2 (for 3 days) with four components: An operative test on a dental manikin (DM); An objective structured clinical examination (OSCE); A diagnostic and treatment planning exercise (DTP); A practical examination in medical emergencies (ME)	Practical examinations (for 2 days) with 16 tasks: Clinical skills day (OSCE 10 stations); 2 x clinical information gathering; 2 x diagnosis and management planning; 6 x clinical treatment and evaluation. Technical skills day (dental models 6 tasks): 3 x restorative-based; 3 x preparation-based.	Practical examinations* (for 2 days) with 13 tasks out of 14: Restoration; class II composite resin, class IV composite resin, class II amalgam. Preparation; class III composite resin, class II amalgam, full gold crown, metal-ceramic crown. Endodontic access. Fabrication of a provisional crown. Applying a rubber dam. Record keeping. Infection control. Clinical communication. Taking radiographs in a manikin.	Assessment of clinical skills* (for 2 days) with 12 tasks: Restoration; class II composite resin, class IV composite resin, class II amalgam. Preparation; class III composite resin,. class II amalgam, full metal crown, metal-ceramic crown. Endodontic access. Fabrication of a provisional crown. Dental dam application. Record keeping. Infection control and safety.

*With almost identical marking criteria on the same tasks in both the ADC and the NDEB exams

2018, for only personal achievements, which left unsuccessful results but valuable findings for this paper. To provide more context, my less than optimal proficiency in the English language and unfamiliarity with dental education in western countries can help to justify my arguments on what and how the competency is evaluated in the examinations for dentists trained overseas. Many colleague candidates contributed to the arguments for this paper by sharing and discussing their 'unofficial' ideas, which have a lot in common with my own.

Formative feedback

For every candidate, the format of the examination and how to pass it are clearly of the utmost importance. This section is feedback on how candidates are assessed by the examination in the actual test venue. In spite of considerable differences in dental education and service systems among countries, the overall format of the examinations appears mostly consistent. The stages comprise a series of an initial qualification assessment, dental knowledge test, and clinical skills test in a chronological order (Table 1). They are seemingly posited on the consensus about the evaluation of learning outcomes in dentistry (for example, both the ADC exam and the ORE are based on Miller's framework of 'Knows', 'Knows how', 'Shows how', 'Does').[8] As can be seen in Table 1, the first stage (initial document assessment/verification) and second stage (written test) of the qualification process are less different from each other than the clinical tests are. In practice, little dissonance and few complaints about the written examinations are observed among candidates, which is supported by relatively high pass rates. For the ADC exam, 35% in written and 22% in clinical tests during 2014–2018; for the ORE, 63% and 39%, respectively, over the same period (calculated on the arithmetic mean of published pass rates). That is presumably interpreted by the nature of multiple choice questions from established item banks and fair marking standards for a pass result. Therefore, this paper will be mainly about practical/clinical tests in formative and summative feedback as well as suggestions. Three foci in this section are the composition, implementation and standard setting/standardisation of the examination.

ADC exam

For the past five years, there have been two major revisions in the ADC exam, mostly on the format of the practical examination. The first revision was in 2014, with the adoption of an analogous composition to that of the NDEB Assessment of Clinical Skills (ACS) executed in Canada. Out of the 14 tasks in the ADC practical exam, 12 tasks were almost identical to those in the NDEB, including the marking criteria. Despite the addition of a 'clinical communication' task, the ADC practical exam was mostly bound in a dental manikin (DM)-based assessment, which contrasts with a more comprehensive evaluation in the NDEB. In Canada, the certification process requires all licensure candidates, including graduates of accredited dental programmes, sit further written examination and objective-structured clinical examination (OSCE), even after the pass result in the NDEB ACS for overseas-trained dentists. To align the examination format with the learning outcomes stated in the *Professional competencies of the newly qualified dentist*,[9] the ADC practical exam has been revised into two methods of assessment – OSCE and DM tasks – from June 2018 onwards. The inclusion of the

OSCE format in the practical examination can be conducive to the assessment of candidates' overall competencies for the fitness of dental practice with reference to the statement.

In the former revision, the implementation of the ADC practical exam produced few issues except for administrative errors in the beginning of the then new format (for example, poor quality of the tooth for the endodontic access or lack of manikin stability for taking radiographs). The time limit and scope of tasks were not restrictive for candidates' performance in the practical examination. By the nature of the DM-based test, however, some 'tricks and tips' for better marks 'worked' in the task, in spite of their counterproductive practice for patients (for example, the bulk filling of composite resin for aesthetics and convenience rather than incrementally filling to reduce polymerisation shrinkage, and the restorative contour with hypo-occlusion in the manikin as practically not being marked). For the latter revision, feedback from the implementation should be acquired to minimise unnecessary errors and loopholes in the evaluation.

If candidates' performance, the difficulty of tasks, and examiners' marking standards are the same, the result of the examination is expected to be the same. However, although almost identical tasks with the same rubric and marking criteria were given as aforementioned, the pass rate of the ADC practical exam and the NDEB ACS were much different from 2014 to 2018 (22% and 38%, respectively). That can either be because, in the ADC exam, two different tasks out of 14 items were decisively difficult, the candidates' abilities were significantly poor, or examiners' standard setting was harsher than in the NDEB. It can be fair for each destination country to have different levels of competency for dental practice, in accordance with different circumstances in their oral health care system. Nevertheless, it should be noted that a reliability issue in the practical examination may occur even under very similar conditions if not calibrated properly, such as being prone to measurement biases in epidemiological studies.

Overseas registration examination

The composition of the ORE part two is more consistent and comprehensive than that of the ADC practical exam. The ORE part two consists of four components which can evaluate candidates' competency – learning outcomes aligned with the *Preparing for practice* document,[10] – in a disparate and thorough format. The extensive scope and diverse modality of the examination compared with only DM-based tests creates a heavy burden but does not necessarily lead to a poorer result (the pass rate of 39% in the ORE part two and 22% in the ADC practical exam from 2014 to 2018). Rather, it can be more beneficial to the actual dental practices, not for the sake of the examination, to be described in sections of summative feedback and suggestions.

The ORE part two is implemented in a pragmatic manner for each format of components from a candidate's perspective. A diagnostic and treatment planning exercise (DTP) and DM allow a sufficient amount of time; 54 minutes and three hours, respectively. 13 minutes for a medical emergency (ME) exercise may seem very tightly time-limited, but the nature of prompt reaction to emergencies can justify the implementation. However, some stations in OSCE require candidates to demonstrate the tasks based on only rote memory during a five-minute time limit (for example, handwriting a referral letter for uncommon oral diseases with reference to an exhaustive list of marking criteria). For those tasks, the format of OSCE in the NDEB-extended match-type questions can be considered to assess candidates' clinical skills in a limited time.

One of the candidates' major concerns about the examination is the reliability of the test result–standardisation. As most practical examinations have inherent limitations of discerning pass or fail results, candidates on the 'borderline' around the 'cut-score' may raise a reliability issue rather than those with an explicit level of satisfactory/unsatisfactory performance.[5] Although the borderline regression has been adopted in both the ADC exam[11] and the ORE,[5] many candidates still wonder what constitutes the fail result in practice. Even those with the pass result are sometimes confused about the marks given. It is not unusual, from candidates' accounts, that a critical fault in DM tasks, described clearly on marking criteria, resulted in the pass and *vice versa*. Among those in disagreement on the criteria are experienced dental specialists trained in their home country with relevant sub-disciplines such as operative dentistry and prosthodontics. In addition, for DM in the ORE part two, only three exercises are tested (two major and one minor) which may cause an issue of internal consistency reliability compared with the NDEB and the ADC exam (six to ten tasks). Therefore, establishing more robust and transparent marking standards with greater reliability is urged for better acceptability of the practical examination to the candidates.

Summative feedback

In contrast to the previous formative feedback, this section is about how the examinations are assessed from a practitioner's perspective in dental practice settings. Luckily, I have passed through the ADC exam and been carrying out dental practices in Australia for over three years. Also, I can assume that my feedback on the ORE, based on the experience in Australia, remains valid to the UK. That is because of the similarity in dental practice, based on the facts that UK-educated dentists are eligible to apply for the registration, being exempt from the ADC exam, and dentists from the UK have been practising without many clinical difficulties in Australia. My findings follow the format of four components in the ORE for its better-balanced classification on the evaluation of competencies than a mostly DM-based assessment of the ADC exam in 2014.

As an OTD practising in Australia, what I value the most among the components in the examination is DTP. Despite six years of clinical practices in my home country, I find the most different and difficult competency being how to establish the relationship, and communicate with culturally and linguistically diverse patients in Australia. The communication skills and management of oral complaints learned through DTP preparation are salient to adapt to the local context of the dental care system. The component of ME provides important learning opportunities as well. It does not have a lot to do with daily dental practices but equips me with the protocol on medical emergencies in the dental setting. In particular, the protocol carries more weight as the need for extra care is common in dental practice, due to an increasingly ageing population with polypharmacy as well as patients with chronic diseases.

On the other hand, the assessment of DM tasks has little merit to dental practice in Australia. It is not because clinical skills on DM are of less value to patients but because they are much more common as a universally compatible competency from pre-existing experiences in a home country. That is to say, DM-based tests are effective for learning outcomes to the students in dental education but not as

important as the evaluation of trans-cultural/system adaptation for experienced dentists. Regarding the OSCE component, it may be less helpful to the evaluation depending on how and what to test. Currently, a few OSCE stations are repeatedly tested from item banks, and candidates sometimes need to carry out certain tasks without a thought for the marking criteria within an insufficient time. In order to align the assessment and cover a wide sample of learning outcomes,[5] OSCE stations should be diversified and marked on the basis of well-structured/organised formats for evaluation.

Suggestions

Inferred from the findings in formative and summative evaluations, I would suggest three points to both the ADC exam and the ORE: seeking feedback from practising dentists registered through the examinations; redirection away from the DM-based assessment; and amendment of expected competencies for the examinations. Most feedback on the examinations is from the candidates who have been through the process. Thus, they mainly tend to be about the difficulty of scoring passable marks in the exam, rather than the improvement of the evaluation for the competencies conducive to the actual dental practice. Furthermore, those comments may lack validity if affected by either acquiescence bias (for example, 'yes-saying') or personal circumstance-based complaints (for example, tasks which they felt were unfair or unexpected but justifiable from the statement of learning outcomes). The examination governing body needs to both seek, and refer to, feedback from actively practising dentists passing through the qualification process. As in the saying 'danger past, god forgotten', once the examination ends up with the pass result, those successfully registered are not inclined to look back and analyse the exam. However, the feedback from more objective and practical viewpoints would become a salutary source for the improvement of the examination, different from those with the expertise in the evaluation of education.

Next, the examinations should redirect the target of competency from DM-centred dexterity to a more comprehensive evaluation. For the ADC practical exam, the format of post-revision appears to be a better composition, with the adoption of OSCE stations rather than the previously DM dominance, but still draws heavily upon intraoral skills. The ORE seems to be structured with four balanced components in the format. In practice, however, the pass rate of DM is critical to the overall result compared with the other components (49% for DM vs 77% DTP, 74% ME and 63% OSCE from 2014 to 2018). The diversification and recalibration of the current dependency upon DM are triangulated by the rationale already raised; commonality across different dental care systems, harsher marking results than the criteria indicated, and concerns about the reliability of marking DM tasks. If the aim of the examinations for OTD is to protect the public,[5] every aspect of dental practice should be equally evaluated, not sending a wrong signal to the candidates that DM is the crucial determinant for the qualification. In this regard, DM tasks need to be tested on the adjusted weighting and standard setting comparable to those of the other components.

Finally, the equivalent level of qualifying competency for the examinations described in official handbooks and guidance may need to be revisited. The competencies expected of candidates are presented as 'a recently qualified Australian dental practitioner at the point of graduation from an ADC-accredited dental program'[11] or 'the standard of a "just passed" UK BDS graduate'.[2] It is reasonable to set a reference point for the evaluation of learning outcomes in education. However, the standards can mislead candidates to two comparability problems. By introducing the same competency level, a concern could arise as to whether ADC-accredited dental graduates and UK BDS graduates can qualify through the ADC exam and the ORE, respectively, as past candidates for the examinations did (that is, direct comparison). That is in line with the principle of equivalence or non-inferiority trial that the comparator's efficacy should be demonstrated first in order to vindicate the result. Another is for the indirect comparison that different levels of competency for different countries are laid on the same comparable scale by adopting the same standards. For example, a candidate qualifying in the ORE may fail in the ADC exam for the fair reason of different competency levels required for different countries. However, as noted above, currently UK BDS graduates are exempt from the ADC exam for registration in Australia. If ORE qualifying candidates are recognised with the same competency of 'just passed' UK BDS graduates, it can be contradictory as a double standard between OTD and UK-educated dentists for registration in Australia. Therefore, I suggest for the qualifying competency that candidates are expected to 'perform competent translation of general dental knowledge and clinical skills into the proper context of the [country's] dental care system'.

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A white elephant in the dental room

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Never say die

Christmas is not in freezing weather in Australia. But the festivity falls on the same holiday season down under as what I used to enjoy in my home country, South Korea. It must be a great pleasure to give a long-lost friend a call to say hello around Christmas before the year is out. His voice still sounded familiar. However, a couple of years were not long enough to miss the minute difference in his tone after losing touch. A few senseless words of bantering were followed by more than a half-sincere confession, “I am terrified of seeing my patients for their poignant complaints and gripes. Not on particular occasions but in general. I didn’t see this smothering pressure coming when in training to qualify as a periodontist. Awful thoughts are looming in my head. I am… quite serious.”

I reckoned he could tell me the story heart to heart as I was living on the opposite side of the globe. He might have concerned about his worries being divulged to those living around him. I felt both relieved and concerned with his account at the same time. On the one hand, the relief was owing to the finding that I was not the only one who suffered from such taxing dread. On the other hand, my reflection concerned me of his serious conditions as I remembered how draining the fear of seeing uncomfortable patients was like social phobia. The only cold comfort that I could offer was to urge him to seek help with a generic platitude and wish him the best of luck.

No news is good news for that matter. I was briefly relaxed to hear nothing further from him over three days since the call on Christmas Eve. However, it was too early to breathe easy. The following day, a different common friend in Seoul sent me a text message. “He died early this morning by hanging himself. He must have been hard-pressed to cope with patients after opening his own clinic.” In hindsight, the date chosen for after Christmas might be the best effort on his part. It was the last favor he could offer to his loved ones for the festive

season before them becoming bereaved. The unpleasant return trip to my home country started unexpectedly to say an unresponsive farewell to him once and for all.

I felt as if it was not any others' story but mine. Even though I am not a religious man, there but for the grace of God, go I. I was in the same situation as his agony, thus I could feel the depressive spirit vicariously or more vividly through the last talk calling for help. The only difference was that I was lucky to be relatively street-smart with resilience. The school of hard knocks I had gone through from pre-dental career saved me before the adversity engulfed me all. Nevertheless, I was confused and curious about how burdensome the stress was enough to claim a 36-year-old competent periodontist leaving four- and two-year-old apples of his eye behind. To make me more saddened, his untimely passing was known to be from heart attack covering the tragedy. It was due to that suicide is a taboo topic and stigma is put on it in Korean culture not only for the deceased but also for those left. Even before the remaining question on him was attempted for an answer, he was started to be forgotten.

It's not all it's cracked up to be

Several times, I have heard of two ungrounded claims about the profession of a dentist. The first is that dentists suffer from the highest suicide rate among other occupations. This compelling claim is not fully supported by an empirical review (Jones et al. 2016) but practically understandable to me with anecdotal evidence aforementioned. The other is that dentists are top-grossing health practitioners from the layman's view in both Korea and Australia where I have worked in dental practices. The answer to the latter claim may be yes and no depending on which figure is highlighted in income statistics. I wished it were absolutely yes when I determined to become a dentist going through a long journey as a "career nomad". However, it did not take too long for me to see the reality seems to speak otherwise.

I have happened to wander around seemingly inconsistent careers so far. It started from the undergraduate major of architectural engineering with a minor in business administration, via the first job landed in a commercial bank as a teller, to becoming a general dentist. Over the time, I would like to be *Jack of all trades* but remained a *master of none*. Even after qualifying as a dentist, I moved to Australia not staying in my home country looking for greener pastures, which turns out to be the same difference. The migration to a different country of unfamiliar language and culture was a dire challenge for a less-competent English speaker in my late thirties (Song 2019). Over the years as a career nomad, I played in the whole drama where my fantasy of life as a dentist appeared, made progress, and ended up with a mirage my naïve wishes formed.

Now that I am doing research on a topic of dentist-patient relationships, I can partially ascribe my latest swerving to what I have found in a dental clinic throughout the trajectory. Having a clinical encounter does not start from a blank slate. Rather it is commonly pre-determined from each other's past experiences. And expectations of each other are to be established based on them. Thus careful negotiations between patients and dentists are here to stay in a dental clinic. It sometimes goes so far as the level of "psychological warfare" until securing enough mutual trust. Pursuant to the rules of engagement delineated by governing authorities, patients and dentists are likely to be confined to their safe comfort zone by a lack of trust in the relationship (Song et al. 2020). The collateral damage may be over-services to *doubtful* patients or under-services to *risky* complainants. If this combines with dentists' financial inducement egged on by the fee-for-service system, the quality of oral healthcare can be compromised or iatrogenically counter-productive.

A white elephant in the dental room

An elephant in the room is a serious and obvious issue that everyone is aware of its presence,

but left ignored or avoided for its difficulty to resolve. A white elephant refers to what is costly but deemed to be less useful or needed. From my past experiences as a dentist in both Korea and Australia, dentist-patient relationships seem to be considered a white elephant in the dental room. Although most dental practitioners are pleased to agree with the importance of the relationship in theory, they usually pretend not to see it involuntarily or unconsciously in the actual clinical settings. Heart-sinking occasions oftentimes remind them of the need for better relationships but danger past, god easily forgotten. Dentist-patient relationships are usually taken for granted as growing mature with time being assigned to an individual's social skills, or put on the backburner compared with clinical expertise. Fortunately the traditional authoritative or hierarchical relationship in dental contexts has changed into patient-centred care with shared decision making by piecemeal, but the encounter is still lop-sided either way.

One of the benefits from my nomadic career is letting myself step back from the issue of dentist-patient relationships with a third perspective. I was not to be *born* as a dentist at the end of year 12, but *raised* to play the role after wandering as a non-dental layperson. The third view by sitting on both sides of the dental chair has enabled me to face the white elephant in the dental room. Customers I served at a banking office are not quite different from patients I serve at dental practices. Despite the difference as an "embodied" person for treatment *outcomes*, I could find enough similarities to regard my patients "customers" at least for their satisfaction with the *process* of care (Hudak et al. 2003). Rather health practitioners may need to reflect if they still remain in "nostalgic professionalism" with paternalism while standing on the basis of a social contract (Holden 2017) whether or not fair.

Nevertheless, I have to admit a pitfall I might have misunderstood that better dentist-patient relationships are only possible by the favour of dental practitioners. If anything, it is like a

dance of tango as both take two. If “risk” is an inherent by-product of healthcare encounters (Damodaran et al. 2017), it should be addressed for and by both parties. Also, there should be cheerful music to coordinate the moves each other. The dental care system and governing bodies should support better relationships in euphony rather than dictating intrusively in cacophony. As social determinants should be considered for the inequity of public health, clinician-patient relationships are to be illuminated for clinically equitable practices in social medicine and dentistry. The journey to seek for the answer questioned by the late friend keeps me awake around the white elephant in the dental room, lest I forget.

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