Willingness-to-pay for Mandibular Two-Implant Overdentures: A Societal Perspective

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This thesis is dedicated to my brother, Aman. If it weren't for him spilling water, juice and paint, I would have finished all my school projects in half the time. He got me addicted to deadlines!

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The journey is the reward and its intemperance is

loyally devoted to coffee shops in McGill Ghetto.

Abstract

Objectives: Oral health care service in Canada is funded primarily by private payers, whose acceptance of a new dental technology depends on their valuation of it. This preference study will provide information to dentists, insurance companies and policy makers on what people are willing to pay for implant overdentures, whether directly or with insurance/government coverage. We aimed to determine how people would value the benefits of mandibular two-implant overdentures using a Willingness-to-Pay (WTP) strategy. Variations in WTP amounts regarding socioeconomic status, etc. were also measured.

Methods: 2001 telephone numbers of a representative sample of Canadians were obtained from a consumer database provider. Individuals who agreed to participate completed either an internet-based or telephonic survey that consisted of 3 cost scenarios. These included: (i) paying it yourself (out-of-pocket), (ii) coverage with private health insurance, and (iii) publicly financed through additional taxes. Personal information (e.g. age, income, etc.) were used as independent variables in a regression model to assess the determinants of WTP amounts.

Results: Among 1096 respondents, 317 participated in the survey (response rate: 28.9%). Participants (age: 41.2±0.6; 54.3% male) who were dentate or missing some teeth were willing to personally pay $5,347 for implant overdentures. Considering a 1 in 5 chance of becoming edentate, they were willing to pay an average of $26.93 as monthly payments for private dental insurance. They were also willing to pay additional yearly taxes of $103.63 to support a public tax-funded program. WTP amounts increased substantially with the individuals' household income. Results of the regression analyses were significantly associated with income, self-perceived need and dental insurance status ($ps<0.05$).

Conclusion: The results of this study suggest that dentate individuals would be willing to pay a significant amount to receive mandibular two-implant overdentures if they become edentate, whether paying privately or contributing to private insurance coverage or government programs.

Résumé

Objectifs: Les services de santé buccodentaire au Canada sont financés principalement par les payeurs privés, dont l'acceptation d'une nouvelle technologie dentaire dépend de leur appréciation de celle-ci. Cette étude de préférence fournira des informations aux dentistes, aux compagnies d'assurances ainsi qu'aux décideurs politiques sur ce que les personnes sont prêtes à payer (directement, couverture d'assurances ou couverture gouvernementale) pour des prothèses sur implants dentaire. Notre objectif était de déterminer de quelle façon les gens évaluent les avantages des implants mandibulaires à deux prostheses à partir d'un stratégie de volonté de payer. Les variations de montants de volonté de payer en lien avec le statut socio-économique ont également été mesurées.

Méthodes: 2001 numéros de téléphone de Canadiens qui represent d'un échantillon de la public ont été obtenues à l'aide d'un fournisseur de base de données. Les personnes qui ont accepté de participer ont rempli un sondage en ligne ou par telephone sur trois scénarios relies aux coûts. Il s'agit notamment: (i) payer de leur poche, (ii) couverture d'assurance privée, et (iii) financement public à partir d'impôts supplémentaires. Les renseignements personnels (par exemple l'âge, le revenu, etc) ont été utilisés comme variables indépendantes dans un modèle de régression pour évaluer les déterminants de montants du volonté de payer.

Résultats: Parmi les 1096 répondants, 317 ont participé à l'enquête (taux de réponse: 28,9%). Les participants (âge: 41,2 ± 0,6; 54,3% d'hommes) dentés ou à qui il manquait quelques dents étaient prêts à payer 5347 $ de leur poche pour des prothèses sur implants. Considérant 1 chance sur 5 de devenir édenté, ils étaient prêts à payer une moyenne de 26,93 $ en paiements mensuels pour l'une assurance privée. Ils étaient également prêts à payer des impôts annuels supplémentaires de 103,63 $ pour soutenir un programme public. Les montants de volonté de payer ont considérablement augmentés selon le revenu du ménage des individus. Les résultats d'analyse de régression ont été associés de façon significative avec le revenu, l'autoévaluation des besoins et le statut d'assurance dentaire (ps <0,05).

Conclusion: Les résultats de cette étude suggèrent que les personnes dentées seraient prêtes à payer un montant significatif pour recevoir des implants mandibulaires à deux prothèses dans le cas d'édentation que ce soit par paiement privée, à l'aide d'une couverture d'assurance ou bien d'une prime governementale.

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List of Abbreviations

AIC	Akaike's Information Criterion
ATP	Ability-to-pay
BG	Bidding Game
CAD	Canadian Dollar
CAMPHOR	Cambridge Pulmonary Hypertension Outcome Review
CBA	Cost-Effectiveness Analysis
CCHS	Canadian Community Health Survey
CEA	Cost-Benefit Analysis
CHMS	Canadian Health Measures Survey
CUA	Cost-Utility Analysis
CV	Contingent Valuation
DBDC	Double-bound Discrete Choice
DC	Discrete Choice
DC*3*	Triple-Bound Discrete Choice
DC*m*	Multiple-Bound Discrete Choice
DFTO	Dental Freetime trade-off
DVAS	Dental Visual Analogue Scale
EQ-5D	EuroQoL 5D
GOHAI	Geriatric (General) Oral Health Assessment Index
HRQoL	Health related Quality of life
HUI	Health Utilities Index
HYE	Healthy-Years Equivalent
ICF	International Classification of Functioning Disability and Health
IIEF	International Index of Erectile Function
IPSS	International Prostate Symptom Score
MLR	Multiple Linear Regression
OE/OP	Open Ended

OHIP	Oral Health Impact Profile
OHIP-14	Oral Health Impact Profile (short version)
OHIP-20	Oral Health Impact Profile (for edentate individuals)
OHIP-49	Oral Health Impact Profile
OHIP-aesthetic	Oral Health Impact Profile (for aesthetics)
OHQoL-UK	UK Oral Health-Related Quality of Life Measure
OHRQoL	Oral health related quality of life
OIDP	Oral Impacts on Daily Performances
OOP	Out-of-pocket
OQoLQ	Orthognathic Quality of Life Questionnaire
PC	Payment Card (Scale)
PIDAQ	Psychosocial Impact of Dental Aesthetics Questionnaire
QALY	Quality-Adjusted Life Year
QAPY	Quality-Adjusted Prosthesis Year
QATY	Quality-Adjusted Tooth Year
RS	Rating Scale
SBDC	Single-bound Discrete Choice
SF-6D	Short Form 6D
SG	Standard Gamble
TTO	Time-Trade Off
VAS	Visual Analogue Scale
VIF	Variance Inflation Factor
WTA	Willingness-to-accept
WTP	Willingness-to-pay

1. General introduction and background to research

1.1 Edentulism and denture use

Edentulism is a state of complete tooth loss that occurs most commonly as a final consequence to dental caries and/or periodontal disease (1). The irreversible nature of the condition has led to its designation as 'Dentistry's equivalent to mortality' (2). Although the rate of edentulism has declined over the past few decades in most developed nations, it continues to be a significant public health issue affecting millions of people worldwide (2, 3) due to the compounded effect of greater life expectancy and an increased rate of tooth loss with aging (4, 5).

The traditional standard of care for edentate people involves the use of prosthetic devices called 'dentures' that artificially replace missing teeth and allow the individual to chew and speak, as well as maintain an aesthetic appearance (5). However, problems with the current form of complete dentures have been reported in the literature since the early 1950s and, despite technological advancements in dentistry, not much seems to have changed in terms of therapeutic strategies for the edentate population (3, 6, 7). Denture wearers encounter psychosocial adversities, functional impairment and overall health problems associated with denture use. With tooth loss, there is a subsequent loss of various orofacial tissues, including alveolar bone, muscle, periodontal ligament and sensory receptors (7-10). The continuous atrophy of alveolar bone and the absence of anchorage between the bone and the denture results in lack of stability and retention, especially in the mandible, and is associated with diminished masticatory ability (7, 11, 12). Thus, edentulism meets the categorization of a 'physical impairment' according to the World Health Organization criteria and a 'disability' by the ICF (International Classification of Functioning Disability and Health) criteria (13, 14). Unstable dentures result in people choosing to eat softer, less healthy foods, that are easier to chew and to avoid harder foods, which may be more nutritious; these include meats, fresh fruits and raw vegetables (15-17). This dietary adjustment implies a risk of malnutrition and associated health disorders (1, 18, 19). Moreover, edentate people

wearing conventional dentures have difficulty speaking due to the morphology of the complete denture system; in addition, they often have diminished sensory perception (5, 20). Most denture wearers experience dissatisfaction and lower self-esteem, while some develop an even stronger social stigma related to denture wearing, justifying the term 'handicapped' associated with edentulism (5, 21). Overall, the limitations of conventional dentures result in a diminished quality of life for edentate people (1, 22). While maxillary (upper jaw) dentures usually provide a more suitable form of treatment for missing upper teeth, mandibular (lower jaw) dentures have been reported to be a source of discomfort for most patients (23). This is because of the smaller mandibular bone foundation area to support the denture and constant movement of the tongue that further destabilizes the mandibular denture (24).

1.1.1 Prevalence of edentulism and denture use in Canada

The consequences due to these limitations with conventional dentures are exacerbated when edentulism is considered as a population health issue. Based on the Canadian Health Measures Survey (CHMS 2007-2009) approximately 2.16 million adults (20-79 years) had no natural teeth in 2009. Among these people, more than 1 million were 65 years and older (25). In the 2003 Canadian Community Health Survey (CCHS), almost 24% Canadians aged 15 years and older reported wearing dentures (26). Moreover, about 9% of the edentate population reported that they did not wear dentures at all (26). Figure 1 illustrates the age distribution of denture wearers in Canada, 2003.

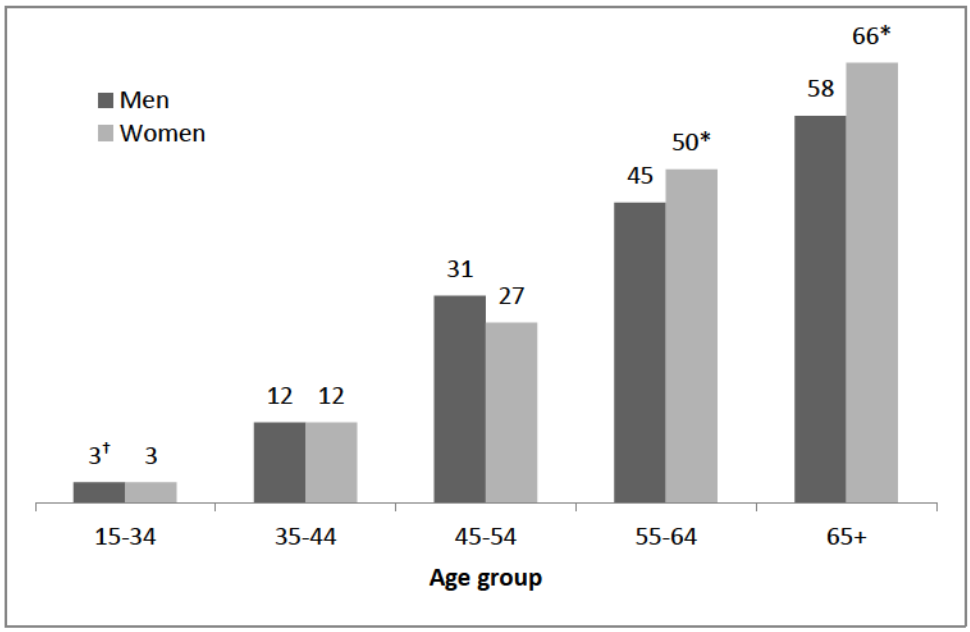


Figure 1. Percentage of Canadian household population who wore dentures, by age group and sex (Data source: 2003 Canadian Community Health Survey; † Coefficient of variation 16.6% to 33.3% (interpret with caution); * significantly higher than estimate for men ($p < 0.05$))

1.2 Mandibular two-implant overdentures

Denture stability can be improved by using dental implants that retain the denture and prevent movement during normal function (27, 28). Investigators have found significantly better oral health related quality of life, masticatory function and patient satisfaction with mandibular implant supported overdentures (29-31). Furthermore, implant-supported overdentures preserve bone mass due to the stimulation of hard tissues provided by the implant (7, 32).

Based on strong scientific clinical and patient-based evidence on the benefits of implant retained overdentures over traditional conventional dentures, a panel of experts in 2002 advocated that mandibular two-implant overdentures should be the first-choice standard of care for edentate patients in the McGill Consensus Statement (23). Seven years following the public release of this statement, the British Society for the Study of Prosthetic Dentistry generated the York Consensus Statement, reinforcing the McGill Consensus Statement and incorporating new evidence produced during the intervening

7 years (24). In 2011, a survey involving leading academic prosthodontists in the United States of America revealed that all were in agreement with the McGill and York Consensus Statements, concurring with the statement that implant-retained mandibular overdenture should be the first choice standard of care for edentate people (33). However, the uptake of this therapy to replace conventional denture treatment has been very limited (34), despite the overwhelming evidence of its clinical-effectiveness and patient satisfaction.

1.3 Economic appraisal to facilitate implant overdentures

Decision to uptake a healthcare intervention either at an individual or at a societal level depends upon the perception of both clinical and economical effectiveness of one intervention over another (35-38). Clinical effectiveness studies provide a measure of the expected change in health outcomes. Additionally, cost-effectiveness studies provide incremental costs per increment of benefit associated with an intervention outcome (39, 40).

Current cost-effectiveness studies on mandibular two-implant overdentures (Table 1) reveal that the costs are high, but so are the benefits compared to conventional dentures (40-42). However, in most parts of the world dental implant provision is largely private in terms of delivery and financing (31, 40). Thus, the ultimate decision to undergo this treatment is vested in the final consumers: the prospective dental patients. This choice is further contingent upon whether these individuals value the incremental benefit of implant treatment to be worth the additional cost, among other factors (31, 43).

While cost-effectiveness studies capture the clinical intervention outcomes, they do not include an individual's appraisal of the outcome. Preference-based evaluations are important in technology diffusion (44, 45), especially in privately financed dental care where economic resources are limited.

1.4 Preference Measurements and decision-making

1.4.1 Decision-making under uncertainty

1.4.1.1 Theory of rational decision-making under uncertainty

In 1944, John von Neumann and Oscar Morgenstern described how a rational individual confronted with uncertain outcomes ought to make decisions (39). This theory is now widely known as the 'expected utility theory' or 'von Neumann-Morgenstern utility theory'. Under this theory, fundamental axioms were defined to characterize 'rational behavior under certainty' that were debated and refined by various authors[1]. Bell and Farquhar (46) restated the axioms as follows:

1) *Preferences exist and are transitive.* For any pair of risky prospects y and y', either y is preferred to y', y' is preferred to y or the individual is indifferent between y and y'. In addition, for any three risky prospects, y, y' and y'', if y is preferred to y', and y' is preferred to y'', then y is preferred to y''; similarly, if y is indifferent to y', and y' is indifferent to y'', then y is indifferent to y''.

2) *Independence.* An individual should be indifferent between a two-stage risky prospect and its probabilistically equivalent one-stage counterpart derived using the ordinary laws of probability. For example, consider two risky prospects, y and y', where y is made up of outcome x_1 with probability p_1 and outcome x_2 with probability $(1 - p_1)$, indicated symbolically as $y = \{p_1, x_1, x_2\}$, and $y' = \{p_2, x_1, x_2\}$. This axiom implies that an individual would be indifferent between the two-stage risky prospect (p, y, y'), and its probabilistically equivalent one-stage counterpart $\{pp_1 + (1 - p) p_2, x_1, x_2\}$.

3) *Continuity of Preferences.* If there are three outcomes such that x_1 is preferred to x_2, which is preferred to x_3, there is some probability p at which the individual is indifferent between outcome x_2 with certainty or receiving the risky prospect made up of outcome x_2 with probability p and outcome x_3 with probability $1 - p$.

[1] The following discussion is drawn from Drummond et al. (39)

In this published theory, von Neumann and Morgenstern termed the associated preference measures as 'utilities' (39).

1.4.1.2 Uncertainty in healthcare decision-making

The outcomes of any health intervention are surrounded by some degree of uncertainty, and an individual's decision to opt for one intervention over another stipulates these uncertain conditions (39, 45). Therefore, methods to measure an individual's preference towards the treatment should replicate this uncertainty (45). Before discussing various methods of preference measurement, clarification of certain terms is essential.

1.4.2 Utility, Value and Preferences

The terms 'utility', 'value' and 'preference' have been used interchangeably in a broad context (39). However, distinction can be made if attention is given to 'what these terms measure'. Preference is a general term that describes interest in a certain set of outcomes whereas utility and value are terms used to describe numbers that measure the idea of 'preference' (47). Utility measurements follow the von Neumann-Morgenstern utility theory and determine 'preferences' under uncertain conditions. On the other hand, value is measured under conditions of certainty (39, 48).

In the context of healthcare, an individual's preference towards an intervention depends on their 'utility' of that particular intervention (45, 49). For example, implant overdentures may result in better oral health than a conventional denture for an edentate patient. However, for an individual to have a greater preference for the overdenture treatment, the associated inconvenience of the surgical procedure, multiple visits, potential complications and costs must all be offset by the improvement in oral health. 'Utility' can then be described as a measure of an individual's assessment of the impact of outcomes on their own well-being (45, 47). The synonymous use with

preference arises due to the direct relation between the two terms; the higher the preference for an outcome, the higher will be the utility associated with it (39).

1.4.3 Measuring preferences

Preference measurement requires categorizing health states based on the interventions under comparison, followed by measurement of an individuals' strength of preference for each health state (50). There are various direct and indirect methods of measuring preferences that are described in the following sections.

1.4.3.1 Direct methods of measuring preferences

Commonly used methods of measuring preferences directly include 'value' measurement by rating scale and its variants and time-trade off method and 'utility' measurement by standard gamble technique (39, 50). Table 2 summarizes the previous use of these methods in dentistry.

Rating scales, category scales and visual analogue scales

The concept behind these scales is to produce an interval scale of preferences where the subject is asked to rank health outcomes from the most desirable to least desirable and then asked to place the outcomes on a scale such that the intervals are representative of the individual's preferences (39, 48). These scales in common use have numerous variants. Rating scales (RS) are usually numerical and most commonly use a range between 0 and 100. Categorical scales consist of a smaller number of categories, often 10 or 11. The categories are placed at equal intervals and do not represent ordinal ranking. The visual analogue scale (VAS) consists of a line, usually 10 cm, and has clearly defined endpoints with or without other markings along the line. A feeling thermometer is a combination of a VAS and a 0-100 rating scale (39).

Standard Gamble

Standard gamble (SG) measures the utility function using basic preference measurements. The incorporation of probability into the measurement accounts for uncertainty and follows the von Neumann-Morgenstern's theory (39, 48). In this technique, an individual is given two options (Figure 2). Option 1 is a treatment that results in a certain outcome that is usually a chronic health state X for a stated length of time. Option 2 is a treatment with two possible health outcomes Y (probability *p*) and Z (probability 1 – *p*). The probability *p* is varied until the individual is indifferent towards the two alternatives. For example, Fyffe and Kay (51) designed a standard gamble questionnaire in which the option 1 resulted in 100% chance of a posterior filling that would last for a lifetime (Health State X). The option 2 had two possible outcomes: Health State Y was the 'chance of a completely healthy posterior tooth for a lifetime' (with probability *p*) vs. Health State Z that included 'a possibility of immediate extraction of the tooth' (with probability 1 - *p*). The utility for a completely health tooth was assigned a value of '1' and the utility for an immediate extraction was assigned a value of '0'. The probability of *p* was varied between 100% and 0%. The utility of the posterior filling was then gauged at the point where the respondent changed from preferring option 2 to preferring option 1 (51).

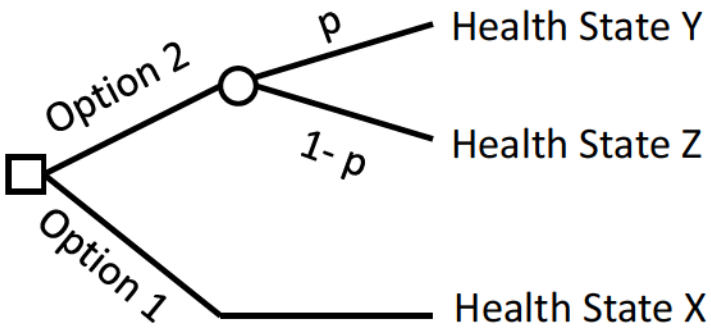


Figure 2. Adapted from von Neumann-Morgenstern's Standard Gamble

Time trade-off

The time-trade off (TTO) method was developed by Torrance et al. in 1972 specifically for use in healthcare (52). In this method, the subject is asked how much time *x* in a state of perfect health would he or she consider equivalent to a period *t* in the current health state, which is usually worse than perfect health. The preference score is then calculated as *x/t* (39, 52).

1.4.3.2 Indirect methods of measuring preferences

Indirect methods are used to measure overall health related quality of life (HRQoL) and include generic preference instruments (EQ-5D, SF-6D and HUI) and disease-specific preference measures from a disease-specific health-related quality of life instrument to a generic instrument (39, 48, 50).

Generic-Utility Instruments

Utilities derived from community-based preference assessments have been used to construct preference-weighted health status classification systems, commonly known as generic utility instruments (49). The three most widely used instruments include: EuroQoL 5D (EQ-5D), Short Form 6D (SF-6D) and Health Utilities Index (HUI). The EQ-5D has been derived using TTO measurements, whereas the SF-6D and HUI have been constructed using SG measurements (39).

These questionnaires include a limited number of health states and corresponding scores for each state:

1) *EQ-5D* has five attributes: mobility, self-care, usual activity, pain/discomfort, and anxiety/depression. Each attribute has 3 levels of health states: 'no problem', 'some problem' and 'major problems', resulting in a total of 243 possible health states with corresponding utility scores (39, 52).

2) *SF-6D* has six attributes with different number of health state levels under each: physical functioning (6 levels), role limitations (4 levels), social functioning (5 levels),

pain (6 levels), mental health (5 levels), and vitality (4 levels). A separate scoring table provides utility scores for each level (39, 52).

3) *Health Utilities Index*: HUI consists of two systems, HUI2 and HUI3. Each includes a different questionnaire consisting of different attributes and separate utility scoring tables. Attributes included in HUI2 are: sensation (4 levels), mobility (5 levels), emotion (5 levels), cognition (4 levels), self-care (4 levels), pain (5 levels) and fertility (3 levels). The HUI3 system has eight different attributes: vision (6 levels), hearing (6 levels), speech (5 levels), ambulation (6 levels), dexterity (6 levels), emotion (5 levels), cognition (6 levels) and pain (5 levels) (39, 52).

These questionnaires produce general health state utilities that can be used to compare the results of two interventions. Takemae et al. (53) used the HUI system to assess changes in overall quality of life after dental implant treatment.

Disease-specific utility instruments

The generic instruments lack sensitivity for specific disease conditions. As a result, preference-based disease specific measures have been developed, such as the International Prostate Symptom Score (IPSS) for benign prostatic hyperplasia (54), the International Index of Erectile Function (IIEF) (55) and the Cambridge Pulmonary Hypertension Outcome Review (CAMPHOR) (56). All of these instruments are based on utilities derived through TTO measurements.

Oral health related quality of life (OHRQol)

Another commonly used method of impact assessment in dentistry is oral health related quality of life (OHRQol) which are self-reports that capture functional, social and psychological impacts of oral disease (57). Table 3 lists the various questionnaires that have been used to measure OHRQol (58-60).

Although the term OHRQoL is suggestive of similarities to HRQol instruments, this measure is not based on derived utilities (45). Questionnaires used for OHRQoL such as OHIP-49, GOHAI, etc. provide non-utility measurements of the impact of intervention

outcomes. These measures can be used to compare outcome of different interventions or before-after intervention outcomes. However, they are based on scaled indices that can measure the impact of an intervention on a particular outcome (e.g. chewing before and after intervention) but do not include an individual's assessment of the effect of this particular outcome on their well-being. Therefore, these instruments should not be considered as direct preference (or utility) measurement tools.

1.4.4 The concept of Cost-Utility Analysis

1.4.4.1 Quality-adjusted life-years (QALY) and its alternatives

The concept of QALY was introduced by Klarman et al. in 1968 and has been used widely as a measure of health outcome (39, 61). QALY incorporates into a single measure the notion of improved quality of life (quality gains) and reduced mortality (quantity gains) resulting from a health intervention. In simple terms, QALY may be described as the period in perfect health that a subject says is equivalent to a year in a state of ill health. QALY measurements use utility weights to denote the quality gains that can be derived from standard gamble utility measurements, time-trade off and visual analogue scale value measurements or preference-weighted generic instruments like the HUI and EQ-5D (39).

Healthy-years equivalent (HYE) was introduced by Mehrez and Gafni and is deemed to be a theoretically superior alternative to QALY (62, 63). Instead of measuring utility weights for particular health states, HYE measures the entire path of health states through which a subject would go through with or without an intervention. Subsequently, it involves two standard gamble measurements: the first measures the utility associated with the path, and the second measures the number of healthy years that would produce the same utility (64).

Other alternatives to QALY include saved-young-life equivalents (SAVEs) and disability-adjusted-life-years (39, 65). These outcome measures including QALY and HYE have not

yet been used in dentistry; however, some variants of QALY have been developed specifically for use in oral health care (66).

Quality-adjusted tooth years (QATY)

This concept, introduced by Birch in 1986, measures additional years of life of each tooth adjusted for the quality of each tooth. These values are added for the entire dentition to produce QATY (67).

Quality-adjusted prosthesis years (QAPY)

The concept of quality-adjusted prosthesis years (QAPYs) was introduced by Jacobson et al. (68) as a measure for reconstruction interventions for edentate patients. QAPY is defined as the number of years of service of a prosthesis adjusted by quality.

1.4.4.2 Cost-utility analysis

Cost-utility analysis (CUA) is similar to cost-effectiveness analysis in the sense that it measures cost per unit of effect (39, 69). The major dissimilarity between CUA and CEA is that the measure of effect in CUA is QALY, which represents an individual's utility of an intervention. In comparison, the effect in CEA is measured in natural units related to the health outcome, for example, number of teeth saved. The advantage of CUA as compared to CEA is that it is a broader form of analysis and incorporates valuation of the outcomes (39).

Jacobson et al. (70) conducted a cost-utility analysis for dental implants by using QAPY. In addition, Birch (67) used QATY in a hypothetical CUA and demonstrated its superiority over cost per tooth saved.

1.4.5 Limitations of utility measurements and cost-utility analysis

As stated earlier, health care interventions, including dental treatments, involve uncertainty around the expected outcomes (45, 69). Direct measurement methods like the rating scale, categorical scale, VAS and the time-trade off method measure an

individual's preferences under certain conditions and are, therefore, not appropriate tools for measuring health interventions under the von Neumann-Morgenstern's theory (45).

Furthermore, an individual's utility maximization for an outcome depends on what he/she is willing to forgo in order to have that outcome. As described by Birch and Ismail (45), utilities are measured by the maximum sacrifice (trade-off) that a subject is prepared to make. Measurement tools like VAS that represent a scale of scoring outcomes do not incorporate the notion of trade-off and cannot be inferred as a subject's utility measurement. Additionally, direct utility measurement methods like SG are time consuming, and often subjects face difficulty in understanding the concept of probabilities (45).

The main drawbacks of generic preference-weighted instruments (EQ-5D, HUI and SF-6D) are that they lack sensitivity in specific disease contexts (39, 71). Moreover, they may be difficult to apply in acute conditions, such as, tooth pain. Also, these questionnaires are based on community derived utility values and do not capture individual preferences in reality. Similarly, cost-utility analysis employing QALY, QATY and QAPY are not based on individual preferences (69). They require complex transformations of existing utility estimates based on researchers' assumptions (45).

In addition, the concept of well-being is not limited to an individual's assessment of health outcomes. The intervention process itself can have certain utilities to an individual (45). For example, an overdenture treatment may result in a net negative utility if the associated inconvenience of the surgical procedure, multiple visits, potential complications and costs are not offset by the improvement in oral health according to an individual's assessment. The direct and indirect utility measures discussed so far may often lack the sensitivity to capture a broader set of utilities associated with oral health care interventions. Therefore, a more comprehensive concept of measurement of well-being is required to encompass the complete concept of well-being.

1.5 Contingent Valuation as a Preference Measurement Method

The foundation of contingent valuation studies is based on the concepts of normative welfare economics, discussed briefly in the following section.

1.5.1 Welfare economics and decision-making

Welfare economics is a branch of economics that relies upon *normative* principles, since it involves value judgments (utilities). In comparison, other branches of economics are based on *positive* principles since they do not incorporate value judgments (39, 72).

'Welfare' is a term used to describe an individual's 'well-being' resulting from consumption of goods and services. Welfare measures are simply changes in *utility converted into monetary terms* (72). The key assumptions underlining welfare theory are that: 1) social welfare is made up from the welfare (or utilities) of each individual member of society, and 2) individuals are the best judges of their own welfare (consumer sovereignty) (39, 72). Economic evaluations in health care based on the theory of welfare economics depend upon assessment of *welfare change* due to health interventions. This allows comparison between the value of what individuals would benefit (welfare gain) from any health care intervention and the value of the resources that individuals are ready to trade-off (e.g. costs) such that it produces a *social ordering* of all alternative health care interventions to facilitate *allocation of resources* based on these rankings (72).

1.5.2 Overview of the contingent valuation method

Contingent valuation (CV) uses a survey-based approach to elicit individual's willingness-to-pay (WTP)/willingness-to-accept (WTA) for specific gains/losses in their health following an intervention (39, 45, 72, 73). Respondents are presented with hypothetical scenarios and are asked to assume health benefits from the intervention under evaluation. Under the *contingency* of these health benefits, the respondents are asked

to state the maximum monetary value that they would be willing to pay for such benefits. Hence, this method is also been known as the *stated preference* approach to measure welfare gains/losses (39, 72, 73).

The benefits of using a CV method over other preference measurement instruments are that it incorporates uncertainty associated with the outcome and allows an individual to value overall consequences of a health program not restricted to health outcomes (39). Moreover, the monetary approach of a CV methodology is highly representative of the way individuals respond to health intervention decisions (particularly in countries in which health care is privately paid) and provides benefit measures that are directly comparable to the costs of the intervention. Economic evaluations that use a monetary approach to measuring benefits are known as cost-benefit analyses (39, 72).

The application of a CV method in health care can be traced back to 1973 when it was first used for a study on heart attacks (74). Since 1985, there has been a consistent progression in the number of CV studies in health care (75). In dentistry, however, preference studies using the CV method are limited (Table 4).

1.5.2.1 Willingness-to-pay versus Willingness-to-accept

WTP and WTA both provide monetary values for a certain health outcome. However, the difference between the two depends on the utility concept of compensating/equivalent variation, and whether a health intervention is being given or removed, known as the direction of measurement (39, 72, 73). Compensating variation is the amount of money taken from an individual (as a trade-off) *after* a health care intervention to make their utility the same as *before* the intervention. Equivalent variation on the other hand is the amount of money taken *before* the health care intervention to make their utility the same as *after* the intervention (39, 72). For instance, if an edentate person was provided mandibular implant-overdenture and he had a gain from the intervention, the compensating variation would be the maximum amount (WTP) that must be taken from the individual as a trade-off for the gain. If the person has a loss of utility from the intervention, the compensating variation would be

the minimum amount (WTA) that must be given to the person to restore his utility level. Conversely, if a person stands to gain from an intervention, the equivalent variation would be the minimum amount of money (WTA) paid to the person before the intervention to forgo the gain. If the person could lose utility from the intervention, the equivalent variation is the maximum amount of money (WTP) the person would pay before the intervention to forgo the loss (39).

1.5.3 Contingent Valuation Survey Design

1.5.3.1 Population and sampling

The initial step in designing a CV survey is identification of the target population that would benefit from the health care intervention. While it may be argued that patients are the principal population that will benefit from an intervention, societal preferences are increasingly being sought in economic evaluations. This arises from the pretext that health care costs, such as private insurance and tax-funded programs, are distributed amongst people who are direct beneficiaries and those who are not (72, 76-78).

After defining the population to be surveyed, a representative sample needs to be selected. Sample selection is crucial because the responses obtained from the sample will determine the preferences of the surveyed population towards the intervention. Moreover, accurate sampling reduces the incidence of sampling biases, such as sample selection bias and sample frame bias. Sample selection bias occurs due to non-response and results in different values obtained from respondents compared to non-respondents. Sample frame bias occurs when the sample drawn from the population differs from the population itself (73).

Mitchell and Carson (73) have indicated two principal methods of sample selection that increases the reliability of the CVM sample: 1) use of a sufficiently large sample, and 2) use of statistical techniques that reduce the influence of outliers. Large sample sizes ensure the precision of WTP measures such as the mean WTP amount, given the large

variance expected from a heterogeneous population. The variations in WTP amounts would be lesser from homogenous groups than from larger heterogeneous populations (73).

1.5.3.2 Scenario Design

The four essential components of a well-designed CV scenario include: 1) a detailed description of the intervention under the hypothetical context that is presented to the respondents, 2) risk communication, 3) payment vehicle and 4) elicitation method. The former three components are discussed in this section. The fourth component is described in section 1.5.3.4.

Defining the intervention/service being valued

Apart from uncertainty in health outcomes from an intervention, a general population represents uncertainty in need. Interventions can be described from different perspectives based on the uncertainty in need as: 1) certain need (ex-post perspective) in the case of patients suffering from the disease, and 2) uncertain need (ex-ante perspective) in case of potential patients (39, 72, 73). For instance, mandibular two-implant overdentures can be described from an ex-post perspective for edentate patients and from an ex-ante perspective for the dentate population, the potential patient pool.

Risk Communication

Due to the complex nature of the CV method to value a health intervention, the scenario should provide a meaningful and comprehensible description to overcome the hypothetical character of the scenario. It is important to consider that a respondent may not be familiar with the intervention being valued in the survey. Therefore, it is crucial to provide all relevant information about the different attributes of the intervention to ensure a correct scenario description (39, 72, 73).

In addition, a scenario might include probabilities of uncertainty with respect to the need and the outcome of the intervention. Gigerenzer (79) suggests that absolute,

rather than relative, risk should be used for proper risk communication, either as probabilities (such as: 1 in 100) or absolute frequencies (such as: 5000 children affected per year).

Payment Vehicle

The payment vehicle denotes the type of payment a respondent is being asked to make. These may include additional income taxes, private insurance premiums, charitable donations, paying 'out-of-pocket', etc. (39, 72, 73). The choice of the payment vehicle depends on the scenario description (72). For instance, insurance premiums and additional taxes best describe an uncertain need and are used from an ex-ante perspective. On the other hand, an ex-post perspective describing a certain need may elicit 'out-of-pocket' payments.

The timing of the payments is equally important and should be well-defined in the scenario. Respondents may be asked to provide their maximum WTP either as a one-time payment or in stages, as monthly or yearly payments (72).

Existing literature shows that, occasionally, respondents may be sensitive to the payment vehicle. For example, respondents may have undesirable reactions when asked to pay additional taxes in a tax-financed health system. It is recommend that the payment vehicle should be neutral with respect to what is being valued to avoid any influence on the respondents' WTP/WTA values (80). Similarly, Fischoff and Furby (81) suggest that the payment vehicle should be naturally related to the policy issue under consideration.

1.5.3.3 Elicitation Format

The elicitation format represents the technique of questioning to obtain WTP/WTA amounts. There are various formats, each with its strength and weaknesses (72, 73). The choice of the elicitation format is essential since the questioning method has been shown to significantly influence the mean and median estimates WTP values (82, 83).

However, there is little consensus on any particular method within the health economic literature (72). Common elicitation formats are described in this section.

Discrete choice versus continuous elicitation methods

Elicitation formats can be either discrete choice or continuous methods. As the name suggests, continuous methods include a range of monetary values that a respondent can choose from. These include open-ended (OE) questions, the iterative bidding game (BG) technique, and the payment scale/card (PC) elicitation format (72, 73). The OE question method simply asks the respondent to provide his maximum WTP without any prompts from the interviewer/questionnaire. This method provides an endless range of possible WTP values (72). Figure 3 provides an example of an open-ended question. As described by McIntosh et al. (72), the iterative bidding technique or the 'bidding game' resembles an auction with a bargaining process. It begins with an initial bid (starting bid) and the respondent can either accept or reject the initial bid (Figure 4). Depending on the response, the subsequent bid is either increased or decreased till the respondent's maximum WTP is achieved. The PC format (Figure 5) lists a range of values, usually a vertical list starting from the lowest bid (at the top) to the highest bid (at the bottom). The respondents choose the bid that best represents the maximum they would be willing to pay (72).

In comparison, discrete choice questions provide a discrete bid amount leading to a yes/no response. Discrete choice methods, also known as close-ended questions, can be dichotomous choice (DC) questions without follow-up (single-bound), dichotomous questions with follow-up (double-bound, triple-bound or multiple bound), and polychotomous questions (72). Figure 6 gives an example of a single dichotomous choice and a double-bound dichotomous choice question. The triple-bound discrete choice question is discussed in section 1.5.3.3.2.

Various studies indicate that there are significant differences between the responses obtained using different approaches (84-86). Discrete choice methods are increasingly being preferred over continuous methods, since the DC format best represents the

common decision making manner that individuals use every day (72, 73, 87, 88). Therefore, the DC format is considered more familiar and easier to answer for the respondents.

In comparison, the continuous methods present unfamiliar choices to the respondents and are prone to various biases. The OE method commonly results in higher non-response rates and/or incorrect interpretation of the WTP estimates (89). This occurs due to lack of any reference point to guide the respondent's value judgment. Even though the PC format provides respondents with more guidance through a range of values than does the OE method, it is subject to various types of bias, including range bias and starting point bias (72). Range bias occurs when the range of bids provided on the payment card influence the respondent's WTP. Starting point bias is due to influence of the starting bid on the respondent's WTP value (73).

However, various authors have reported overestimation of WTP values using discrete choice elicitation formats (82). Moreover, the DC method provides less statistical information about an individuals' WTP. Nonetheless, DC methods are preferable due to their close resemblance to familiar market and voting decisions (87). The single-bound dichotomous choice (SBDC) is susceptible to biases, including 'yea-saying'. This represents a situation in which respondents agree to pay regardless of the bid amount offered. Moreover, the selection of a single bid amount is a difficult task and an inefficient value would greatly influence the WTP estimates (72). These limitations can be improved by including follow-up questions. This method was proposed by Hanemann in 1985 and first used by Carson et al. in 1986 (90, 91). In this method, the respondent is presented with an initial bid, which they either accept or reject. Based on the previous response, they are offered a second discrete choice. If a respondent indicates a willingness to pay the first bid amount, the second bid choice that is offered is higher than the first; if they are not willing to pay the first bid then this second bid is set at a lower bid amount than the first. This is known as the double-bound discrete choice (DBDC) method; in any direction, a respondent has to answer a maximum of two

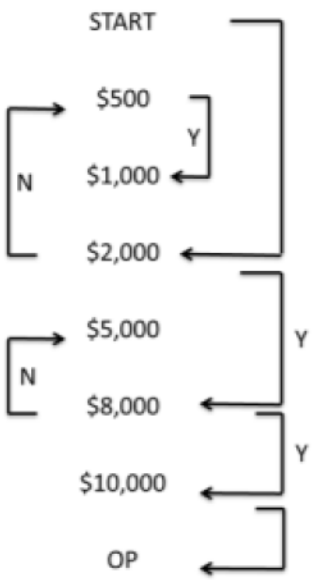
questions (72). If a third bid is added based on the response to the second bid, the method is known as the triple bound discrete choice question (92). Smith (93) argues that these approaches provide significantly more information that SBDC questions. However, the multiple bound DC questions are susceptible to biases similar to bidding algorithms, such as starting point bias (94).

What is the maximum that you would be willing to pay (in 2012 CAD$) to have mandibular two-implant overdenture treatment for yourself?

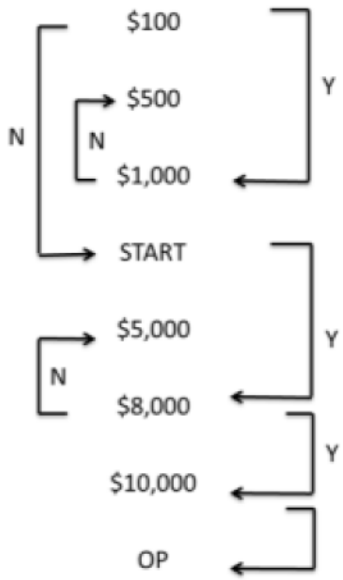
Please provide your answer in the space provided. $_____

Figure 3. Example of open-ended question (Adapted from McIntosh et al. 2010)

Algorithm 1



Algorithm 2



Y= Yes (willing to pay the bid); N= No (not willing to pay the bid); OP= Open ended

Figure 4. Example of bidding algorithms (Adapted from McIntosh et al. 2010 and Drummond et al. 1997)

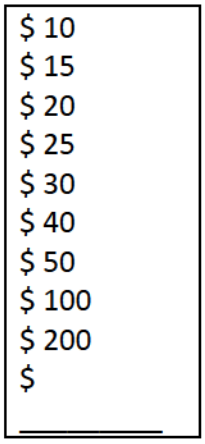


Figure 5. Example of payment card/scale question format (Adapted from McIntosh et al. 2010)

Single dichotomous choice question Are you willing to pay $10 monthly as insurance premium for intervention X? Answer yes or no
Double-bound dichotomous choice question A. Are you willing to pay $10 monthly as insurance premium for intervention X? If yes go to B; if no go to C B. Are you willing to pay $20 monthly as insurance premium for intervention X? Answer yes or no C. Are you willing to pay $5 monthly as insurance premium for intervention X? Answer yes or no

Figure 6. Example of a single and double-bound dichotomous choice question (Adapted from McIntosh et al. 2010)

1.5.4 Validity Assessment

Two essential enquiries pertaining to validity of any CV study are: 1) whether the CV methods are valid, and 2) whether the findings of a particular CV study are valid (73). The concept of validity of CV methods is a highly debated subject, especially due to its hypothetical construct and expected divergence from actual purchase decisions (95). Economist critics of CV methods believe that preference measurements should be based on observed behavior that is revealed in real market transactions (Bishop et al. 1995). They argue that CV methods capture the buying intention of an individual and not the buying behavior (73, 96, 97).

In 2003, Bhatia et al. (95) compared hypothetical valuation and actual payments for a marketed good and concluded that there were no differences between the two measures at the population level; however, considerable differences were noted at the individual level. WTP for marketed goods may be influenced by recurrent buying behavior which improves market price knowledge (97). However, in health care CV studies, the concepts of normal markets don't apply. Market failure occurs in health care due to: risk and uncertainty of developing a disease, asymmetry in health care knowledge between providers and consumers (supplier induced demand due to doctors acting as agents), and externalities created due to health interventions (72, 98). As a result, health care often requires government intervention and regulation at some level, and health care interventions are valued as public goods.

In 1989, Mitchell and Carson defined validity as it may apply to contingent valuation studies measuring WTP for public goods (73):

"The validity of a measure is the degree to which it measures the theoretical construct under investigation. This construct is, in the nature of things, unobservable; all we can do is obtain imperfect measures of that entity. In the contingent valuation context the theoretical construct is the maximum amount of money that respondents would actually pay for the public good if the appropriate market for the public good existed".

Validity as it pertains to findings of a particular CV study is based on whether the WTP estimated obtained from the survey accurately represent the respondent's true willingness-to-pay (73). Mitchell and Carson (73) described three types of validity for CV studies: content, construct and criterion.

1.5.4.1 Content Validity

Content validity reflects the adequacy of the study to reflect the structure of the market and the description of the public good. This type of validity can be evaluated only by subjective judgment of the survey questionnaire, most importantly the wording of the questions (73). A well-designed questionnaire must have: 1) plausible and comprehensible information for the respondents, 2) detailed specification of the good (health intervention) to be valued, and its attributes, 3) a payment vehicle that is natural to participants and does not create difficulties in valuation (72, 73).

1.5.4.2 Construct Validity

Construct validity refers to the extent to which a measure from a CV method is related to other measures predicted theoretically (73). Construct validity can further be categorized into convergent and theoretical validity. Convergent validity measures the correlation between values obtained from two separate valuation methods of the same construct (73). For example, values from WTP may be contrasted with values from other nonmarket valuation methods that measure preferences by observing actual behavior, such as, travel cost approach or hedonic pricing.

If convergence is not observed between the two values, then either the WTP or the other methods are inaccurate (99). Various investigators have previously compared CV measures with travel cost and hedonic pricing measures, and they found reasonably strong convergence between the two measures (100).

On the other hand, theoretical validity measures whether the data from a CV study are consistent with theoretical predictions (39, 73). This includes assessment of the relationship between the WTP values and determinants of WTP. As explained by

Drummond et al. (39), there are two theoretical propositions that can be easily tested. Firstly, most goods tend to have a positive income elasticity, which means that higher respondent incomes should predict higher WTP values. This proposition can be validated if a positive relationship between WTP outcomes and income measures is observed using regression methods. Secondly, the WTP values should be positively related with increasing benefits from a valued good (39). For instance, if the success of a hypothetical treatment increases, the corresponding WTP values should be higher.

1.5.4.3 Criterion Validity

Criterion validity is a concept that defines the relationship between CV measurements and another criterion. An ideal criterion for comparison would be to what consumers actually pay. However, for CV studies concerning most health care interventions, actual markets do not exist. The concept of criterion validity has progressed greatly in environmental economics where it is highly applicable, since CV measures can be compared with hypothetical-simulated markets (99), unlike health economics.

1.6 Study Rationale

Mandibular two-implant overdentures have been shown to have high clinical effectiveness as a treatment approach for edentate people. However, diffusion and adoption of costly and sophisticated health care technology/interventions such as dental implants depend not only on its clinical effectiveness. In Canada, since costs of oral health care are mostly borne by private payers, either out-of-pocket or as insurance, the demand for an intervention is highly contingent on the individuals' perception of its benefits. While edentate people's demand for overdentures can be evaluated to some extent by assessing actual utilization of the intervention, future demand by potential patients cannot be similarly assessed. Moreover, preferences for private and public insurance for implant interventions remain undetermined. Thus, measurement of how potential patients (currently dentate/partially edentate people)

perceive the benefits of overdenture treatment can be of tremendous value in assessing this obscure demand.

As discussed previously, willingness-to-pay surveys measure individuals' preferences in monetary terms. This study was designed to elicit dentate individual's WTP for mandibular two-implant overdentures under three hypothetical constructs, namely, 'out-of-the-pocket' payments, private dental insurance coverage and public funding through additional taxes. The survey was designed to elicit monetary evidence that would be valuable to many stakeholders, such as dentists, insurance companies and employers. Furthermore, WTP results are a necessary first step in conducting a cost-benefit analysis for a healthcare service. This analysis will be informative to policy-makers when a tax-financed public funding strategy is considered for implant overdenture treatment.

1.7 Study Objectives

Primary objective: To assess dentate individuals' willingness-to-pay for mandibular two-implant overdenture treatment as 'out-of-pocket' payments, dental insurance premiums or additional yearly taxes.

Secondary objectives: To assess 1) variations in willingness-to-pay amounts with ability-to-pay, oral health indicators, previous knowledge of disease and/or treatment, attitude towards dental care and other sociodemographic factors, 2) individual's attitudes towards public funding for implant treatment, and 3) individuals' preferences for telephone interviews vs. internet-based surveys for willingness-to-pay studies.

Table 1. Cost-effectiveness analyses for implant overdentures

Attard, 2003 (101)	A cost minimization analysis of implant treatment in mandibular edentulous patients.
Attard, 2005 (27)	Long-term treatment costs associated with implant-supported mandibular prostheses in edentulous patients.
Heydecke, 2005 (40)	Cost-effectiveness of mandibular two-implant overdentures and conventional dentures in the edentulous elderly
Stoker, 2007 (102)	An eight-year follow-up to a randomized clinical trial of aftercare and cost-analysis with three types of mandibular implant-retained overdentures
Takanashi, 2004 (103)	A cost comparison of mandibular two-implant overdenture and conventional denture treatment.
Zitzmann, 2006 (42)	A cost-effectiveness analysis of implant overdentures.

Table 2. Publications including direct methods of utility measurements in Dentistry

Krischer, 1976 (104)	Cleft Lip and Palate intervention	Standard Gamble
Antczak,1987 (105)	Surgical, nonsurgical and antimicrobial therapies for periodontal disease	SG and TTO (to calculate QATYs)
Tulloch, 1987 (106)	Third molar surgeries	TTO
Cohen, 1990 (107)	Third molar surgeries (retrospective)	Variant of TTO
Fyffe, 1992 (51)	Restorative treatment (Cariology)	SG
Jacobson, 1992 (68)	Dental Implants (endosseous vs. transosseus vs. conventional dentures)	RS (Feeling thermometer)
Brickley, 1995 (108)	Complications associated with lower third molar surgeries	VAS
Armstrong, 1995 (109)	Third molar care	VAS
Downer, 1997 (110)	Oral Cancer	SG
Birch, 1988 (111)	Caries Treatment	Category Rating and SG
Fyffe, 1999 (112)	Different tooth states	DVAS (Variant of VAS) and DFTO (Variant of TTO)
Nassani, 2005 (113)	Tooth loss	VAS
Balevi, 2007 (114)	Endodontic treatment	SG
Nassani, 2009 (115)	Tooth loss	VAS
Nassani, 2011 (116)	Tooth loss	VAS
Fukai, 2012 (117)	Different dental states, Regular dental check ups	VAS, TTO

SG- Standard Gamble; TTO- Time trade-off; RS- Rating Scale; DVAS- Dental Visual Analogue Scale; DFTO- Dental Freetime trade-off; QATYs- Quality adjusted tooth years

Table 3. Instruments used to measure oral health related quality of life (OHRQoL)*

Instruments	*Abbreviation*
Oral Health Impact Profile (118)	OHIP-49
Oral Health Impact Profile (short version) (119)	OHIP-14
Oral Health Impact Profile (for edentate individuals) (120)	OHIP-20
Oral Health Impact Profile (for aesthetics) (121)	OHIP-aesthetic
UK Oral Health-Related Quality of Life Measure (122)	OHQoL-UK
Oral Impacts on Daily Performances (123)	OIDP
Psychosocial Impact of Dental Aesthetics Questionnaire (124)	PIDAQ
Orthognathic Quality of Life Questionnaire (125)	OQoLQ
Geriatric (General) Oral Health Assessment Index (126)	GOHAI

*Does not include pediatric OHRQoL instruments

Table 4. Willingness-to-pay studies for oral health care interventions

Author (year)	*Intervention*	*Payment Vehicle*	*Elicitation Method*
Matthews, 1999 (127)	Periodontal Therapy	Dental Insurance Premiums	Bidding algorithms
Dixon, 1999 (128)	Community Water Fluoridation	Taxation	Payment Card
Cunningham, 2000 (129)	Orthognathic treatment	Out-of-pocket	Payment Card
Matthews, 2002 (130)	Dental Anesthetic gel	Out-of-pocket and Dental Insurance Premiums	Bidding algorithms
Smith, 2004 (131)	Orthognathic	Out-of-pocket	Payment Card
Tamaki, 2004 (132)	Regular dental check-ups	Out-of-pocket	Payment Card
van Steenberghe, 2004 (133)	Dental Anesthetic gel	Out-of-pocket	Bidding algorithms
Birch, 2004 (134)	Dentin regeneration	Out-of-pocket and Dental Insurance Premiums	Open-ended question
Halvorsen, 2004 (135)	Dental Fear Treatment	Out-of-pocket	Open-ended
Atchison, 2007 (136)	Mandibular fracture treatment	Winning the lottery and indicating WTP out of the lottery received	Visual Analogue Scale
Oscarson, 2007 (137)	Caries Prevention	Monthly payment	Close-ended question with open-ended follow up
Tianviwat, 2008 (138)	Caries Prevention and Caries treatment	Out-of-pocket	Bidding algorithms
Tianviwat, 2008 (139)	Mobile dental clinics	Out-of-pocket	Bidding algorithms

Table 4. Willingness-to-pay studies for dental care (Contd.)

Author (year)	*Intervention*	*Payment Vehicle*	*Elicitation Method*
Tuominen, 2008 (140)	Dental check-up	Out-of-pocket	Open ended
Esfandiari, 2009 (141)	Mandibular two-implant overdentures	Out-of-pocket (one time and monthly payments)	Open-ended and closed-ended questions
Rosvall, 2009 (142)	Orthodontic appliances	Out-of-pocket	Payment Card
Tianviwat, 2009 (143)	Hospital-based and mobile dental clinics based treatments	Out-of-pocket	Bidding algorithms
Leung, 2010 (144)	Single Implant replacement	Out-of-pocket	Bidding algorithms
Bech, 2011 (145)	Various attributes of dental services	Not reported	Discrete choice experiment
Vermaire, 2012 (146)	Caries Prevention	Out-of-pocket Monthly payments	Payment card (with range of WTP amount)
Widstrom, 2012 (147)	Unexpected Dental Expenses	Out-of-pocket	Open-ended

2. Methods

2.1 Overview of Study Design

This study uses a stated preference willingness-to-pay survey to obtain preference measurements of dentate individuals selected from a representative Canadian population. The public good being valued in this WTP survey is a mandibular two-implant overdenture. Payments are evaluated from three perspectives: one time out-of-pocket payment, monthly dental insurance premiums and yearly additional taxes to support a public funded program.

The survey design was guided by a pilot study conducted during Fall 2011 (148). It was conducted with a sample of 52 Quebec residents using an internet-based survey. This pilot study provided valuable information with respect to the feasibility of conducting a study with a larger sample size. Furthermore, it established the content and theoretical (construct) validity of the survey questionnaire.

The current survey was carried out using telephonic interviews and internet-based surveys. Data collection for this study ran between March 2012 and August 2012.

2.2 Survey Sampling

The source population of the study comprised of a general population in Canada who have a registered telephone number. Telephone numbers and names of 2001 individuals across Canada were obtained from InfoCanada,[1] on January 27, 2012. InfoCanada is an authorized consumer database provider that offers data licensed under Statistics Canada. The requested telephone numbers were based on pre-defined specifications given to InfoCanada: 1) the selected individuals should be Canadian

[1]InfoCanada, division of infoUSA Inc. is an Authorized User of selected Environics Analytics Inc. Computer File(s) and Distributor of derived Information Products under a licensing agreement. Based on Computer File(s) licensed from Statistics Canada. (c) Copyright, HER MAJESTY InfoCANADA THE QUEEN IN RIGHT OF CANADA, as represented by the Minister of Industry, Statistics Canada 2002

citizen/ resident, 2) 25 years or older, 3) annual household income greater than 10,000, and 4) the number of randomly selected individuals across all Canadian provinces should be representative of the provincial population with respect to absolute numbers, age, gender and income categories. The first three specifications were made to ensure that the selected individuals were Canadian tax-payers. This stratified random selection of individuals was preferred over random-digit dialing method to ensure a more representative sample of participants. The telephone numbers that were obtained excluded individuals who were listed on a National Do-Not-Call List. This sample size of 2001 individuals was selected due to time and resource considerations.

2.2.1 Eligibility Criteria

The general inclusion criteria for the study were: 1) Canadian tax payers, 2) 25 years or older, 3) able to understand English, and 4) dentate or partially edentate.

2.3 Survey Technique

Common survey techniques used for WTP surveys include face-to-face interviews, telephone interview and mail surveys. The instrumentation technique selection usually depends on the elicitation format and availability of resources. For instance, bidding algorithm techniques require face-to-face or telephonic interviews and cannot be carried out using mail surveys (72). Similarly, complex question formats such as the modified discrete choice approach in this study cannot be controlled in a mail survey. Moreover, mail surveys have a significant risk of non-response (149). Face-to-face interviews are preferable due to the essence of synchronous communication; however, the major offset is the loss of sample size and potential interviewer effect. Interviewer effect results when interviewees try to respond to sensitive questions in a socially desirable manner due to the presence of an interviewer. Telephonic interviews on the other hand allow access to a geographically larger sample while retaining the benefits of personal communication, although non-response is a significant risk (150, 151). The use of internet-based surveys for eliciting WTP surveys is an increasingly popular method

(152-154). The use of innovative features in online survey software, termed 'advanced survey logic', allows development of complex questions by creating branches, loops, jumps etc. For this study, a combination of telephonic interviews and internet-based surveys was used.

A trained researcher (148) called all the people whose telephone numbers and names were obtained from the InfoCanada database using a personal telephone number. Each number was called three times if unanswered following which the number was categorized under 'unanswered calls'. Invalid numbers were also noted and later replaced by InfoCanada. An excel worksheet with all names and phone numbers was designed *a priori* to record the date/time of the calls, whether the call was answered, the number of calls when it was answered (first/second/third), whether the respondent agreed to participate, and the survey method opted by the respondent. Each individual who answered the call was given a short introduction to the survey and the survey team along with contact details of the study coordinator. They were informed about the confidentiality of the survey and were requested to participate in the survey. They were also informed about their right to quit the survey at any time even if they decided to participate initially. Each individual was asked preliminary questions to assess eligibility based on the above-mentioned inclusion criteria. If the respondent was not-eligible, another member from the household was requested to participate. Each respondent who agreed to participate was provided contact information for the McGill Ethics Officer in case of any questions about their rights or ethical concerns as a participant in the study. Following this, each respondent was given an option for a telephonic interview conducted at the same time or at a time convenient to the respondent. Alternatively, the respondent could participate by completing an internet-based survey. If the individual opted for the internet-based survey, he/she was requested to provide his/her email address to which a link to the internet-based survey was sent. In addition, all of the individuals were informed that they have a choice to enter a lottery to win a cash prize of $200 if they completed the survey.

2.3.1 Survey Instruments

2.3.1.1 Internet-based survey

The internet-based survey was designed using Fluid Surveys. Fluid Surveys is an online survey tool hosted in Canada which allows data privacy and security. A one-year pro-plan was purchased that allowed advanced question formats and customizable publishing settings.

The survey (Appendix I) included a cover letter with an introduction to the survey, rights of the participants, contact details of the study coordinator and the McGill Ethics Officer. A compulsory check-box was used at the end of the cover letter for an 'agreement to participate' in the survey. The second page provided the participants an elaborate description about the state of edentulism, the experience of denture wearing and the alternate treatment with two-implants (mandibular implant overdentures). Following this description, the participants were given three hypothetical scenarios, and their maximum willingness-to-pay under each scenario was obtained. The last section of the questionnaire elicited socio-demographic information about the participants such as age, gender, dental health, education, household income, likelihood of becoming edentulous, etc. All questions other than age and income were made compulsory.

2.3.1.2 Telephonic Interview

The content and structure of the telephonic interview was the same as that of the internet-based survey questionnaire. The telephone calls were made using a personal telephone number with Canada-wide calling. A response-sheet was designed *a priori* to record the respondents' answers (Appendix II). Each respondent was asked to verbally state an agreement to participate and the response-sheet included a check-box for the same. All of the participants who complete the telephonic interview were also asked if they wish to enter the lottery for the $200 prize and their responses were recorded on the response-sheet.

2.4 Survey Design

2.4.1 Scenario Design

The survey included three hypothetical scenarios where respondent's had to indicate their maximum willingness-to-pay. Differences between the three scenarios with respect to the ex-post/ex-ante perspective, risk communication and payment vehicle are summarized in Table 5.

2.4.1.1 Out-of-pocket WTP scenario

The out-of-pocket WTP scenario simulated the *ex-post perspective* of contingent valuation which is based on certain needs. In other words, this scenario elicits an individual's WTP under the assumption that the individual is eligible for the treatment and needs it. Under this scenario, the respondents were asked to imagine that they were edentate and wore conventional dentures. Respondents were informed that conventional dentures should be replaced every 5-7 years. The costs for a new set of dentures were stated at approximately $1,750 and an average of $200 for any repairs. These projected amounts are an estimated average of market prices for denture treatment by dentists and denturists in Montreal (in October 2011). The respondents were then told that their dentist advised them to get mandibular implant-overdentures that would increase the retention and stability of their dentures. The maximum WTP was recorded as a one-time payment for the implant treatment excluding the cost of the dentures and any future maintenance costs.

2.4.1.2 Private Dental Insurance WTP Scenario

This scenario replicated the *ex-ante private insurance perspective* where the need for treatment is uncertain and the payment is through private dental insurance. Under this scenario, the respondents were asked to assume that they had a 1 in 5 chance of becoming edentate at a later stage in their life. This probability was estimated from the prevalence of edentulism in people aged 55 to 74 as stated in Statistics Canada 2009 report (155). The respondents were informed that they could get implant overdenture

treatment in the future by paying for it themselves (out-of-pocket). They were informed that the approximate cost for the implant treatment would be $5,000 and maintenance costs would be $2,000 for the next 10 years if they underwent treatment in 2012. Conversely, they were given an option to buy private dental insurance coverage for mandibular two-implant overdentures that would cover treatment and follow-up costs for 10 years if needed in the future. The maximum WTP was recorded as monthly payments paid to the private dental insurance company for mandibular two-implant overdentures.

2.4.1.3 Public Tax-funded Program WTP scenario

This scenario created the *ex-ante public insurance perspective* where the need for treatment is uncertain and the payment is through additional taxes. Under this scenario, the respondents were asked to assume that government is planning to fund mandibular two-implant overdenture treatment for all edentate individuals. However, this program would be financed by higher taxes. The respondents were informed that they would benefit from this program if they ever became edentate. Furthermore, they were informed that there are currently more than 2 million people in Canada who are edentate and can benefit from this health program. They were asked if they would support this program and the maximum amount that they would be willing to pay as additional yearly taxes.

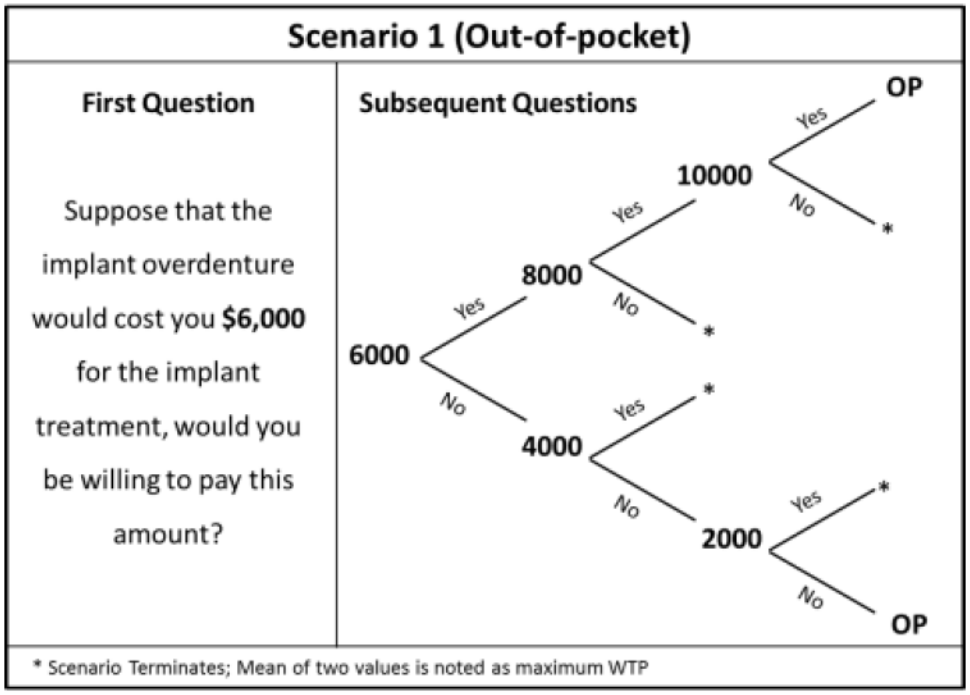
2.4.2 Elicitation Format

As previously discussed, dichotomous choice questions are the preferred format for eliciting WTP values since they present easy to understand, market-like situations to the respondents and reduce strategic responses. Multiple-bound discrete choice (DC*m*) designs provide a solution to the statistical insufficiency of single discrete choice questions (91, 156). In 1996, Langford (92) utilized the triple-bounded discrete choice (DC*3*) approach that essentially simulates the bidding game technique truncated at a

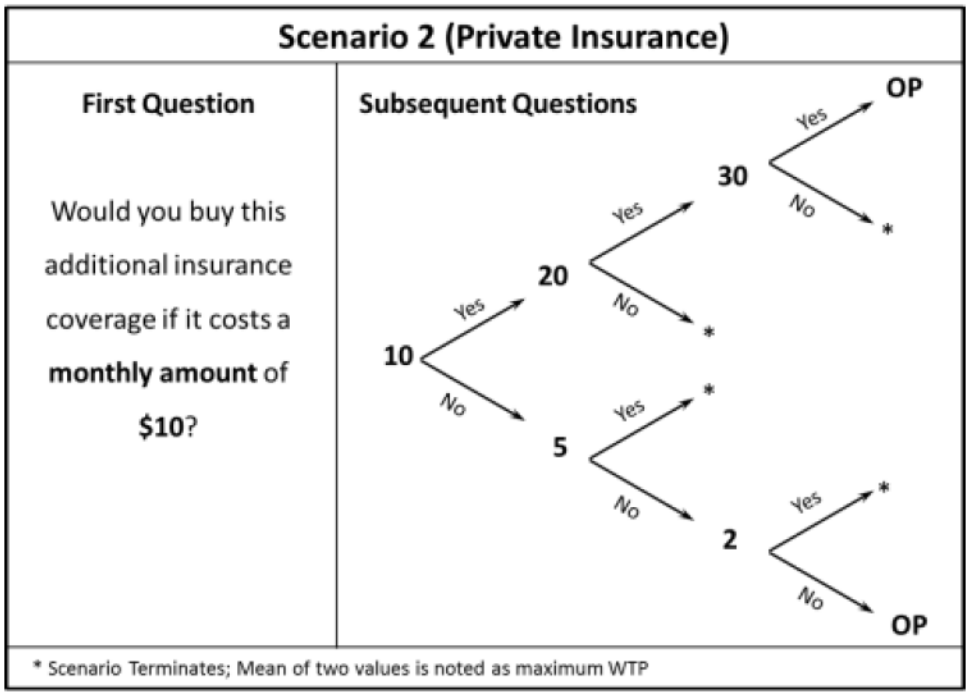
maximum of 3 bids per respondent. However, the statistical information is still limited as compared to open-ended questions since discrete choice questions are bound by bids preset by the researchers (93). To resolve this issue, this current study used a modified DC3 approach. Each hypothetical scenario employed a *triple bound discrete choice (DC3) question terminating in an open ended question*. This simulated bidding game formats that have been commonly designed to incorporate an open-ended question after the maximum bid (72, 95, 157). Furthermore, a similar technique was used by Stevens et al. (158) where each respondent was given a single discrete choice question followed by the option to raise/lower their bid in an open-ended format.

The modified DC*3* format used in this study is schematically described in Figure 7. The first question in each hypothetical scenario started with a specific amount; $6000 for the out-of-pocket scenario, $10 for the private dental insurance scenario, $100 for the income tax-funded public program scenario. These starting amounts were computed from the average WTP values obtained from the pilot study. The question included a dichotomous yes/no answer format. If the respondent agreed to pay this amount, the second question included a higher bid (amount). If the respondent agreed to pay this amount as well, the third question had a higher bid than the second one. Following acceptance on the third question, the respondents were given an open-ended question with the choice to enter any amount as their maximum willingness-to-pay. If the respondent refused to pay the amount in the first question, the same structure was followed with the second and third questions having a lower bid and ending in an open-ended question. All the amounts were stated in 2012 Canadian $.

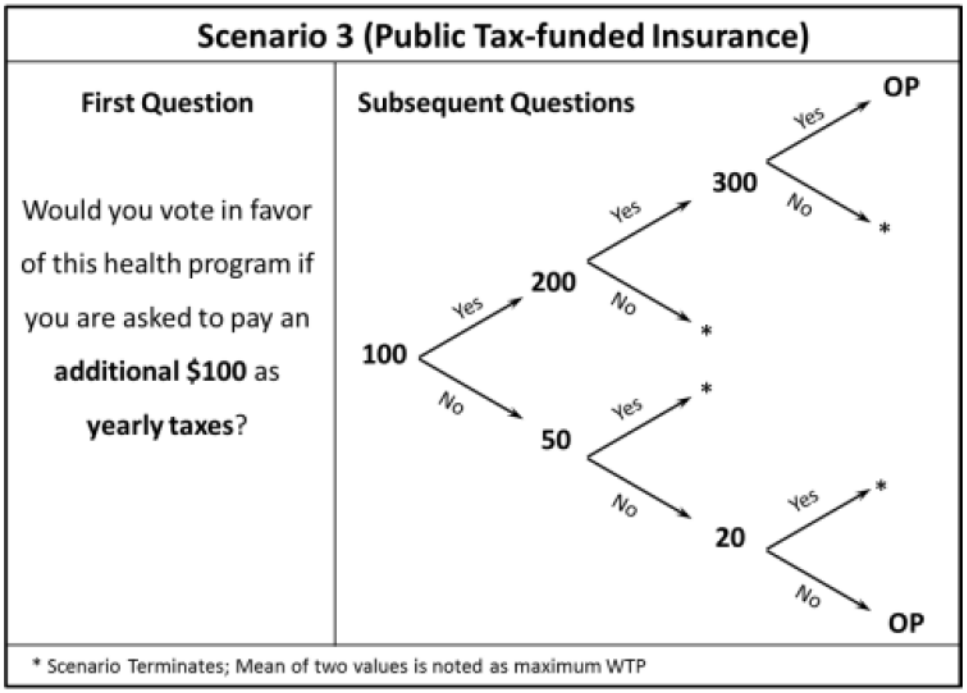
The discrete choice questions provided the interval for a respondent's WTP and the maximum WTP was recorded as the mean of the interval, which is similar to the method used for bidding game and payment card techniques (72, 159). For instance, if a respondent refused to pay $6,000 but accepted to pay $4,000 in the out-of-pocket scenario, the actual WTP would be recorded as $5,000.


Scenario 1 (Out-of-pocket)
First Question
Suppose that the implant overdenture would cost you $6,000 for the implant treatment, would you be willing to pay this amount?
Subsequent Questions
6000
Yes
No
8000
Yes
No
*
10000
Yes
No
*
OP
4000
Yes
No
*
2000
Yes
No
*
OP
* Scenario Terminates; Mean of two values is noted as maximum WTP

(a)


Scenario 2 (Private Insurance)
First Question
Would you buy this additional insurance coverage if it costs a monthly amount of $10?
Subsequent Questions
10
Yes
No
20
Yes
No
*
30
Yes
No
*
OP
5
Yes
No
*
2
Yes
No
*
OP
* Scenario Terminates; Mean of two values is noted as maximum WTP

(b)



(c)

Figure 7. Elicitation format and bid amounts for a) out-of-pocket, b) private dental insurance, and c) public tax-funded insurance WTP scenario

2.4.3 Pretesting of the Instrument

Mitchell and Carson (73) argue that pretesting is the most effective way to assess a study's reliability as it allows the investigators to assess survey weaknesses before applying it in the field. The construct of the hypothetical scenarios were justified by the content and construct validity established during the pilot study.

The elicitation format was modified based on the pilot study and further discussed with two experts in the fields of Health Economics and Prosthodontics to establish content validity. The modified questionnaire was also scrutinized for content validity in a forum consisting of researchers and dentists at the Division of Oral Health and Society, Faculty of Dentistry, McGill University. Prior to formally beginning the survey, the questionnaire

was pretested with two people each using the telephonic interview and the internet-based survey to assess the estimated time required for the survey.

2.5 Ethical Considerations

Prior to the start of the study, ethical approval was obtained from the McGill University Faculty of Medicine Institutional Review Board in January 2012. The survey was conducted between March and August 2012.

For the internet-based surveys, the purchased Fluid Survey pro-plan allowed various privacy and security features to be enabled: 1) the survey could not be indexed by search engines, 2) the survey was made anonymous by hiding invite codes, email address of respondents, custom invite variables, referring URL, get parameters, IP address of the respondent and the username if the user was logged in. Furthermore, the survey was based on 'invite only' feature such that only users with a valid unused invite were able to take the survey. This ensured that multiple responses were not generated by the same individual. The survey allowed the respondents to save their answers and return to them later. However, the respondents could not go back and change answers once saved. After completion of the survey, the participants were redirected to another web page where they could confirm their entry into the lottery by providing their name and contact information. This webpage was designed independently and was not linked to the study survey. Furthermore, the lottery webpage was designed to save names in a random order so that the responses could not be linked to the survey responses by time/date or order of response. The participants were assured that their contact details will be kept confidential and will not be associated with their survey response.

2.6 Data Management

The data collected using the internet-based survey was downloaded into an excel sheet and then exported to Statistical Product and Service Solutions (SPSS), version 20.0.0 for Windows, IBM SPSS Statistics. Telephonic interview data from the response-sheets was manually entered into SPSS and rechecked for reliability of data entry. Prior to data analysis, value labels were assigned to each variable based on the questionnaire. Preliminary assessment including frequency analysis was done to assess the data for missing values and inconsistencies. The errors were verified by re-examination of the raw data in the response-sheets. All statistical analyses were performed using the SPSS software.

2.7 Data Analysis

2.7.1 Variables

2.7.1.1 Outcome Variables

Three outcome variables were defined based on the three WTP scenarios: 1) out-of-pocket WTP, 2) private dental insurance WTP and 3) tax funded program WTP. As previously discussed, these variables describe an individual's WTP in monetary values (2012 CAD) and therefore, were treated as continuous variables.

2.7.1.2 Explanatory Variables

Annual Household Income

Following the concepts of income elasticity of demand (160), individuals with higher incomes were expected to have higher WTP amounts. This was also established in our pilot study. Annual household income was preferred over individual income measures since it better represents the availability of financial resources. Annual household income, hereinafter referred to as 'income', was recorded using the following categories: less than $30,000, $30,000-$60,000, $60,000-$90,000, $90,000-$120,000,

more than $120,000. Categorical responses were obtained, rather than precise income amounts, due to sensitivity issues with income-related questions (72), especially in the telephonic interview.

Oral Health Indicators

Willingness-to-pay for health interventions has been previously shown to be positively related to personal health care needs (161). We expected WTP for mandibular two-implant overdentures to increase for individuals with a greater chance of becoming edentulous. To assess this need, we recorded individuals' self-perceived oral health status, self-perceived likelihood of edentulism, and the number of missing teeth, if any.

Self-perceived oral health status is known to be correlated with various oral diseases such as decayed, missing and restored teeth, oral and facial pain or discomfort, periodontal disease, dry mouth, esthetic perceptions and the psychosocial impact of each of these factors (162-164). It is also likely influenced by an individual's overall psychic resilience towards risk of oral disease (165). On the other hand, **self-perceived likelihood of edentulism** is a narrower construct, often erroneously assumed to be guided solely by number of decayed, loose (periodontally compromised) or missing teeth. However, self-perceived indicators may diverge significantly from actual need. Therefore, it was of interest to ascertain if actual need (missing teeth) was concomitant with the perceived need and whether the latter guided WTP values significantly. Thus, the decision to record both oral health status and likelihood of edentulism was made.

Self-perceived oral health status (excellent/very good/good/fair/poor) was recorded as a categorical variable. Self- perceived likelihood of edentulism was recorded from 0 to 10, representing a range of 0% to 100% probability. **Missing teeth** (yes/no) was recorded as a categorical variable. Number of missing teeth was recorded as a continuous variable for respondents who answered 'yes' for the variable missing teeth.

Previous Knowledge of Disease and/or Treatment

Dolan (78) established that an individual's preferences towards a certain treatment could be molded by previous experience of the illness, either through personal incidents

or through those of a family member, friend or acquaintance. Furthermore, previous knowledge about the benefits of a certain commodity can result in higher preferences (166). Therefore, we expected WTP amounts to be higher for respondents who **previously knew edentulous people** and from those who had **previous knowledge of implants**. Furthermore, this was also verified in our pilot study findings.

These factors were recorded as dichotomous categorical variables by examining '*have you heard about dental implants before the survey*' (yes/no) and '*do you know anyone personally missing all their teeth*' (yes/no).

Attitude Towards Dental Care

WTP values were expected to be higher for individuals with more favorable attitudes towards dental health care. This was measured by 4 different paradigms.

Respondents who indicated that they were missing one or more teeth were asked if they had **replaced the missing tooth/teeth** (yes/no). This was recorded as a categorical measure and replacement of teeth was considered to reflect positive attitude towards dental care.

Respondents were asked if they would **opt for dental implants** (or did they opt for dental implants) if they were to lose (or lost) any tooth. Responses were recorded as yes/no categories, and respondents answering 'yes' were believed to have positive attitudes towards implant treatment.

There is controversial evidence whether health seeking behavior and health care utilization are related to health insurance coverage (167, 168). In our study, respondents' current **dental insurance status** (yes/no) was recorded to assess any potential relationship with WTP amounts.

Attitude towards public funded programs was expected to influence an individual's WTP for public programs through additional taxes. Respondents were asked whether the health ministry should pay for mandibular two-implant overdentures (yes/no). People with an affirmative response were expected to have higher WTP for additional

taxes. These respondents were further asked if public funding for implants should be restricted to mandibular two-implant overdentures or it should be extended to anyone missing one or more teeth.

Additional Variables

Age was recorded as a continuous variable, and sex (male/female) as a categorical variable. The highest level of education (primary school, high school, CEGEP/college, university degree, graduate university or higher) were also recorded as categorical variables.

2.7.2 Descriptive Statistics

Descriptive statistics were performed to describe the basic features of the collected data. The response rate was calculated as the total number of telephonic and internet based responses divided by the total number of answered calls. Differences in responses obtained from telephonic interviews, as opposed to internet-based surveys, were evaluated using Independent sample t-tests for continuous variables and cross-tabulations for categorical variables.

2.7.2.1 Demand Curves

Demand curves graphically represent the relationship between the price of a certain commodity and its demand, that is, the amount of the commodity that consumers are willing to buy at each given price. The curve is created by adding individual demands at each price level. McIntosh et al. (72) have described a procedure to create demand curves using WTP data that we followed to create demand curves for all three WTP outcomes (p. 129). For comparison between the demand curves for monthly private dental insurance WTP amounts and yearly public tax-funded program WTP amounts, the obtained WTP values for monthly private were multiplied by 12 to produce annual amounts.

2.7.3 Model Specifications

Multiple linear regression analysis was used to describe the association between the WTP outcome (dependent) and the explanatory (independent) variables described previously. Multiple linear regression (MLR) is a statistical method used for demonstrating the relationship between a scalar or continuous dependent variable and one or more independent variables by fitting a linear equation to the observed data (169). This relation is shown in the equation below,

$$y_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_k x_k$$

where β_0 is the intercept on the y-axis and X_1 to X_k represent k independent variables used in the model to predict the outcome (y_i). β_1 to β_k represent the coefficients of the independent variables and describe the change in outcome variables per unit change in the independent variable.

WTP survey data utilizing discrete choice elicitation formats are usually analyzed by logistic regression and hierarchical multiple regression for single-bound and multiple bound discrete choice questions, respectively (72, 92). However, the modified design of our elicitation format included open-ended questions that resulted in practically continuous data. Therefore, multiple linear regression was considered to be an appropriate statistical method for analyzing our data. Statistical significance was assumed at α=0.05.

2.7.3.1 Model construction

Variable assessment and transformations

Validation of statistical tests of significance in multiple linear regression requires that the data be carefully assessed for sampling distribution of the variables prior to fitting regression models (169). Continuous variables were assessed for normal (bell-shaped) distributions, since highly skewed data tend to produce flawed results, such as *heteroskedastic* effects. Highly skewed variables should be transformed using log or square root transformations to produce more uniform distributions (169); however, this

was not required for WTP variables obtained through our study. Tests for normality for quantitative variables included visual assessment of Q-Q plots and the statistical Kolmogorov-Smirnov test. The variable 'age' was not expected to have a normal distribution, which would otherwise indicate absence of a representative population. Dummy variables were created for variables with multiple categories.

Correlation analysis

Correlation analysis provides the degree of association between two variables and determines interdependence of the variables. Interdependence between the outcome variable and the explanatory variables is desirable, since regression is conducted to describe the dependence of the outcome variable on the explanatory variables (169). However, high correlations (≥0.8) between two explanatory variables may generate issues of multicollinearity (170), which will be discussed in the following sections. Therefore, correlation analyses were carried out as an initial assessment for all possible two-variable relationships (171).

Initial visual assessment of the relationship between the variables was done using graphical scatterplots. Spearman's correlation analysis was used to assess correlations between all continuous variables that were not normally distributed but demonstrated a monotonic relationship, such as the dependent WTP variables and age. A point-biserial correlation analysis (172) was conducted to assess the correlation between the dependent variables and independent dichotomous variables including gender, missing teeth, heard of implants before, would chose dental implants, dental insurance and knowing someone edentate. Interdependence between the dependent and independent categorical variables, including oral health status, education and household income, was assessed using a One-way Analysis of Variance (ANOVA). A chi-square independence test was carried out to determine the relationships amongst the independent categorical variables (169, 171).

Building the Regression Models

One of the objectives of our study was to assess variations in WTP amounts with ability-to-pay, oral health indicators, previous knowledge of disease and/or treatment, attitude towards dental care and other socio-demographic factors. We constructed multiple linear regression models for each of the three main outcome groups (out-of-pocket WTP, dental insurance WTP and public tax-funded program WTP). Additionally, sub group regression analysis was done for respondents who were missing teeth to assess their out-of-pocket and private dental insurance WTP. Another sub group regression was created to assess variations in additional tax WTP for respondents who had a positive attitude towards public funding, as we hypothesized a positive relationship between the two factors.

Initially, all of the key variables were used to assess the model fit using a forced entry method of variable selection. Key variables (or main effect variables) were not removed, even if they were not significant. Subsequently, all 2-way interactions between variables were introduced in the model; only significant interaction terms were retained. For this procedure, we used a stepwise method of variable selection of interaction terms while maintaining the key variables in the regression model. (SPSS settings for stepwise regression followed conventional settings with entrance probability= 0.05 and exit probabilities = 0.10.). A statistically significant interaction was observed between the dummy variables of income and education in our three main outcome groups. Therefore, the final main group models are presented using these new variables. Furthermore, interaction between sex and age was significant for the out-of-pocket WTP outcome. None of the interactions were significant in sub group regression analysis models for people missing their teeth or in the additional tax WTP model for respondents who had a positive attitude towards public funding. Missing observations (n=3) were excluded from the regression analysis.

Adjusted R square and Akaike's Information Criterion (AIC) were used to compare several models for their goodness-of-fit. Adjusted R square is a measure that provides

the amount of variation in the outcome variable as explained by the explanatory variables, adjusted for the number of variables. Higher adjusted R square values represent better model fits (169). On the other hand, AIC is based on the concept of deviance, and smaller AIC values represent better model fits (173, 174). As a rule of thumb, if the model with a larger AIC, compared to the one with a lower AIC, has an absolute difference less than 2, then the models are not different in their fit. If the absolute difference is within 4-7, the model with the larger AIC has a poorer fit. An absolute difference greater than 10 signifies that the higher AIC model fails to explain substantial structural variation in the data and should be omitted (174).

2.7.3.2 Model Diagnosis

Multiple linear regression is based on certain statistical assumptions that must be verified before any statistical inferences are drawn. *Residual diagnostics* is an essential procedure for evaluating violations of regression assumptions (175). We conducted residual diagnostics for each regression model to determine whether the model could be used for statistical inference purposes.

Multicollinearity is a result of a high correlation between two explanatory variables, such that one variable can be predicted from the other. This creates substantial issues in multiple regression, since the multicollinear variables provide redundant information. Thus, the prediction of the outcome variable is distorted, and statistical tests of significance provide incorrect estimates (169, 170). Diagnosis of multicollinearity was done through variance inflation factor (VIF) and variables with VIF ≥ 5 considered to be of potential concern. Self-perceived 'oral health status' and self-perceived 'likelihood of edentulism' variables demonstrated multicollinearity. Therefore, the 'likelihood of edentulism' variable was dropped from all regression models.

Influential observations may dramatically affect the regression results by changing the co-efficient estimates of the variables (176). These are often outliers and may/may not represent the population. One diagnostic method of *influential points* is 'Cook's distance method' that identifies observations that strongly influence the regression line. As a rule

of thumb, Cook's distance values greater than 4/(n – k – 1) are treated as influential observations, where n = sample size, and k= number of predictors (176). In WTP studies, respondents who are willing to pay very high/low amounts may be statistical outliers but, practically, may represent a portion of the population that would actually be willing to pay substantially high/low amounts compared to the median population. Therefore, we assessed these influential outliers using the Cook's distance method, followed by sensitivity analyses to fit regression models after omitting these influential observations.

2.7.3.3 Statistical Power

Post-hoc power analyses were conducted for all final regression models using G*Power 3.1 statistical power analysis software (177). Statistical power (1-β) was computed as a function of significance level (α=0.05), sample size, and the population effect size (Cohen f^2) (177, 178).

Table 5. Differences between out-of-pocket, private dental insurance and public tax-funded program WTP scenario designs

	Out-of-pocket	***Private Dental Insurance***	***Public tax-funded program***
Perspective	Ex-post	Ex-ante	Ex-ante
Risk Communication	Certain need	Uncertain need	Uncertain need
		Risk expressed in terms of probabilities (1 in 5 chance)	Risk expressed in terms of absolute frequencies (e.g. 2 million edentulous people)
Payment Vehicle			
– **Timing**	One-time payment	Monthly payment	Yearly payment
– **Payment type**	Treatment fees	Insurance purchase	Additional income tax

3. Results

3.1 Sample Results

3.1.1 Response Rate

Out of 1,096 answered calls, 277 respondents chose telephonic interview and 58 individuals opted for internet-based survey (Figure 8). However, only 40 respondents completed the internet-based survey resulting in a total of 317 responses (response rate=28.92%).

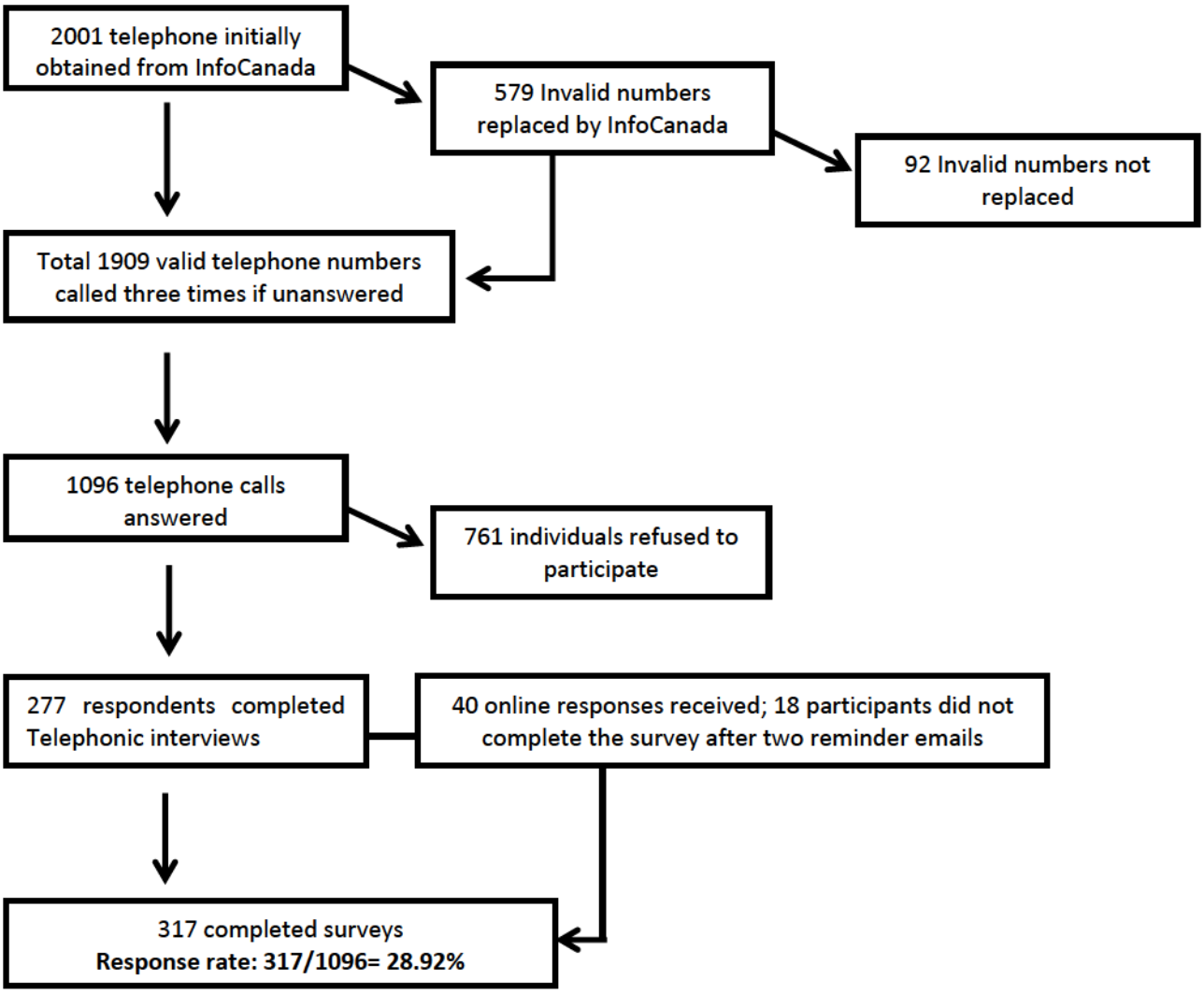


Figure 8. Response rate

3.1.2 Sample Characteristics

The age of the participants who chose to complete the internet-based survey (M=37.53; SD=9.134) was significantly lower than those who opted for telephonic interviews (M=41.70; SD=9.797); $t(315)$=-2.542, p=0.010. There were no other significant differences between those who responded by telephone or online; hence, the data were pooled together. WTP amounts showed no significant correlations with the survey mode (p>0.05). Furthermore, the education categories of 'primary' and 'high' school were merged due to limited numbers in these categories. A detailed description of the sample characteristics can be found in Table 6.

Self-perceived likelihood of edentulism was measured on a scale of 0 to 10. Almost two-thirds of the respondents believe that they were unlikely to lose all of their teeth (<4) (Figure 9). Notably, 57.7% respondents believe that the government should pay for implants. Amongst these individuals, almost 65% felt that all dental implant treatments, irrespective of the number of missing teeth, should be funded by the Canadian Health Ministry (Table 7).

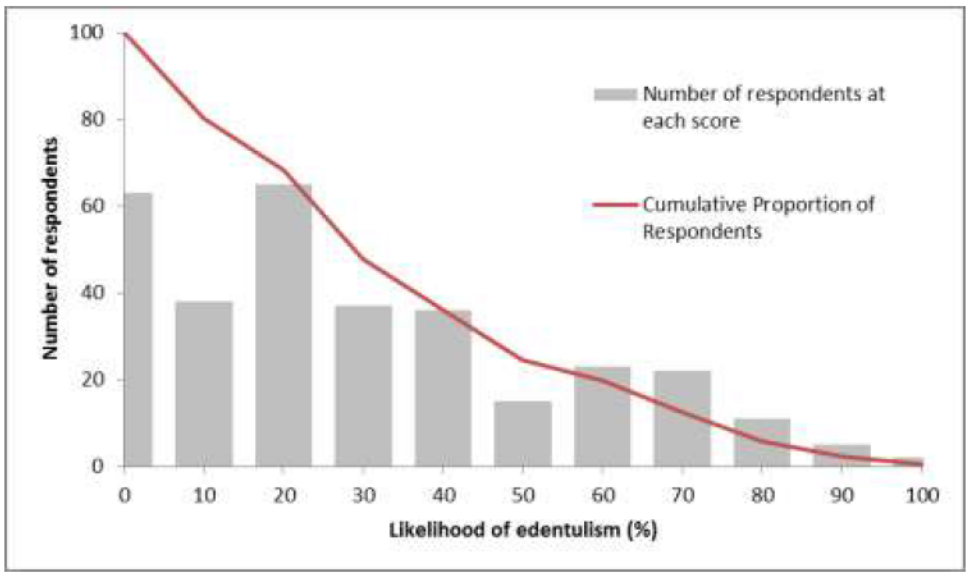


Figure 9. Self-perceived likelihood of edentulism

3.1.2.1 Associations between Sample Characteristic Measures

There was a significant positive correlation between actual need for treatment, measured as number of missing teeth and perceived need for treatment, measured as self-perceived likelihood of edentulism ($r(166)=0.765$, $p<0.001$); older individuals believing that they have a higher likelihood of edentulism ($r(315)=0.536$, $p<0.001$).

Furthermore, self-perceived oral health status was better in individuals from higher education categories levels ($\chi^2(12, n=317)=60.595$, $p<0.001$), however, there was no relationship with income ($\chi^2(16, n=315)=18.019$, $p=0.323$). Interestingly, better self-perceived oral health status was found to be significantly related to those who had private dental insurance ($\chi^2(4, n=317)=38.306$, $p<0.001$).

Furthermore, higher education levels were associated with higher annual income ($\chi^2(12, n=315)=210.847$, $p<0.001$), presence of dental insurance ($\chi^2(3, n=317)=107.050$, $p<0.001$) and previous knowledge about dental implants ($\chi^2(3, n=317)=65.888$, $p<0.001$).

To assess attitudes towards dental implant treatment, respondents were asked if they would opt (or have they ever opted) for dental implants if they were to lose (or lost) any tooth. This measure was positively related to higher income ($\chi^2(4, n=315)=27.409$, $p<0.001$) and higher education level ($\chi^2(3, n=317)=37.432$, $p<0.001$). Moreover, the chance for respondents to opt for dental implants increased by 27% as their likelihood of becoming edentulous increased incrementally from 0 to 10 ($p<0.001$).

3.2 Mean WTP for Mandibular Two-Implant Overdentures

Out-of-pocket willingness-to-pay ranged from $0 to $15,000 for the treatment, with a mean of $5,347.00 (2012 CAD; Table 8). Additional monthly WTP payments for private dental insurance ranged from $3.50 to $100, with a mean of $26.90 per month. Additional willingness-to-pay for a public funded program in yearly taxes ranged from $0 to $500, with a mean of $103.63.

3.2.1 Demand Curves

Demand curves for 'out-of-pocket', 'private dental insurance' and 'public tax-funded program' WTP were constructed (Figures 10 and 11). The X-axes of the demand curves represent the WTP recorded through this study rather than a uniform scale. These curves represent the percentage of respondents who are willing to pay for mandibular two-implant overdentures at different prices for the treatment, either paying by themselves or by private/public insurance. Almost 85% of individuals were willing to pay out-of-pocket for the overdenture treatment at a price-point of $1,500, whereas 50% of the respondents would pay up to a price-point of $4,000. The curves show a more than 40% decline in demand for the treatment as the price increases from $3,000 to $7,000. Furthermore, the demand curves for private and public insurance (Figure 11) reveal that, at any given price point, more respondents are willing to pay for private insurance than for public insurance with the same benefits.

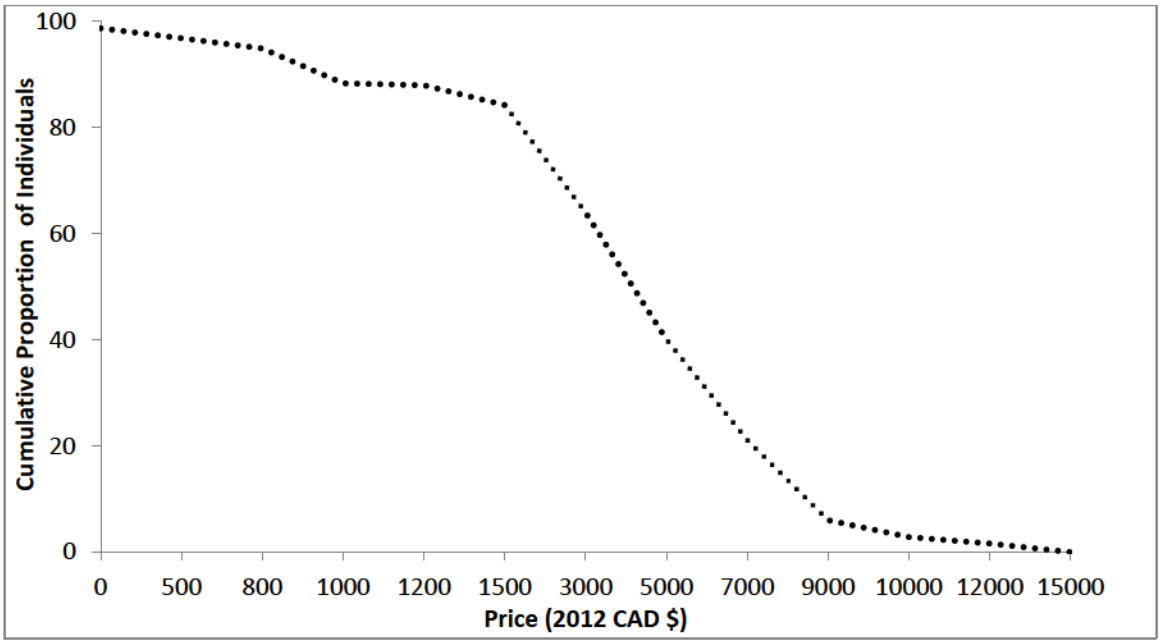


Figure 10. Demand Curve for Out-of-pocket payment

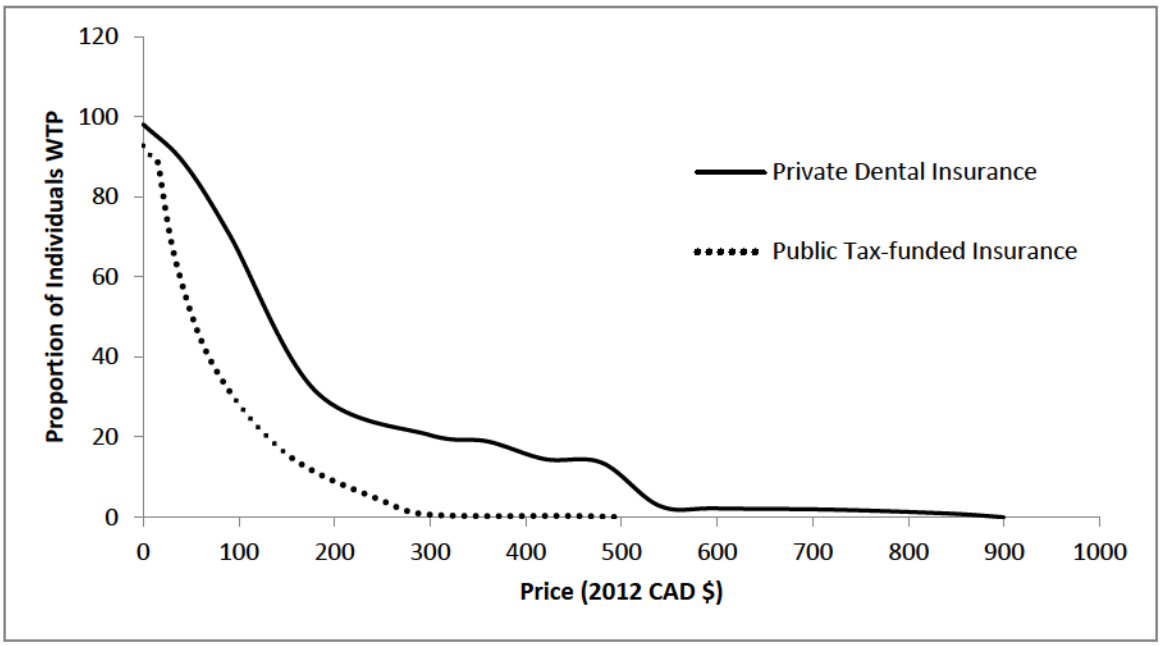


Figure 11. Demand Curves for Private Dental Insurance WTP and Public Tax-funded Program WTP

3.3 Regression Analysis

As described previously, the final model selection for each WTP scenario was based on lowest AIC and highest adjusted R^2 values, after determining the model fit and underlying assumptions of multiple linear regression (MLR). MLR model interpretation of each explanatory variable was done *ceteris paribus*. A comparison in mean willingness-to-pay amounts stratified by sample characteristics is also presented with the regression analyses in Tables 9, 11 and 13 for the three scenarios.

The post-hoc statistical power analysis suggests that all three models had a power (1-β) approximately equal to 1, such that the probability of making false negative decisions from the regression models is nil.

3.3.1 Regression Analysis for Out-of-pocket WTP

The MLR model for out-of-pocket WTP included interaction variables between income and education, as well as age and sex, in addition to all of the key explanatory variables (Table 9). This model fit the data well ($F(29, 284)=19.939$, $p<0.001$) and provided better prediction of the WTP outcome (adjusted $R^2=0.637$; AIC=4789.985) when compared to a model without interaction variables (adjusted $R^2=0.578$; AIC=4752.876). These interaction variables explained approximately 7% more variation when assessed by unadjusted R^2 changes. There were no observations of interactions between CEGEP/College education level and >$120,000 income level.

A sensitivity analysis model was constructed after removing 22 influential observations that were identified by Cook's distance method. Although the sensitivity model provided a better prediction of the WTP amounts (adjusted $R^2=0.737$; AIC=4287.724), there were no differences in the statistical significance for the explanatory variables. Changes, if any, were restricted to small variations in the regression co-efficients. Therefore, the interpretation of the regression analyses was based on the main MLR model, while deviations from the sensitivity analysis models were noted.

Younger individuals were willing to pay higher out-of-pocket payments for mandibular two-implant overdentures ($p=0.016$). Men had a significantly lower out-of-pocket WTP than women ($p=0.002$). However, the interaction between sex and age was statistically significant ($p=0.002$); this means that for every year increase in age, men had a $72 increase over that of women in WTP.

Furthermore, WTP values were negatively associated with self-perceived oral health status ($p<0.05$). Respondents who perceived their oral health status as good, very good or excellent, had significantly lower WTP compared to those who considered their oral health to be poor. There were no significant WTP differences between respondents with fair and poor oral health status. In addition, the fact that respondents were missing teeth had no significant effect on the WTP outcome ($p>0.05$).

WTP was positively related to income; those in higher income categories were willing to pay greater out-of-pocket payments for mandibular two-implant overdentures (p<0.05). On the other hand, education was not significantly associated with WTP amounts. However, there was an interaction between education and income revealing that individuals with a higher income, given a higher level of education, had higher WTP (p<0.05). Interestingly, individuals having dental insurance were willing to pay a higher amount out-of-pocket for the treatment (p=0.004). Respondents who had knowledge about implants before the survey had significantly higher WTP (p<0.001). Finally, respondents who have experienced implants or indicated a desire to opt for implants, if needed, offered a higher out-of-pocket WTP (p<0.001).

3.3.1.1 Regression Analysis for Out-of-pocket WTP among people with missing teeth

As seen in the previous model, missing teeth did not influence out-of-pocket WTP for overdenture treatment. However, amongst these individuals who were missing teeth, WTP was influenced by various other factors (Table 10). With each increase of 1 missing tooth, respondents were willing to pay approximately $128 more out-of-pocket for implant overdenture treatment (p=0.045).

Amongst those missing teeth, older people who were willing to pay greater amounts out-of-pocket (p=0.016). In addition, dental insurance status was positively associated with WTP for people with missing teeth; individuals with dental insurance were willing to pay approximately $900 more out-of-pocket than those who did not have dental insurance (p=0.026). Men and higher income individuals were willing to pay more out-of-pocket when they were missing teeth (p<0.01).

3.3.2 Regression Analysis for Private Dental Insurance WTP

The regression and sensitivity analysis models for private dental insurance were built in a similar way to that of the out-of-pocket MLR model (Table 11). Interaction terms between education and income were included in the final model (adjusted R^2=0.483;

AIC=1526.055) that explained nearly 4.4% of additional variations in the WTP variable, as compared to a model without interactions (adjusted R^2=0.455; AIC=1533.889). In general, the final MLR model with interactions and key explanatory variables fits the data well and significantly (F(28, 285)=11.457, p<0.001). The sensitivity analysis model fits the overall data better than the other models (adjusted R^2=0.559; AIC=1284.061); however, it does not provide statistically different estimates of the independent variables.

Notably, age and sex of an individual had no effect on the amount they were WTP for private dental insurance (p>0.5). People who perceived their oral health status as poor were willing to pay higher monthly premiums than those who believed their oral health status was very good or excellent (p<0.5).

When compared to people with an annual household income of less than $30,000, those who had an income between $30,000 and $90,000 were WTP higher monthly insurance premiums (p<0.05). Education itself had no significant prediction of the WTP for private insurance premiums; however, compared to people with less than high school education, individuals who had an education higher than CEGEP/College and those who had an annual income greater than $90,000 were willing to pay higher insurance premiums (p<0.05).

Interestingly, the willingness-to-pay for private dental insurance was not affected by whether the individual currently had dental insurance or not (p=0.932). However, individuals who had previously heard of implants and were willing to opt for implants, if needed, had a significantly higher WTP for private dental insurance with this coverage (p<0.001).

3.3.2.1 Regression Analysis for Private Dental Insurance WTP among people with missing teeth

Similar to out-of-pocket payments, individuals who were missing one or more teeth did not have an overall increase in WTP for private dental insurance (Table 12). However,

amongst these people, WTP for private dental insurance escalated with the increase in number of missing teeth (p=0.039).

In addition, respondents with previous knowledge of implants and a desire to opt for implants, if needed, had higher WTP for dental insurance when they were missing teeth (p=0.001). Interestingly, the current status of dental insurance did not affect the amount people would pay as additional monthly insurance premiums (p=0.732).

Finally, amongst people who were missing teeth, those with a graduate university degree or higher were WTP significantly more than people whose highest level of education was high school (p<0.001). People in all income categories greater than $30,000 had higher WTP for insurance than people who had less than $30,000 income ($p$<0.05).

3.3.3 Regression Analysis for Public Tax-funded Program WTP

The final regression model (Table 13) for public tax-funded insurance included interactions between education and income (F(29, 284)=19.939, p<0.001). The model with interactions (adjusted R^2=0.382; AIC=2688.176) explained 4.6% more variations in the outcome WTP variable when compared to a model without interactions (adjusted R^2=0.355; AIC=2692.545), as assessed by changes in the unadjusted R^2. Sensitivity analysis was conducted after removing 16 influential observations. The sensitivity analysis model provided no statistically different estimates of the independent variables, although it improved the overall model fit (adjusted R^2=0.450; AIC=2458.223).

Notably, older people were willing to pay higher yearly taxes to support a publicly funded program for mandibular two-implant overdentures (p<0.001). Other personal characteristics, such as sex, income, education, dental insurance status and missing teeth, were not associated with WTP for public insurance. However, people with prior knowledge of implants and willingness to opt for implants for themselves, were WTP higher taxes to benefit themselves and others, if ever needed (p<0.02).

Interestingly, people who were acquainted with someone who was missing all of their teeth had higher WTP for public insurance; they were willing to pay an additional $15 as yearly taxes compared to people who were not personally acquainted with an edentate individual (p=0.045). However, affirmative attitudes towards public funding were not related to the amount that people were willing to pay as additional taxes (p=0.528).

3.3.3.1 Regression Analysis for Public Tax-funded Program WTP among respondents in favor of public funding

Another regression model was constructed that included characteristics of only those respondents who said that government should publicly fund implant overdenture treatment (Table 14). Interestingly, education was significantly associated with WTP higher yearly taxes; in comparison to individuals whose highest education level was high school completion, individuals with an education level of CEGEP/college, university and graduate school or higher were willing to pay approximately $20, $30 and $65 as additional yearly taxes, respectively (p<0.05).

In addition, higher age and acquaintance with someone edentate had a positive effect on WTP for public funding (p<0.001). Previous knowledge of dental implants was also associated with higher WTP (p=0.012). Conversely, personal desire to opt for implants, if needed, was not associated with WTP for extra taxes (p=0.052).

Interestingly, WTP for a public program did not depend on whether individuals believed that public funding should be restricted to overdenture treatment or extended to any implant treatment for one or more teeth (p=0.992).

Table 6. Surveyed population characteristics

	n	%		n	%
Sex			**Heard of implants**		
Male	172	54.3	**before the survey**		
Female	145	45.7	Yes	237	74.8
			No	80	25.2
Age*	41.18 (.550)		**Chose/ would choose dental implants**		
			Yes	240	75.7
			No	77	24.3
Missing one or more teeth			**Know anybody missing all their teeth**		
Yes	169	53.3	Yes	150	47.3
No	148	46.7	No	167	52.7
Number of missing teeth (n=168)			**Self-perceived oral health status**		
<5	113	67.3	Poor	35	11.0
5-9	42	25.0	Fair	75	23.7
10-14	8	4.7	Good	75	23.7
15-19	2	1.2	Very good	87	27.4
≥20 (less than 28)	3	1.8	Excellent	45	14.2
Education			**Income** (n=315)**		
High school or less	43	13.6	<30	41	13.0
CEGEP/ College	106	33.4	30-60	86	27.3
University	117	36.9	60-90	99	31.4
Graduate level or higher	51	16.1	90-120	60	19.0
			>120	29	9.2
Replaced missing teeth (n=165)			**Have dental insurance**		
Yes	100	60.6	Yes	191	60.3
No	65	39.4	No	126	39.7

n=317, unless specified
*** Mean (SD)**
**** Income is expressed in 1000 dollars (CAD)**

Table 7. Attitude towards public funding for dental implant treatment

	n	*%*
Do you believe that the government should pay for the mandibular two-implant overdentures? (n=317)	183	57.7
Yes	134	42.3
No		
Now imagine that your government will pay for dental implants. (n=179)		
Do you think only those missing all their teeth should receive this benefit (mandibular two- implant overdenture treatment)?	64	35.8
Do you think everyone irrelevant of the number of missing teeth should get this benefit (please be informed that dental implants can be used for single and multiple missing teeth)?	115	64.2

Table 8. Mean willingness-to-pay for mandibular two-implant overdentures

	Out-of-pocket *(one-time payment)*	**Private Insurance** *(monthly payment)*	**Public tax-funded** *(yearly payment)*
Mean	5347.00	26.93	103.63
Standard Error of Mean	172.96	0.85	4.94
Median	5000.00	25.00	75.00
All values are in 2012 Canadian Dollars (CAD)			

Table 9. Mean WTP by sample characteristics and Multiple Linear Regression of Out-of-pocket WTP for mandibular two-implant overdentures

	Willingness-to-pay		Regression Analysis (n=314)		Sensitivity Analysis(n=292)	
	Mean WTP (SE)	**P-Value**	**β**	**P-value**	**β**	**P-value**
Age			-50.920	.016	-51.710	.003
Sex						
Female	5513.37 (235.640)		**Reference**		**Reference**	
Male	5149.66 (254.562)	.296	-3008.163	.002	-2542.829	.003
Self-perceived Oral Health Status						
Poor	5128.57 (513.475)		**Reference**		**Reference**	
Fair	4981.33 (349.840)		128.704	.754	230.323	.499
Good	5657.33 (370.897)		-302.855	.047	-141.719	.038
Very good	5190.80 (333.690)		-1457.650	.003	-1289.598	.002
Excellent	5911.11 (433.243)	.446	-1199.417	.033	-933.377	.048
Education						
High school or less	3034.88 (385.146)		**Reference**		**Reference**	
CEGEP/College	4141.51 (238.190)		315.685	.651	436.229	.437
University	6021.37 (230.518)		208.694	.898	341.481	.638
Grad. Univ	8254.90 (446.198)	.000	359.958	.753	407.870	.576
Income (in 1000 CAD)						
<30	1914.63 (237.044)		**Reference**		**Reference**	
30-60	3779.07 (217.994)		1724.009	.017	1832.689	.002
60-90	5469.70 (195.789)		5544.265	.000	6475.475	.000
90-120	7483.33 (328.919)		3578.425	.000	4335.821	.000
>120	9758.62 (545.142)	.000	6278.249	.033	No observations	-
Missing any teeth						
No	5286.49 (250.691)		**Reference**		**Reference**	
Yes	5426.19 (239.466)	.688	-127.995	.695	101.590	.711

	Willingness-to-pay		Regression Analysis (n=314)		Sensitivity Analysis(n=292)	
	Mean WTP (SE)	**P-Value**	**β**	**P-value**	**β**	**P-value**
Heard of implants before survey						
No	3680.00 (302.706)		**Reference**		**Reference**	
Yes	5909.70 (194.694)	.000	671.133	.021	774.877	.001
Chose/ will choose dental implants						
No	3416.88 (255.007)		**Reference**		**Reference**	
Yes	5966.25 (197.490)	.000	1478.240	.000	1288.625	.000
Have dental insurance						
No	3604.76 (222.091)		**Reference**		**Reference**	
Yes	6496.34 (208.987)	.000	831.725	.004	723.119	.003
Know anybody missing all their teeth						
No	5474.86 (237.319)		**Reference**		**Reference**	
Yes	5204.67 (172.959)	.436	149.696	.506	-15.807	.933
Education*Income						
Educ(CEGEP/Coll)*Inc(30-60)			-607.944	.528	-802.220	.299
Educ(CEGEP/Coll)*Inc(60-90)			-3000.926	.563	-3834.247	.109
Educ(CEGEP/Coll)*Inc(90-120)			923.630	.006	5356.748	.000
Educ(University)*Inc(30-60)			759.901	.481	1443.719	.000
Educ(University)*Inc(60-90)			2671.319	.018	2823.952	.004
Educ(University)*Inc(90-120)			1407.836	.038	5623.498	.000
Educ(University)*Inc(>120k)			3678.247	.011	6183.448	.000
Educ(Grad. Univ.)*Inc(30-60)			2787.841	.006	No observations	-
Educ(Grad. Univ)*Inc(60-90)			3784.161	.000	4331.837	.000
Educ(Grad. Univ)*Inc(90-120)			5544.265	.049	4419.230	.000
Educ(Grad. Univ)*Inc(>120k)			6414.463	.002	7643.129	.000
Sex*Age			72.406	.002	61.214	.002
R^2 (Adjusted R^2)				**.671 (.637)**		**.761 (.737)**

Table 10. Multiple Linear regression of Out-of-pocket WTP for mandibular two-implant overdentures among respondents missing teeth

	β	P-value		β	P-value
Age	37.518	.016	**Number of missing teeth**	127.995	.045
Sex			**Replaced missing teeth**		
Female	**Reference**		No	**Reference**	
Male	421.332	.002	Yes	247.170	.052
Self-perceived OH Status					
Poor	**Reference**		**Know anybody missing all their teeth**		
Fair	97.521	.834			
Good	-1006.342	.083	No	**Reference**	
Very good	-1242.568	.114	Yes	164.591	.625
Excellent	NA	NA			
Education			**Heard of implants before survey**		
High school or less	**Reference**				
CEGEP/College	-264.271	.585	No	**Reference**	
University	183.806	.769	Yes	468.156	.070
Grad. Univ	1765.977	.044			
Income[¶]			**Chose/ will choose dental implants**		
<30	**Reference**				
30-60	1351.721	.015	No	**Reference**	
60-90	2872.734	.000	Yes	1094.773	.006
90-120	4671.510	.000			
>120	4438.407	.000			
Have dental insurance			**R^2 (Adjusted R^2)**	**.658 (.615)**	
No	**Reference**				
Yes	928.617	.026			

n=163
β – unstandardized coefficients
NA- no observations were noted in this category
[¶]Income is expressed in 1,000 dollars (2012 CAD)

Table 11. Mean WTP by sample characteristics and Multiple Linear Regression of Private Dental Insurance WTP for mandibular two-implant overdentures

	Willingness-to-pay		Regression Analysis (n=314)		Sensitivity Analysis(n=296)	
	Mean WTP (SE)	**P-Value**	**β**	**P-value**	**β**	**P-value**
Age			.112	.197	.083	.261
Sex						
Female	26.56 (1.42)		**Reference**		**Reference**	
Male	27.36 (1.01)	.642	-2.874	.034	-1.221	.255
Self-perceived Oral Health Status						
Poor	26.14 (2.02)		**Reference**		**Reference**	
Fair	26.63 (1.90)		1.312	.587	.660	.731
Good	26.31 (1.45)		-4.035	.056	-3.358	.090
Very good	27.08 (1.74)		-6.243	.031	-5.460	.018
Excellent	28.78 (2.55)	.921	-6.917	.036	-4.598	.048
Education						
High school or less	16.27 (1.40)		**Reference**		**Reference**	
CEGEP/College	22.54 (1.00)		4.153	.311	3.025	.355
University	27.54 (1.12)		5.169	.300	3.298	.424
Grad. Univ	43.63 (2.77)	.000	13.099	.414	7.817	.391
Income (in 1000 CAD)						
<30	15.83 (1.68)		**Reference**		**Reference**	
30-60	20.79 (1.31)		2.934	.048	3.796	.026
60-90	26.43 (1.02)		10.026	.040	10.421	.007
90-120	32.88 (1.64)		3.786	.644	4.934	.674
>120	49.48 (3.55)	.000	5.961	.607	No observations	-
Missing any teeth						
No	26.80 (1.25)		**Reference**		**Reference**	
Yes	27.15 (1.16)	.839	-1.455	.449	.212	.892

	Willingness-to-pay		Regression Analysis (n=314)		Sensitivity Analysis(n=296)	
	Mean WTP (SE)	**P-Value**	**β**	**P-value**	**β**	**P-value**
Heard of implants before survey						
No	17.78 (0.91)		**Reference**		**Reference**	
Yes	30.02 (1.02)	.000	6.738	.000	6.018	.000
Chose/ will choose dental implants						
No	18.23 (0.95)		**Reference**		**Reference**	
Yes	29.71 (1.02)	.000	7.937	.000	6.854	.000
Have dental insurance						
No	20.91 (1.14)		**Reference**		**Reference**	
Yes	30.90 (1.11)	.000	.144	.932	.887	.524
Know anybody missing all their teeth						
No	27.64 (1.23)		**Reference**		**Reference**	
Yes	26.13 (1.16)	.375	-.216	.870	.830	.431
Education*Income						
Educ(CEGEP/Coll)*Inc(30-60)			-.488	.931	.666	.881
Educ(CEGEP/Coll)*Inc(60-90)			-3.946	.534	-2.985	.548
Educ(CEGEP/Coll)*Inc(90-120)			2.494	.047	8.305	.041
Educ(University)*Inc(30-60)			-2.022	.750	-1.318	.796
Educ(University)*Inc(60-90)			-5.729	.385	-3.341	.531
Educ(University)*Inc(90-120)			8.211	.037	14.511	.000
Educ(University)*Inc(>120k)			13.593	.030	20.068	.001
Educ(Grad. Univ.)*Inc(30-60)			45.535	.000	No observations	-
Educ(Grad. Univ)*Inc(60-90)			3.059	.595	-.016	.997
Educ(Grad. Univ)*Inc(90-120)			17.500	.041	22.187	.000
Educ(Grad. Univ)*Inc(>120k)			27.885	.018	31.254	.000
R^2 (Adjusted R^2)				**.530 (.483)**		**.596 (.559)**

Table 12. Multiple Linear regression of Private Dental Insurance WTP for mandibular two-implant overdentures among respondents missing teeth

	β	P-value		β	P-value
Age	.204	.085	**Number of missing teeth**	.114	.039
Sex			**Replaced missing teeth**		
Female	**Reference**		No	**Reference**	
Male	-1.209	.524	Yes	1.549	.455
Self-perceived OH Status					
Poor	**Reference**		**Know anybody missing all their teeth**		
Fair	1.183	.652			
Good	-5.114	.118	No	**Reference**	
Very good	2.565	.561	Yes	2.008	.290
Excellent	NA	NA			
Education			**Heard of implants before survey**		
High school or less	**Reference**				
CEGEP/College	3.319	.225	No	**Reference**	
University	3.337	.345	Yes	7.886	.001
Grad. Univ	19.173	.000			
Income[¶]			**Chose/ will choose dental implants**		
<30	**Reference**				
30-60	4.006	.019	No	**Reference**	
60-90	7.074	.034	Yes	7.528	.001
90-120	8.274	.034			
>120	10.896	.035			
Have dental insurance			**R^2 (Adjusted R^2)**	**.543 (.486)**	
No	**Reference**				
Yes	.799	.732			

n=163
β – unstandardized coefficients
NA- no observations were noted in this category
[¶]Income is expressed in 1,000 dollars (2012 CAD)

Table 13. Mean WTP by sample characteristics and Multiple Linear Regression of Public Tax-Funded Program WTP for mandibular two-implant overdentures

	Willingness-to-pay		Regression Analysis (n=314)		Sensitivity Analysis(n=298)	
	Mean WTP (SE)	**P-Value**	**β**	**P-value**	**β**	**P-value**
Age			2.074	.000	`1.191	.026
Sex						
Female	106.13 (7.38)		**Reference**		**Reference**	
Male	100.66 (6.34)	.581	-4.243	.622	-3.658	.626
Self-perceived Oral Health Status						
Poor	107.71 (18.28)		**Reference**		**Reference**	
Fair	104.07 (10.48)		12.435	.421	22.677	.105
Good	106.67 (9.68)		18.952	.843	14.826	.300
Very good	90.92 (7.80)		-14.373	.437	4.338	.793
Excellent	119.22 (14.82)	.496	18.952	.373	27.570	.150
Education						
High school or less	63.72 (11.37)		**Reference**		**Reference**	
CEGEP/College	84.58 (6.93)		19.152	.463	19.986	.373
University	107.69 (8.09)		24.768	.437	15.801	.566
Grad. Univ	103.63 (13.58)	.000	39.060	.680	21.989	.560
Income (in 1000 CAD)						
<30	45.12 (9.298)		**Reference**		**Reference**	
30-60	63.20 (5.562)		21.364	.424	6.431	.788
60-90	110.10 (7.963)		40.265	.194	56.963	.063
90-120	136.08 (12.258)		-8.942	.864	11.817	.452
>120	213.79 (16.627)	.000	143.073	.053	No observations	-
Missing any teeth						
No	93.07 (6.51)		**Reference**		**Reference**	
Yes	112.05 (7.24)	.055	7.871	.519	12.857	.231

	Willingness-to-pay		Regression Analysis (n=314)		Sensitivity Analysis(n=298)	
	Mean WTP (SE)	**P-Value**	**β**	**P-value**	**β**	**P-value**
Heard of implants before survey						
No	67.25 (7.57)		**Reference**		**Reference**	
Yes	115.91 (5.90)	.000	24.837	.022	25.173	.009
Chose/ will choose dental implants						
No	69.09 (7.98)		**Reference**		**Reference**	
Yes	114.71 (5.83)	.000	27.837	.010	19.867	.039
Have dental insurance						
No	72.06 (6.255)		**Reference**		**Reference**	
Yes	124.45 (6.680)	.000	14.073	.194	13.401	.167
Know anybody missing all their teeth						
No	95.93 (6.538)		**Reference**		**Reference**	
Yes	112.20 (7.442)	.100	15.635	.045	9.305	.029
Education*Income						
Educ(CEGEP/Coll)*Inc(30-60)			-14.326	.690	2.369	.940
Educ(CEGEP/Coll)*Inc(60-90)			13.564	.737	8.476	.807
Educ(CEGEP/Coll)*Inc(90-120)			15.428	.795	14.641	.604
Educ(University)*Inc(30-60)			-16.641	.679	3.166	.928
Educ(University)*Inc(60-90)			-5.799	.890	-15.814	.661
Educ(University)*Inc(90-120)			80.618	.017	78.219	.003
Educ(University)*Inc(>120k)			61.505	.046	79.093	.042
Educ(Grad. Univ.)*Inc(30-60)			147.271	.009	No observations	-
Educ(Grad. Univ)*Inc(60-90)			-15.400	.678	-32.715	.307
Educ(Grad. Univ)*Inc(90-120)			110.870	.043	101.581	.000
Educ(Grad. Univ)*Inc(>120k)			13.564	.035	172.518	.000
Should govt. pay for implants						
No			**Reference**		**Reference**	
Yes			5.904	.528	3.164	.700
R^2 (Adjusted R^2)				**.440 (.382)**		**.498 (.450)**

Table 14. Multiple Linear regression of Public Tax-funded Program WTP for mandibular two-implant overdentures among respondents in favor of public funding

	β	P-value		β	P-value
Age	2.686	.000	**Missing any teeth**		
			No	**Reference**	
			Yes	5.326	.736
Sex			**Know anybody missing all their teeth**		
Female	**Reference**				
Male	3.600	.756	No	**Reference**	
			Yes	40.036	.000
Self-perceived OH Status			**Heard of implants before survey**		
Poor	**Reference**				
Fair	-.992	.955	No	**Reference**	
Good	-26.832	.167	Yes	33.-64	.012
Very good	-18.304	.420			
Excellent	19.226	.492			
Education			**Chose/ will choose dental implants**		
High school or less	**Reference**				
CEGEP/College	20.650	.026	No	**Reference**	
University	30.901	.017	Yes	28.012	.052
Grad. Univ	65.512	.027			
Income[¶]			**If govt. funds implants**		
<30	**Reference**		All implant treatments	**Reference**	
30-60	.854	.959	Only mandibular two-implant overdentures	.534	.996
60-90	33.253	.036			
90-120	48.500	.037			
>120	84.839	.008			
Have dental insurance			**R^2 (Adjusted R^2)**	**.511 (.452)**	
No	**Reference**				
Yes	23.548	.075			

n=163
β – unstandardized coefficients
NA- no observations were noted in this category
[¶]Income is expressed in 1,000 dollars (2012 CAD)

4. Discussion

4.1 Summary of research findings

This willingness-to-pay study was designed to measure preferences of the Canadian population for mandibular two-implant overdentures. As mentioned previously, the WTP valuation method was chosen over other preference measurement techniques, such as standard gamble and time-trade-off, since WTP involves a monetary approach to assessing individuals' perceived benefits for health care interventions (44, 72, 93, 179). This makes the resulting WTP values directly comparable to the costs of the treatment. Moreover, the methodology used for this WTP survey simulates real-world decision-making situations, in which people in a privately financed oral health care industry are bound to incorporate economic considerations in their final decision towards dental treatments. Furthermore, this study provides valuable insight into the obscure demand for private and public insurance in the general non-affected population.

These WTP results suggest that dentate individuals would be willing to pay a significant amount to receive mandibular two-implant overdentures if they become edentate, whether paying privately or contributing to private insurance coverage or government programs. However, each scenario had substantial variation in these WTP values. This variation was explained, in part, by the association between one's willingness-to-pay and his/her ability-to-pay or budget constraints. The positive association of income with the WTP values is in accordance with our expectations that those in higher income groups would have higher WTP values. It further establishes the theoretical validity of the survey. As explained earlier, most non-luxury goods have positive income elasticity, such that higher respondent incomes should predict higher WTP values (39, 180). Generally, dental treatments, including mandibular two-implant overdentures, represent need-based interventions and cannot be categorized as luxury goods.

Therefore, the income elasticity of willingness-to-pay for the associated intervention is a reasonable theoretical prediction. Most WTP studies on oral health care interventions have also demonstrated a positive relationship between higher income and higher WTP values (127, 135, 136). However, our surveyed sample marginally under-represents income groups of <30k and >120k and over-represents groups of 60k-90k and 90k-120k, when compared to the distribution of total household income in the Canadian population (181). Therefore, a more representative sample might include a wider variation in WTP values.

The number of survey respondents who indicated having dental insurance is representative of the Canadian population, according to data collected for the 2009 Canadian Health Measures Survey (CHMS) that reports 62% of Canadians as having dental insurance (182). We found that individuals with dental insurance were willing-to-pay higher out-of-pocket coverage than non-insured individuals, perhaps because they may be more accustomed to receiving high quality oral health care. However, this is controversial (183-185).

Furthermore, our study also shows a positive correlation between dental insurance status and income, education level and perceived need, measured as self-perceived oral health status. This is in agreement with previous reports that have described a complex interplay between insurance status and various factors including demographics, socioeconomic status and need (185).

Our findings also show that respondents who had previously heard about implants were willing to pay more in all three scenarios. This echoes Diaz et al. (166) findings, that consumer's previous knowledge about the benefits of a certain commodity can influence the WTP values, as it may shape individual preferences. Positive experience and knowledge is expected to yield higher WTP.

Correspondingly, it has been stated that experience of the illness, either through personal incidents or those of family member(s), friends or acquaintances may shape the preferences of an individual towards a certain treatment (78). Various WTP studies have also reported a positive relationship between an increased likelihood of disease with higher WTP amounts (159, 186). In our study, people with poorer self-perceived oral health status, which is an indicator of perceived need, had higher WTP for out-of-pocket and private insurance payment. In contrast, a study carried out by Leung et al. in 2010 to measure preferences for single-implant treatment demonstrated that WTP values were associated with actual need of treatment, measured as 'missing teeth or not'. However, no association between self-perceived oral health and WTP was seen (144). In our study, there was no significant relationship between actual need (missing teeth or not) and WTP. However, sub-group regression analyses for people who were missing teeth showed that the WTP amounts increased for out-of-pocket and private insurance payments with an increase in the number of missing teeth. The discrepancy may be a result of limitations in the analytical information derived from a dichotomous variable compared to a continuous variable in linear regression models (187).

On similar grounds, it is recognized that the valuation of a health care intervention would be different for patients and the general population, since their experience of the illness is substantially different (186, 188). A true representative sample of the general population would include both dentate and edentate individuals. However, assessment of variations in the preferences of edentate patients, compared to the unaffected population, would require a substantially larger sample size. Unfortunately, that would have been beyond the resources available for this study. Nevertheless, a study of societal perspective is valuable when assessing insurance and public funding perspectives, since the bearers of the associated costs might not always be the beneficiaries (78).

Preferences for mandibular two-implant overdentures have been previously assessed by Esfandiari et al. in a WTP-WTA study in a population of edentate patients (141). The respondents were asked if they were willing to pay three times the cost of conventional dentures to receive mandibular two-implant overdentures, which today equals an amount of approximately CAD 4,000, including inflation. Their results revealed that a majority of edentate patients were willing to pay that amount out-of-pocket. That amount is similar to the out-of-pocket WTP values in our study. However, these studies are not statistically comparable since WTP surveys employ a hypothetical scenario, and the decision-making heuristics of individuals may differ according to the stated scenario (72).

Our study also shows that respondents who personally knew an edentate person were willing to pay more in additional taxes to fund a public program. This trend may be explained by a complex relationship between altruistic behavior and previous knowledge of illness through non-personal sources, as stated above. Altruistic behavior arises due to people being concerned about the well-being of others (72). Following this claim, the overall WTP for public insurance may be attributed to altruistic behavior, as reported in other WTP studies involving public insurance scenarios (159). Since the respondents of our survey were told that there are currently more than 2 million edentate people in Canada, the altruistic behavior may be attributed to this particular information and/or personally knowing someone edentate. Altruism is very commonly seen among family members but is reported to extend beyond the family as well (72).

Another reason for choosing to pay higher taxes may be self-perceived need and expected benefits from a publicly funded program, similar to benefits from private insurance. However, considerable differences were noted between respondents' WTP for public, compared to private, insurance. The demand curves demonstrate that for any given price, a substantially higher proportion of the respondents were willing to buy

private, rather than public, insurance, despite similar benefits provided by both. This may be explained by negative attitudes towards higher tax payments (159, 189), as well as experiences with public health care provision in Canada (190). Furthermore, this may also be due to a difference in perception about what governmental programs may provide, compared to private insurance.

During our survey, every individual had the choice to opt for either a telephonic or an internet-based questionnaire. A majority of the population opted for the telephonic interview, which agrees with previously noted response differences between telephonic and web surveys (191). None of the variables, other than age, were significantly different between the respondent groups, based on the mode of the survey. This finding is in agreement with previous research findings that older individuals prefer telephonic surveys over internet-based questionnaires (191).

4.2 Limitations

4.2.1 Methodological limitations

The conceptual background of willingness-to-pay surveys as a benefit measurement technique for conducting cost-benefit analyses is a much debated topic. Critics against this approach argue that the idea of allocating monetary values to life states and quality of life is meaningless and unethical. They claim that human life cannot be traded and, therefore, should not have a monetary value placed on it (39). Proponents argue that the purpose of assigning monetary values is to provide a guideline for resource allocation-related decisions, and not for the purpose of trading, in its usual sense of the term. In addition, properly employed WTP surveys are consistent with the principles of welfare economics (179). Despite these issues, the interest in WTP surveys within health care appears to have been revived in recent years (189, 192, 193). Furthermore, since

dentistry in Canada is a private industry, the use of such patient/public centered preference measures seems highly appropriate.

There are various potential biases associated with the WTP methodology. These can be broadly divided into three main groups: 1) construction of a hypothetical market, 2) survey administration, and 3) interpretation of the data. While a detailed description of all these potential issues is beyond the scope of this dissertation, those pertinent are discussed here.

Construction of the contingent market is subject to two forms of biases: hypothetical and strategic. Hypothetical bias occurs due to probable deviations in an individual's stated buying intention and his/her real buying behavior (192). Recent evidence suggests that hypothetical WTP surveys systematically overestimate the actual WTP (as revealed in actual decisions) (194). Kemp and Maxwell (195) claim that this bias may occur because surveys do not impose a financial commitment similar to 'real' purchases. Therefore, the respondents may be influenced by factors such as wanting to get over with the interview quickly or trying to sound reasonable (195). It is an accepted fact that hypothetical questions produce hypothetical answers. However, this does not weaken its role in decision-making. As stated by Smith et al. (192), *"if a well-constructed question is asked, people will try to oblige with honest answers to the best of their ability"*. Recommendations to minimize hypothetical bias involve simulating as 'real-life' situations as possible (192). To ensure this, we chose to use discrete choice questions that represent everyday market situations, rather than other elicitation formats that may increase the potential of hypothetical bias. However, we cannot statistically compare the stated WTP values in this survey to real-life scenarios, due to the lack of real markets in Canada. However, current evidence suggests that this bias is a minimal problem in health care WTP studies, when compared to environmental and transport economic surveys (192).

Strategic bias results when respondents deliberately understate or overstate WTP amounts in an attempt to influence the provision of funding or implementation of a program (72, 73, 192). Again, this is a significant problem in environmental and transport-related WTP surveys, affecting health care WTP to a much lesser degree (192). In our study, strategic bias was not suspected to be a potential issue, since the use of discrete choice questions (fixed bids with yes/no format) minimizes the incentive of strategic behavior (73, 192), compared to open ended questions to which respondents may state any possible WTP amounts. Moreover, the WTP values obtained through our survey were well within the expected range, and no trends of strategic responses were observed for any individual. Values deemed as outliers were trusted to be random effects that represent true preferences of a small proportion of the population who would actually be willing to pay a higher amount for the overdenture treatment. These outlier values were similar to those seen in our pilot study (196), in which individuals had limited WTP options (using a payment scale), and strategic bias was not observed.

Other potential biases associated with administration of the survey include order effect of questions, starting point bias, compliance/interviewer bias, and protest and zero bids. Order effects of questions are seen when the sequence of questions might affect the WTP values stated by the respondents. For instance, in our study, asking about private insurance before public insurance may result in pre-conceived valuations in the respondents' minds, such that the behavior in the private insurance market situation may guide their response to public insurance questions. Recommendations to avoid this form of bias include random ordering of scenarios and statistical exclusion of this bias (73, 189). During our survey, the out-of-pocket scenario could not be randomized, since it required the respondents to not know about the real market price of overdenture treatment, which was subsequently provided in the private insurance scenario. However, the private and public insurance scenarios were administered randomly during the telephonic interview, and no statistical differences were noted. However, the

same scenario randomization could not be carried out for the internet-based survey due to software limitations; hence, it was not assessed for this type of bias.

Starting point bias occurs when the elicitation format starts at a particular bid/amount, and this influences the WTP amount stated by the respondents (72, 73, 189). In particular, this bias is a major concern when the initial bid anchors the respondents towards the starting bid, thus narrowing the distribution around the mean (very close to the initial bid). This is known as an 'anchoring effect' and may be a significant issue with surveys involving an initial bid with follow up questions, such as in our study (72). To avoid this bias, varying the starting bid across respondents is suggested (72, 189). Variations in the initial bid could not be applied to this study due to the involved complexities with the internet-survey software. Statistical analysis revealed that the average WTP value for private insurance was significantly different from the initial bid and, thus, starting point bias was not suspected. Even though the average out-of-pocket and public insurance WTP were close to the initial bids, the individual WTP amounts were well distributed. Moreover, the average out-of-pocket value was fairly comparable to our pilot study results that used a different elicitation technique.

Interviewer bias is a form of compliance bias, that may result when respondents express WTP values that differ from their true WTP, either to please the interviewer or because they may be led by the interviewer, a form of 'yea-saying' bias (73, 189). This bias is speculated to be greater in face-to-face interviews, as reported in other quantitative public health surveys (197). Experts recommend that professionally trained and independent interviewers should conduct data collection, instead of graduate students and researchers who may be "tempted to adapt the survey in some fashion" (189). However, hiring a professional interviewer was beyond our available resources. To minimize the bias, data collection was conducted by a single trained graduate student, which avoided potential variations due to multiple interviewers. Furthermore, there was no significant difference between the responses obtained through the telephonic

interviews and the internet-based surveys. This indicates that interviewer bias was not a significant issue in our study.

Protest bids are considered an extreme form of strategic bias whereby respondents passively protest the investigation by either stating zero WTP values or unreasonable high or low values (72, 189). Recommendations by experts include reporting of such zero and very high bids and assessment of possible reasons, if such responses are greater than 10%. In addition, it is advised that respondents indicating zero bids be asked a question about why they did so (189). Our findings indicated that protest bids were not a significant issue in this study. Approximately 7.3% of individuals stated zero bids for the public tax-funded insurance scenario; however, this is in agreement with our expectations. Negative attitudes towards additional tax payments is a potential explanation, and this has been discussed previously in Section 4.1.

Other methodological issues associated with WTP surveys include sample size calculations. Economic evaluations face substantial issues with sample size calculations, due to lack of guidance on an acceptable value for standard error around the mean value (193). Due to this, most WTP studies rely on the maximum sample size that is feasible with the available resources. Similarly, our potential pool of 2001 participants was selected based on time and monetary resource availabilities. It is recommended that sample sizes should be large enough to ensure statistically significant estimates of the WTP (193). Our statistical analyses had sufficient statistical power and, hence, we speculate that our sample size was adequate. However, some sample limitations were observed and are described in the following section.

4.2.2 Sample limitations

Similar to other surveys (198-201), this study may have been limited by low response rate, despite our efforts ensure a higher survey acceptance, such as choice between telephonic/online survey, interview rescheduling for respondents' convenience and lottery compensation.

Non-response, a component of selection bias, may compromise the accuracy of the results. It creates substantial issues when responders are significantly different than the non-respondents (193). Since our survey was supposed to be conducted primarily through telephone, there was no possibility of assessing the characteristics of the non-respondent sample. To counter this problem, we chose a representative initial sample of the Canadian population, instead of randomly selecting participants. Matching our final respondents to the Canadian population revealed a fairly representative sample (202). Slight deviations in income categories were noted. However, these were not assessed to be of major negative consequences. This has been previously discussed in Section 4.1.

In addition, variations in WTP values may not always be explained. If the regression analyses are not sufficiently powered, interpretation of the results may be inaccurate. However, the explanatory power of our regression models were fairly high. Also, post-hoc statistical power of the models was close to 1, signifying almost no chance of false negative inference.

4.3 Implications

4.3.1 Policy Implications

An increasing reliance on economic analyses in the development and evaluation of regulations and policies has been observed (203). A central issue is scarcity of resources that results in trade-offs. Allocative efficiency requires that health care resources,

including finances, should be mobilized to supply interventions that are desirable in the society and high in demand. Economic efficiency is measured as the difference between the benefits and costs, and is a fundamental criterion for evaluation of policies/interventions (203).

The economic data available through this study can be used further to conduct cost-benefit analyses (CBA), in which the WTP results will be used as the benefit measurement. In CBA, the net social benefit is deduced from the relationship between the costs and the benefits, both of which are in monetary terms (50). If an intervention's net benefits are higher than the costs, then it is a positive net benefit and the policy/intervention should be adopted. CBA can be used by the government and private insurance companies to assess the desirability of funding mandibular two-implant overdentures.

The WTP results of this survey also directly provide invaluable data for many stakeholders. For clinicians, the WTP amounts reveal what people are willing to pay for implant overdentures for themselves/their relatives. It provides information to employers and insurance companies on how people value having coverage for this kind of service. Furthermore, it provides public policy makers the value that the Canadian people place on public funding of such treatments and how they would support a decision to publicly fund such a treatment.

4.3.2 Implications for future research

Although this study provides constructive economic data, larger studies including edentate individuals may aid in establishing the overall population demand. Furthermore, any detected differences in valuation of overdenture treatment between edentate and dentate populations could provide evidence to assist in resolving the

current dispute in the literature about the differences in preferences of affected and non-affected populations (78, 188).

Furthermore, the 'triple bound discrete choice with open ended termination' elicitation format is a novel methodology. Some economists argue that triple bound discrete choice questions create a bidding game technique with a smaller number of bids (189). This has created a perplexing situation, and future research should focus on distinguishing between the two methodologies in terms of benefits, limitations, administration and analysis of data collected from both.

Also, as mentioned previously, survey design and administration is of utmost importance in collecting WTP data potentially free from biases. Although, our survey was well-designed and imposed no major difficulties, improvements can be made to refine the survey administration further. For instance, variations in initial bidding amounts to assess a starting point bias would be informative. Furthermore, addition of a qualitative question will assist in identifying protestors against public funding, as suggested by McIntosh et al. (72). In addition, as discussed previously, WTP is highly contingent on an individual's ability-to-pay. Commonly, individual and household income has been measured to ascertain the ability-to-pay (ATP). Alternatively, social class has been measured as a proxy for ATP. However, these measures do not provide the most reliable ATP estimates. For instance, the same annual household income may have significantly different ATP values for a person living alone as opposed to a family with two children. Therefore, additional questions should be included in the survey that describes an individual's situation with regard to ATP (72). As an example, an additional question may ask the individual about his/her situation with respect to payments for basic necessities, measured as a scale of easy/hard to pay.

5. Conclusion

The Canadian population substantially values mandibular two-implant overdenture treatment. Thus, dental insurance companies and policy makers in Canada can use this information to determine the desirability of including implant overdentures in their insurance policies and in future governmental public health programs.

6. References

1. Starr JM, Hall R. Predictors and correlates of edentulism in healthy older people. Curr Opin Clin Nutr Metab Care. 2010;13(1):19-23.
2. Crocombe LA, Slade GD. Decline of the edentulism epidemic in Australia. Aust Dent J. 2007;52(2):154-6.
3. Ferencz JL, Felton DA. Facing the future of edentulism. J Prosthodont. 2009;18(2):86-7.
4. Shamrany MA. Is depression associated with edentulism in Canadian adults? Master's thesis: Graduate Department of Dentistry, University of Toronto, Toronto, Canada; 2008.
5. Polzer I, Schimmel M, Muller F, Biffar R. Edentulism as part of the general health problems of elderly adults. Int Dent J. 2010;60(3):143-55.
6. Tuckfield WJ. The problem of the mandibular denture. Dent J Aust. 1951;23(9-10):331-54.
7. Doundoulakis JH, Eckert SE, Lindquist CC, Jeffcoat MK. The implant-supported overdenture as an alternative to the complete mandibular denture. J Am Dent Assoc. 2003;134(11):1455-8.
8. Afrashtehfar KI, Kurtzman GM, Mahesh L. Improving oral rehabilitation through the preservation of the tissues through alveolar preservation. J Adv Prosthodont. 2012;4(3):174-8.
9. Polzer I, Schimmel M, Muller F, Biffar R. Edentulism as part of the general health problems of elderly adults. Int Dent J. 2010;60(3):143-55.
10. Rutkunas V, Mizutani H, Peciuliene V, Bendinskaite R, Linkevicius T. Maxillary complete denture outcome with two-implant supported mandibular overdentures. A systematic review. Stomatologija. 2008;10(1):10-5.

11. Koshino H, Hirai T, Yokoyama Y, Tanaka M, Toyoshita Y, Iwasaki K, et al. Mandibular residual ridge shape and the masticatory ability in complete denture wearers. Nihon Hotetsu Shika Gakkai Zasshi. 2008;52(4):488-93.
12. Mack F, Schwahn C, Feine JS, Mundt T, Bernhardt O, John U, et al. The impact of tooth loss on general health related to quality of life among elderly Pomeranians: results from the study of health in Pomerania (SHIP-O). Int J Prosthodont. 2005;18(5):414-9.
13. Suarez-Sanchez OR. The Harvard Multidimensional Diagnostic Model for Oral health, disease, trauma and dysfunction. Journal of Disability and Oral health. 2006;7(2):56-61.
14. Feine JS, Carlsson GE, Awad MA, Chehade A, Duncan WJ, Gizani S, et al. The McGill consensus statement on overdentures. Mandibular two-implant overdentures as first choice standard of care for edentulous patients. Montreal, Quebec, May 24-25, 2002. Int J Oral Maxillofac Implants. 2002;17(4):601-2.
15. Muller K, Morais J, Feine J. Nutritional and anthropometric analysis of edentulous patients wearing implant overdentures or conventional dentures. Brazilian dental journal. 2008;19(2):145-50.
16. Mobley CC. Nutrition issues for denture patients. Quintessence International. 2005;36(8):627-31.
17. Nowjack-Raymer RE, Sheiham A. Association of edentulism and diet and nutrition in US adults. J Dent Res. 2003;82(2):123-6.
18. De Marchi RJ, Hugo FN, Padilha DM, Hilgert JB, Machado DB, Durgante PC, et al. Edentulism, use of dentures and consumption of fruit and vegetables in south Brazilian community-dwelling elderly. J Oral Rehabil. 2011;38(7):533-40.
19. Hutton B, Feine J, Morais J. Is there an association between edentulism and nutritional state? J Can Dent Assoc. 2002;68(3):182-7.
20. Petrovic A. Speech Sound Distortions Caused by Changes in Complete Denture Morphology. J Oral Rehabil. 1985;12(1):69-79.

21. Feine JS, Carlsson GE, editors. Implant Overdentures: The Standard of Care for Edentulous Patients: Quintessence Publishing Co, Inc; 2003.
22. Allen PF. Association between diet, social resources and oral health related quality of life in edentulous patients. Journal of oral rehabilitation. 2005;32(9):623-8.
23. Feine JS, Carlsson GE, Awad MA, Chehade A, Duncan WJ, Gizani S, et al. The McGill consensus statement on overdentures. Mandibular two-implant overdentures as first choice standard of care for edentulous patients. Gerodontology. 2002;19(1):3-4.
24. Thomason JM, Feine J, Exley C, Moynihan P, Muller F, Naert I, et al. Mandibular two implant-supported overdentures as the first choice standard of care for edentulous patients--the York Consensus Statement. Br Dent J. 2009;207(4):185-6.
25. Health Canada. Report on the Findings of the Oral Health Component of the Canadian Health Measures Survey 2007–2009. Canada: Authority of the Minister of Health; 2010.
26. Millar WJ, Locker D. Edentulism and denture use. Health Reports: Statistics Canada; 2005.
27. Attard NJ, Zarb GA. Long-term treatment outcomes in edentulous patients with implant overdentures: the Toronto study. Int J Prosthodont. 2004;17(4):425-33.
28. Carpentieri JR, Tarnow DP. The two-implant mandibular overdenture as first-choice treatment objective. Practical procedures & aesthetic dentistry : PPAD. 2003;15(10):750-2.
29. Awad MA, Locker D, Korner-Bitensky N, Feine JS. Measuring the effect of intra-oral implant rehabilitation on health-related quality of life in a randomized controlled clinical trial. J Dent Res. 2000;79(9):1659-63.

30. Heydecke G, Locker D, Awad MA, Lund JP, Feine JS. Oral and general health-related quality of life with conventional and implant dentures. Community dentistry and oral epidemiology. 2003;31(3):161-8.

31. Zitzmann NU, Sendi P, Marinello CP. An economic evaluation of implant treatment in edentulous patients-preliminary results. Int J Prosthodont. 2005;18(1):20-7.

32. Vercruyssen M, Quirynen M. Long-term, retrospective evaluation (implant and patient-centred outcome) of the two-implant-supported overdenture in the mandible. Part 2: marginal bone loss. Clin Oral Implants Res. 2010;21(5):466-72.

33. Das KP, Jahangiri L, Katz RV. The first-choice standard of care for an edentulous mandible: a Delphi method survey of academic prosthodontists in the United States. J Am Dent Assoc. 2012;143(8):881-9.

34. Muller F, Salem K, Barbezat C, Herrmann FR, Schimmel M. Knowledge and attitude of elderly persons towards dental implants. Gerodontology. 2012;29(2):e914-23.

35. Ramsey S, Willke R, Briggs A, Brown R, Buxton M, Chawla A, et al. Good research practices for cost-effectiveness analysis alongside clinical trials: The ISPOR RCT-CEA task force report. Value in Health. 2005;8(5):521-33.

36. van der Wijk P, Bouma J, van Waas MAJ, van Oort RP, Rutten FFH. The cost of dental implants as compared to that of conventional strategies. Int J Oral Maxillofac Implants. 1998;13(4):546-53.

37. Simon Walker, Mark Sculpher, Drummond M. The Methods of Cost-Effectiveness Analysis to Inform Decisions about the Use of Health Care Interventions and Programs: Oxford Handbooks Online; 2012.

38. Eichler HG, Kong SX, Gerth WC, Mavros P, Jonsson B. Use of cost-effectiveness analysis in health-care resource allocation decision-making: How are cost-effectiveness thresholds expected to emerge? Value in Health. 2004;7(5):518-28.

39. Drummond MF, Sculpher MJ, Torrance GW, O'Brien BJ, Stoddart GL. Methods for the economic evaluation of health care programmes. Oxford: Oxford University Press.; 1997.

40. Heydecke G, Penrod JR, Takanashi Y, Lund JP, Feine JS, Thomason JM. Cost-effectiveness of mandibular two-implant overdentures and conventional dentures in the edentulous elderly. J Dent Res. 2005;84(9):794-9.

41. Lewis DW. Optimized therapy for the edentulous predicament: cost-effectiveness considerations. J Prosthet Dent. 1998;79(1):93-9.

42. Zitzmann NU, Marinello CP, Sendi P. A cost-effectiveness analysis of implant overdentures. J Dent Res. 2006;85(8):717-21.

43. Esfandiari S. Oral health technology assessment: Study of Mandibular 2-implant overdentures. Montreal: McGill University; 2008.

44. Drummond M. Evaluation of health technology: economic issues for health policy and policy issues for economic appraisal. Soc Sci Med. 1994;38(12):1593-600.

45. Birch S, Ismail AI. Patient preferences and the measurement of utilities in the evaluation of dental technologies. J Dent Res. 2002;81(7):446-50.

46. Bell DE, Farquhar PH. Perspectives on Utility-Theory. Oper Res. 1986;34(1):179-83.

47. Alchian AA. The Meaning of Utility Measurement. Am Econ Rev. 1953;43(1):26-50.

48. Torrance GW. Measurement of Health State Utilities for Economic Appraisal - a Review. J Health Econ. 1986;5(1):1-30.

49. Sendi PP, Palmer AJ, Marinello CP. Health State Utilities in Dentistry. Acta Med Dent Helv. 1997;2:243-8.

50. Neumann PJ, Goldie SJ, Weinstein MC. Preference-based measures in economic evaluation in health care. Annu Rev Public Health. 2000;21:587-611.

51. Fyffe HE, Kay EJ. Assessment of dental health state utilities. Community Dent Oral Epidemiol. 1992;20(5):269-73.

52. Torrance GW, Thomas WH, Sackett DL. A utility maximization model for evaluation of health care programs. Health Serv Res. 1972;7(2):118-33.

53. Takemae R, Uemura T, Okamoto H, Matsui T, Yoshida M, Fukazawa S, et al. Changes in mental health and quality of life with dental implants as evaluated by General Health Questionnaire (GHQ) and Health Utilities Index (HUI). Environmental health and preventive medicine. 2012;17(6):463-73.

54. Kok ET, McDonnell J, Stolk EA, Stoevelaar HJ, Busschbach JJV, Grp TR. The valuation of the International Prostate Symptom Score (IPSS) for use in economic evaluations. Eur Urol. 2002;42(5):491-7.

55. Stolk EA, Busschbach JJV. Validity and feasibility of the use of condition-specific outcome measures in economic evaluation. Qual Life Res. 2003;12(4):363-71.

56. McKenna SP, Ratcliffe J, Meads DM, Brazier JE. Development and validation of a preference based measure derived from the Cambridge Pulmonary Hypertension Outcome Review (CAMPHOR) for use in cost utility analyses. Health Qual Life Outcomes. 2008;6.

57. Gift HC, Redford M. Oral health and the quality of life. Clin Geriatr Med. 1992;8(3):673-83.

58. Ohrn K, Jonsson B. A comparison of two questionnaires measuring oral health-related quality of life before and after dental hygiene treatment in patients with periodontal disease. Int J Dent Hyg. 2012;10(1):9-14.

59. Jokovic A, Locker D, Tompson B, Guyatt G. Questionnaire for measuring oral health-related quality of life in eight- to ten-year-old children. Pediatr Dent. 2004;26(6):512-8.

60. Hultin M, Davidson T, Gynther G, Helgesson G, Jemt T, Lekholm U, et al. Oral rehabilitation of tooth loss: a systematic review of quantitative studies of OHRQoL. Int J Prosthodont. 2012;25(6):543-52.

61. Klarman HE, Francis JO, Rosenthal GD. Cost Effectiveness Analysis Applied to Treatment of Chronic Renal Disease. Med Care. 1968;6(1):48-54.

62. Mehrez A, Gafni A. Healthy-Years Equivalents Versus Quality-Adjusted Life Years - in Pursuit of Progress. Med Decis Making. 1993;13(4):287-92.

63. Mehrez A, Gafni A. Quality-Adjusted Life Years, Utility-Theory, and Healthy-Years Equivalents. Med Decis Making. 1989;9(2):142-9.

64. Mehrez A, Gafni A. The Healthy-Years Equivalents - How to Measure Them Using the Standard Gamble Approach. Med Decis Making. 1991;11(2):140-6.

65. Daly A, Hess S, Train K. Assuring finite moments for willingness to pay in random coefficient models. Transportation. 2012;39(1):19-31.

66. Sendi PP, Palmer AJ, Marinello CP. Health State Utilities in Dentistry. Acta Med Dent Helv. 1997;2(10):243-8.

67. Birch S. Measuring dental health: improvements on the DMF index. Community Dent Health. 1986;3(4):303-11.

68. Jacobson JJ, Maxson BB, Mays K, Kowalski CJ. A utility analysis of dental implants. Int J Oral Maxillofac Implants. 1992;7(3):381-8.

69. Gafni A, Birch S. Preferences for outcomes in economic evaluation: an economic approach to addressing economic problems. Soc Sci Med. 1995;40(6):767-76.

70. Jacobson J, Maxson B, Mays K, Peebles J, Kowalski C. Cost-effectiveness of dental implants: a utility analysis. J Dent Educ. 1990;54(11):688-9.

71. Barton GR, Bankart J, Davis AC. A comparison of the quality of life of hearing-impaired people as estimated by three different utility measures. Int J Audiol. 2005;44(3):157-63.

72. McIntosh E, Clarke PM, Frew EJ, Louviere JL, editors. Applied Methods of Cost-Benefit Analysis in Health Care. 1 ed: Oxford University Press; 2010.

73. Mitchell RC, Carson RT. Using Surveys to Value Public Goods: The Contingent Valuation Method. Washington DC.: Resources for the Future; 1989.

74. Acton JP. Evaluating public programs to save lives: the case of heart attacks. Santa Monica: RAND Corporation Report No: R950RC. 1973.

75. Diener A, O'Brien B, Gafni A. Health care contingent valuation studies: a review and classification of the literature. Health Econ. 1998;7(4):313-26.

76. Ryan M, Scott D, Reeves C, Bate A, Teijlingen Ev, Russell E, et al. Eliciting public preferences for healthcare: a systematic review of techniques. Health Technol Assess. 2001;5(5).

77. Dolan P, Olsen JA, Menzel P, Richardson J. An inquiry into the different perspectives that can be used when eliciting preferences in health. Health Econ. 2003;12(7):545-51.

78. Dolan P. Whose preferences count? Med Decis Making. 1999;19(4):482-6.

79. Gigerenzer G. The psychology of good judgment: Frequency formats and simple algorithms. Med Decis Making. 1996;16(3):273-80.

80. Sutherland RJ, Walsh RG. Effect of Distance on the Preservation Value of Water-Quality. Land Econ. 1985;61(3):281-91.

81. Fischhoff B, Furby L. Measuring values: A conceptual framework for interpreting transactions with special reference to contingent valuation of visibility. J Risk Uncertain. 1988;1(2):147-84.

82. Boyle KJ, Johnson FR, McCollum DW, Desvousges WH, Dunford RW, Hudson SP. Valuing public goods: Discrete versus continuous contingent-valuation responses. Land Econ. 1996;72(3):381-96.

83. Grether DM, Plott CR. Economic-Theory of Choice and the Preference Reversal Phenomenon. Am Econ Rev. 1979;69(4):623-38.

84. Bohara AK, McKee M, Berrens RP, Jenkins-Smith H, Silva CL, Brookshire DS. Effects of total cost and group-size information on willingness to pay responses: Open ended vs dichotomous choice. J Environ Econ Manage. 1998;35(2):142-63.

85. Ryan M, Scott DA, Donaldson C. Valuing health care using willingness to pay: a comparison of the payment card and dichotomous choice methods. J Health Econ. 2004;23(2):237-58.

86. Frew EJ, Wolstenholme JL, Whynes DK. Comparing willingness-to-pay: bidding game format versus open-ended and payment scale formats. Health Policy. 2004;68(3):289-98.

87. Arrow K, Solow R, Portney PR, Leamer EE, Radner R, Schuman H. Report of the NOAA Panel on Contingent Valuation. Fed Regist. 1993;48:4601-14.

88. Halvorsen B, Saelensminde K. Differences between willingness-to-pay estimates from open-ended and discrete-choice contingent valuation methods: The effects of heteroscedasticity. Land Econ. 1998;74(2):262-82.

89. Loomis JB. Comparative Reliability of the Dichotomous Choice and Open-Ended Contingent Valuation Techniques. J Environ Econ Manage. 1990;18(1):78-85.

90. Hanemann WM. Some Issues in Continuous and Discrete Response Contingent Valuation Studies. Northeastern Journal of Agricultural Economies. 1985;14:5-13.

91. Carson RT, Hanemann MW, Mitchell RC. Determining the Demand for Public Goods by Simulating Referendums at Different Tax Prices. Working Paper, Department of Economies, University of California, San Diego: 1986.

92. Langford IH, Bateman IJ, Langford HD. A Multilevel Modelling Approach to Triple-Bounded Dichotomous Choice Contingent Valuation. Environmental and Resource Economics. 1996;7:197-211.

93. Smith R. Contingent Valuation: Indiscretion in the Adoption of Discrete Choice Question Formats? Austrailia: Centre for Health Program Evaluation, 1997.

94. Herriges JA, Shogren JF. Starting point bias in dichotomous choice valuation with follow-up questioning. J Environ Econ Manage. 1996;30(1):112-31.

95. Bhatia MR, Fox-Rushby JA. Validity of willingness to pay: hypothetical versus actual payment. Appl Econ Lett. 2003;10(12):737-40.

96. Hensher DA. Hypothetical bias, choice experiments and willingness to pay. Transportation Research Part B-Methodological. 2010;44(6):735-52.

97. Heberlein TA, Bishop RC. Assessing the Validity of Contingent Valuation - 3 Field Experiments. Sci Total Environ. 1986;56:99-107.

98. Vogel WB. How resource allocation decisions are made in the health care market. Pharmacotherapy. 2000;20(10 Pt 2):333S-9S.

99. Bishop R., Champ P., Mullarkey D. The Handbook of Environmental Economics. Bromley D, editor. Oxford, UK: Blackwell Publishing; 1995.

100. Ronald G. Cummings DSB, Richard C. Bishop, Kenneth Joseph Arrow. Valuing Environmental Goods: An Assessment of the Contingent Valuation Method. Allanheld R, editor. New Jersey1986.

101. Attard N, Wei X, Laporte A, Zarb GA, Ungar WJ. A cost minimization analysis of implant treatment in mandibular edentulous patients. Int J Prosthodont. 2003;16(3):271-6.

102. Stoker GT, Wismeijer D, van Waas MA. An eight-year follow-up to a randomized clinical trial of aftercare and cost-analysis with three types of mandibular implant-retained overdentures. J Dent Res. 2007;86(3):276-80.

103. Takanashi Y, Penrod JR, Lund JP, Feine JS. A cost comparison of mandibular two-implant overdenture and conventional denture treatment. Int J Prosthodont. 2004;17(2):181-6.

104. Krischer JP. The mathematics of cleft lip and palate treatment evaluation: measuring the desirability of treatment outcomes. Cleft Palate J. 1976;13:165-80.

105. Antczak-Bouckoms AA, Weinstein MC. Cost-effectiveness analysis of periodontal disease control. J Dent Res. 1987;66(11):1630-5.

106. Tulloch JF, Antczak-Bouckoms AA. Decision analysis in the evaluation of clinical strategies for the management of mandibular third molars. J Dent Educ. 1987;51(11):652-60.

107. Cohen ME, Arthur JS, Rodden JW. Patients' retrospective preference for extraction of asymptomatic third molars. Community Dent Oral Epidemiol. 1990;18(5):260-3.

108. Brickley M, Kay E, Shepherd JP, Armstrong RA. Decision analysis for lower-third-molar surgery. Med Decis Making. 1995;15(2):143-51.

109. Armstrong RA, Brickley MR, Shepherd JP, Kay EJ. Healthy decision making: a new approach in health promotion using health state utilities. Community Dent Health. 1995;12(1):8-11.

110. Downer MC, Jullien JA, Speight PM. An interim determination of health gain from oral cancer and precancer screening: 1. Obtaining health state utilities. Community Dent Health. 1997;14(3):139-42.

111. Birch S, Gafni A, Markham B, Marriott M, Lewis D, Main P. Health years equivalents as a measurement of preferences for dental interventions. Community Dent Health. 1998;15(4):233-42.

112. Fyffe HE, Deery C, Nugent Z, Nuttall NM, Pitts NB. The reliability of two methods of utility assessment in dentistry. Community Dent Health. 1999;16(2):72-9.

113. Nassani MZ, Devlin H, McCord JF, Kay EJ. The shortened dental arch--an assessment of patients' dental health state utility values. Int Dent J. 2005;55(5):307-12.

114. Balevi B, Shepperd S. The management of an endodontically abscessed tooth: patient health state utility, decision-tree and economic analysis. BMC Oral Health. 2007;7:17.

115. Nassani MZ, Locker D, Elmesallati AA, Devlin H, Mohammadi TM, Hajizamani A, et al. Dental health state utility values associated with tooth loss in two contrasting cultures. J Oral Rehabil. 2009;36(8):601-9.

116. Nassani MZ, Kay EJ. Tooth loss--an assessment of dental health state utility values. Community Dent Oral Epidemiol. 2011;39(1):53-60.

117. Fukai K, Yoshino K, Ohyama A, Takaesu Y. Dental patient preferences and choice in clinical decision-making. Bull Tokyo Dent Coll. 2012;53(2):59-66.

118. Slade GD, Spencer AJ. Development and evaluation of the Oral Health Impact Profile. Community Dent Health. 1994;11(1):3-11.

119. Slade GD. Derivation and validation of a short-form oral health impact profile. Community Dent Oral Epidemiol. 1997;25(4):284-90.

120. Allen F, Locker D. A modified short version of the oral health impact profile for assessing health-related quality of life in edentulous adults. Int J Prosthodont. 2002;15(5):446-50.

121. Wong AH, Cheung CS, McGrath C. Developing a short form of Oral Health Impact Profile (OHIP) for dental aesthetics: OHIP-aesthetic. Community Dent Oral Epidemiol. 2007;35(1):64-72.

122. McGrath C, Bedi R. An evaluation of a new measure of oral health related quality of life--OHQoL-UK(W). Community Dent Health. 2001;18(3):138-43.

123. Adulyanon S, Sheiham A. Oral Impacts on Daily Performances. In: Slade GD, editor. Measuring Oral Health and Quality of Life: Department of Dental Ecology, School of Dentistry, University of North Carolina; 1997. p. 151-60.

124. Klages U, Claus N, Wehrbein H, Zentner A. Development of a questionnaire for assessment of the psychosocial impact of dental aesthetics in young adults. Eur J Orthod. 2006;28(2):103-11.

125. Cunningham SJ, Garratt AM, Hunt NP. Development of a condition-specific quality of life measure for patients with dentofacial deformity: II. Validity and responsiveness testing. Community Dent Oral Epidemiol. 2002;30(2):81-90.

126. Atchison KA, Dolan TA. Development of the Geriatric Oral Health Assessment Index. J Dent Educ. 1990;54(11):680-7.

127. Matthews DC, Birch S, Gafni A, DiCenso A. Willingness to pay for periodontal therapy: development and testing of an instrument. J Public Health Dent. 1999;59(1):44-51.

128. Dixon S, Shackley P. Estimating the benefits of community water fluoridation using the willingness-to-pay technique: results of a pilot study. Community Dent Oral Epidemiol. 1999;27(2):124-9.

129. Cunningham SJ, Hunt NP. Relationship between utility values and willingness to pay in patients undergoing orthognathic treatment. Community Dent Health. 2000;17(2):92-6.

130. Matthews D, Rocchi A, Gafni A. Putting your money where your mouth is: willingness to pay for dental gel. Pharmacoeconomics. 2002;20(4):245-55.

131. Smith AS, Cunningham SJ. Which factors influence willingness-to-pay for orthognathic treatment? Eur J Orthod. 2004;26(5):499-506.

132. Tamaki Y, Nomura Y, Teraoka K, Nishikahara F, Motegi M, Tsurumoto A, et al. Characteristics and willingness of patients to pay for regular dental check-ups in Japan. J Oral Sci. 2004;46(2):127-33.

133. van Steenberghe D, Bercy P, De Boever J, Adriaens P, Geers L, Hendrickx E, et al. Patient evaluation of a novel non-injectable anesthetic gel: a multicenter crossover study comparing the gel to infiltration anesthesia during scaling and root planing. J Periodontol. 2004;75(11):1471-8.

134. Birch S, Sohn W, Ismail AI, Lepkowski JM, Belli RF. Willingness to pay for dentin regeneration in a sample of dentate adults. Community Dent Oral Epidemiol. 2004;32(3):210-6.

135. Halvorsen B, Willumsen T. Willingness to pay for dental fear treatment. Is supplying dental fear treatment socially beneficial? Eur J Health Econ. 2004;5(4):299-308.

136. Atchison KA, Gironda MW, Black EE, Schweitzer S, Der-Martirosian C, Felsenfeld A, et al. Baseline characteristics and treatment preferences of oral surgery patients. J Oral Maxillofac Surg. 2007;65(12):2430-7.

137. Oscarson N, Lindholm L, Kallestal C. The value of caries preventive care among 19-year olds using the contingent valuation method within a cost-benefit approach. Community Dent Oral Epidemiol. 2007;35(2):109-17.

138. Tianviwat S, Chongsuvivatwong V, Birch S. Prevention versus cure: measuring parental preferences for sealants and fillings as treatments for childhood caries in Southern Thailand. Health Policy. 2008;86(1):64-71.

139. Tianviwat S, Chongsuvivatwong V, Birch S. Different dental care setting: does income matter? Health Econ. 2008;17(1):109-18.

140. Tuominen R. Evaluation of three methods assessing the relative value of a dental program. Acta Odontol Scand. 2008;66(2):82-7.

141. Esfandiari S, Lund JP, Penrod JR, Savard A, Thomason JM, Feine JS. Implant overdentures for edentulous elders: study of patient preference. Gerodontology. 2009;26(1):3-10.

142. Rosvall MD, Fields HW, Ziuchkovski J, Rosenstiel SF, Johnston WM. Attractiveness, acceptability, and value of orthodontic appliances. Am J Orthod Dentofacial Orthop. 2009;135(3):276-7.

143. Tianviwat S, Chongsuvivatwong V, Birch S. Optimizing the mix of basic dental services for Southern Thai schoolchildren based on resource consumption, service needs and parental preference. Community Dent Oral Epidemiol. 2009;37(4):372-80.

144. Leung KC, McGrath CP. Willingness to pay for implant therapy: a study of patient preference. Clin Oral Implants Res. 2010;21(8):789-93.

145. Bech M, Kjaer T, Lauridsen J. Does the number of choice sets matter? Results from a web survey applying a discrete choice experiment. Health Econ. 2011;20(3):273-86.

146. Vermaire JH, van Exel NJ, van Loveren C, Brouwer WB. Putting your money where your mouth is: parents' valuation of good oral health of their children. Soc Sci Med. 2012;75(12):2200-6.

147. Widstrom E, Seppala T. Willingness and ability to pay for unexpected dental expenses by Finnish adults. BMC Oral Health. 2012;12:35.

148. Srivastava A, Feine J, Esfandiari S. Are people who still have their natural teeth willing to pay for mandibular two-implant overdentures? J Investig Clin Dent (In Press). 2012.

149. Newland CA, Waters WE, Standford AP, Batchelor BG. Study of Mail Survey Method. Int J Epidemiol. 1977;6(1):65-7.

150. Burnard P. The Telephone Interview as a Data-Collection Method. Nurs Educ Today. 1994;14(1):67-72.

151. Opdenakker R. Advantages and Disadvantages of Four Interview Techniques in Qualitative Research. Forum: Qualitative Social Research [Internet]. 2006; 7(4). Available from: http://nbn-resolving.de/urn:nbn:de:0114-fqs0604118.

152. Damschroder LJ, Ubel PA, Riis J, Smith DM. An alternative approach for eliciting willingness-to-pay: A randomized Internet trial. Judgm Decis Mak. 2007;2(2):96-106.

153. Iraguen P, Ortuzar JD. Willingness-to-pay for reducing fatal accident risk in urban areas: an Internet-based Web page stated preference survey. Accid Anal Prev. 2004;36(4):513-24.

154. Nielsen JS. Use of the Internet for willingness-to-pay surveys A comparison of face-to-face and web-based interviews. Resource and Energy Economics. 2011;33(1):119-29.

155. Statistics Canada. Oral health: Edentulous people in Canada 2007 to 2009. 2010; Available from: http://www.statcan.gc.ca/pub/82-625-x/2010001/article/11087-eng.htm.

156. Welsh MP, Poe GL. Elicitation effects in contingent valuation: Comparisons to a multiple bounded discrete choice approach. J Environ Econ Manage. 1998;36(2):170-85.

157. O'Brien BJ, Goeree R, Gafni A, Torrance GW, Pauly MV, Erder H, et al. Assessing the value of a new pharmaceutical - A feasibility study of contingent valuation in managed care. Medical care. 1998;36(3):370-84.

158. Stevens TH, Echeverria J, Glass RJ, Hager T, More TA. Measuring the Existence Value of Wildlife - What Do Cvm Estimates Really Show. Land Economics. 1991;67(4):390-400.

159. Neumann PJ, Johannesson M. The willingness to pay for in vitro fertilization: a pilot study using contingent valuation. Med Care. 1994;32(7):686-99.

160. Horowitz JK, McConnell KE. Willingness to accept, willingness to pay and the income effect. J Econ Behav Organ. 2003;51(4):537-45.

161. Lofgren C, Thanh NX, Chuc NT, Emmelin A, Lindholm L. People's willingness to pay for health insurance in rural Vietnam. Cost Eff Resour Alloc. 2008;6:16.

162. de Andrade FB, Lebrao ML, Santos JL, Duarte YA. Correlates of change in self-perceived oral health among older adults in Brazil: findings from the Health, Well-Being and Aging Study. J Am Dent Assoc. 2012;143(5):488-95.

163. Locker D. Clinical correlates of changes in self-perceived oral health in older adults. Community Dent Oral Epidemiol. 1997;25(3):199-203.

164. Cruz GD, Galvis DL, Kim M, Le-Geros RZ, Barrow SY, Tavares M, et al. Self-perceived oral health among three subgroups of Asian-Americans in New York City: a preliminary study. Community Dent Oral Epidemiol. 2001;29(2):99-106.

165. Martins AB, Dos Santos CM, Hilgert JB, de Marchi RJ, Hugo FN, Pereira Padilha DM. Resilience and self-perceived oral health: a hierarchical approach. J Am Geriatr Soc. 2011;59(4):725-31.

166. Diaz FJM, Pleite FMC, Paz JMM, Garcia PG. Consumer knowledge, consumption, and willingness to pay for organic tomatoes. Br Food J Hyg Rev. 2012;114(3):318-34.

167. Amaral G, Geierstanger S, Soleimanpour S, Brindis C. Mental health characteristics and health-seeking behaviors of adolescent school-based health center users and nonusers. J Sch Health. 2011;81(3):138-45.

168. Lucas JW, Barr-Anderson DJ, Kington RS. Health status, health insurance, and health care utilization patterns of immigrant Black men. Am J Public Health. 2003;93(10):1740-7.

169. Wooldridge JM. Introductory Econometrics: A Modern Approach. 4 ed. United States of America: Cengage Learning; 2009.

170. Mason CH, William D. Perreault J. Collinearity, Power, and Interpretation of Multiple Regression Analysis. J Mark Res. 1991;28(3):268-80.

171. Rosner B. Fundamentals Of Biostatistics. 4 ed. United States of America: Cengage Learning; 2006.

172. Glass GV, Hopkins KD. Statistical Methods in Education and Psychology. 3 ed. Bacon A, editor. Boston1995.

173. Burnham KP, Anderson DR, Huyvaert KP. AIC model selection and multimodel inference in behavioral ecology: some background, observations, and comparisons. Behav Ecol Sociobiol. 2011;65(1):23-35.

174. Burnham KP, Anderson DR. Multimodel inference - understanding AIC and BIC in model selection. Sociol Methods Res. 2004;33(2):261-304.

175. Yang H. Visual Assessment of Residual Plots in Multiple Linear Regression: A Model-Based Simulation Perspective. Multiple Linear Regression Viewpoints. 2012;38(2):24-37.

176. Belsley DA, Kuh E, Welsch RE. Regression diagnostics : identifying influential data and sources of collinearity. New York: Wiley; 1980.

177. Faul F, Erdfelder, E., Lang, A.-G., & Buchner, . G*Power 3: A flexible statistical power analysis for the social, behavioral, and biomedical sciences. Behavior Research Methods. 2007;39:175-91.

178. Cohen J. Statistical power analysis for the behavioral sciences. 2nd ed. Hillsdale, N.J.: L. Erlbaum Associates; 1988.

179. Gafni A. Willingness-to-pay as a measure of benefits. Relevant questions in the context of public decisionmaking about health care programs. Med Care. 1991;29(12):1246-52.

180. Flores NE, Carson RT. The relationship between the income elasticities of demand and willingness to pay. J Environ Econ Manage. 1997;33(3):287-95.

181. Statistics Canada. Table 202-0401 - Distribution of total income, by economic family type, 2010 constant dollars, annual. Canada 2012; Available from: http://www5.statcan.gc.ca/cansim/a26;jsessionid=FECFF41E8E9181C6ABEA4EBF9045BAD2?lang=eng&retrLang=eng&id=2020401&pattern=2020401..2020411&tabMode=dataTable&srchLan=-1&p1=-1&p2=-1.

182. Health Canada. Report on the Findings of the Oral Health Component of the Canadian Health Measures Survey 2007-2009. 2010; Available from: http://www.apha.org/NR/rdonlyres/23B5656E-E96F-4E17-B1EE-1843039494CC/0/CanadaOralHealth20079FullReport.pdf.

183. Bhatti T, Rana Z, Grootendorst P. Dental insurance, income and the use of dental care in Canada. J Can Dent Assoc. 2007;73(1):57.

184. Cooper PF, Manski RJ, Pepper JV. The effect of dental insurance on dental care use and selection bias. Medical care. 2012;50(9):757-63.

185. Freeman JD, Kadiyala S, Bell JF, Martin DP. The Causal Effect of Health Insurance on Utilization and Outcomes in Adults A Systematic Review of US Studies. Med Care. 2008;46(10):1023-32.

186. Sackett DL, Torrance GW. Utility of Different Health States as Perceived by General Public. J Chronic Dis. 1978;31(11):697-704.

187. Royston P, Altman DG, Sauerbrei W. Dichotomizing continuous predictors in multiple regression: a bad idea. Stat Med. 2006;25(1):127-41.

188. Boyd NF, Sutherland HJ, Heasman KZ, Tritchler DL, Cummings BJ. Whose Utilities for Decision-Analysis. Med Decis Making. 1990;10(1):58-67.

189. Smith R, Olsen JA, Harris A. A Review of Methodological Issues in the Conduct of WTP Studies in Health Care II: Administration of a CV Survey. Austrailia: Centre for Health Program Evaluation, 1999.

190. Sullivan P. Canada's public health system beset by problems: report. Can Med Assoc J. 2002;166(10):1319-.

191. Roster CA, Rogers RD, Albaurn G, Klein D. A comparison of response characteristics from web and telephone surveys. Int J Market Res. 2004;46(3):359-73.

192. Smith R, Olsen JA, Harris A. A Review of Methodological Issues in the Conduct of WTP Studies in Health Care I: Construction and Specification of the Contingent Market. Austrailia: Centre for Health Program Evaluation, 1999.

193. Smith R, Olsen JA, Harris A. A Review of Methodological Issues in the Conduct of WTP Studies in Health Care III: Issues in the Analysis and Interpretation of WTP Data. Austrailia: Centre for Health Program Evaluation, 1999.

194. Johannesson M. The contingent valuation controversy in environmental economics and its relevance to health services research. J Health Serv Res Policy. 1996;1(2):116-7.

195. Kemp MA, Maxwell C. Exploring a Budget Context for Contingent Valuation Estimates. Contingent Valuation. 1993;220:217-69.

196. Breffle WS, Morey ER, Lodder TS. Using contingent valuation to estimate a neighbourhood's willingness to pay to preserve undeveloped urban land. Urban Stud. 1998;35(4):715-27.

197. Davis RE, Couper MP, Janz NK, Caldwell CH, Resnicow K. Interviewer effects in public health surveys. Health Educ Res. 2010;25(1):14-26.

198. Sinclair M, O'Toole J, Malawaraarachchi M, Leder K. Comparison of response rates and cost-effectiveness for a community-based survey: postal, internet and

telephone modes with generic or personalised recruitment approaches. BMC Med Res Methodol. 2012;12:132.

199. Ethier RG, Poe GL, Schulze WD, Clark J. A Comparison of Hypothetical Phone and Mail Contingent Valuation Responses for Green-Pricing Electricity Programs. Land Economics. 2000;76(1):54-67.

200. Kaneko N, Chern WS. Willingness to pay for genetically modified oil, cornflakes, and salmon: Evidence from a US telephone survey. Journal of Agricultural and Applied Economics. 2005;37(3):701.

201. Angulo AM, Gil JM. Risk perception and consumer willingness to pay for certified beef in Spain. Food Quality and Preference. 2007;18(8):1106-17.

202. Statistics Canada. Census Profile- Age, Sex, Marital Status, Families, Households, Dwellings and Language for Canada and Forward Sortation Areas, 2011 Census. Canada 2012; Available from: http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/details/download-telecharger/comprehensive/comp-ivt-xml-dwnld-tlchrgr.cfm?Lang=E.

203. Arrow KJ, Cropper ML, Eads GC, Hahn RW, Lave LB, Noll RG, et al. Is there a role for benefit-cost analysis in environmental, health, and safety regulation? Science. 1996;272(5259):221-2.

APPENDIX I – Survey Questionnaire

(Internet-Based Survey: Question Loop Design)

COVER LETTER

Dear Survey Respondent

Implants for lower dentures are an alternative treatment option to standard dentures for people who are completely edentate (missing all teeth). We are conducting this survey to better understand how people feel about the costs of this implant treatment.

In the survey, three different cost situations will be described, and you will be asked your opinion about each. At the end, you will be asked to provide some personal information (e.g. your age, education, dental health, etc.). Completing the survey should take only 5 to 10 minutes.

When you submit the survey, you will be given an opportunity to enter a lottery for a $200 cash prize

Your participation is voluntary and you have the right to discontinue the survey at any time by closing the browser. There are no foreseeable risks from participating in this study. All of your responses are confidential. The server ensures privacy of your information and does not capture your IP address or email address. Please do not provide your name anywhere in the survey.

For any enquiries about the questionnaire, please feel free to contact the survey coordinator. Thank you again for your participation.

Sincerely,

Prof. Jocelyne Feine
Faculty of Dentistry,
McGill University

COVER LETTER (Contd.)

Our Contact Information

Study Coordinator:
Dr. Akanksha Srivastava
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Tel: (Office) 514 398 7203 Ext: 00065# (9am to 5pm)

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Agreement to Participate

*If you have any questions or concerns about your rights or ethical concerns as a participant in this study, please contact the McGill Ethics Officer at 514-398-8302.

By checking the box you agree to participate in the survey. Once again please be informed that you have the right to leave the survey at any time even if you decide to participate now.

☐ I Agree to participate in the survey

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DESCRIPTION PAGE

Mandibular two-implant overdenture

Edentate persons (people with no teeth) wear complete dentures for chewing food, talking and appearance. While denture wearers are usually satisfied with their upper dentures, they often have difficulties wearing their lower dentures because of looseness and discomfort, and they cannot eat the foods they wish. This has a negative effect on their general health. Many of them also feel embarrassed at dinners and social functions, because the lower denture loosens while chewing and talking.

Almost half of Canadians aged 65 and older are edentate. Dental implants can make a lower denture more stable, improving chewing and comfort. People who wear a two-implant supported overdenture in the lower jaw report eating a wider range of foods. They are more comfortable socially and rate their overall quality of life significantly better than with conventional dentures.

Two-implant overdenture treatment generally involves a minor surgical treatment, in which the implants are placed in the bone and then the dentures are attached to the implants.

Most edentate patients can physically receive implants, unless they are severely medically compromised. Implants have an overall success rate of more than 95%. If an implant fails (less than 5% chance), a new implant can be placed most of the time without any additional procedures.

SCENARIO 1

We would like you to imagine for the moment that you are missing all of your teeth and that you wear dentures. Conventional dentures should be replaced every 5-7 years and cost $1,750 for a set of new upper and lower dentures. Any repairs may cost an extra $200 on average over the years.

Now your dentist advises you to get two implants in your lower jaw under your dentures which would increase the retention and stability of your dentures and enable you to chew better.

Question 1 *Suppose that the implant overdenture would cost you $ 6000 for the implant treatment and revisits/ repairs for the next 10 years, would you be willing to pay this amount?

- Yes
- No

Question 2 *Suppose that the implant overdenture would cost you $ 8000 for the implant treatment and revisits/ repairs for the next 10 years, would you be willing to pay this amount?

- Yes
- No

If the respondent answers **No**, he/she is redirected to Scenario 2

Question 3 *Suppose that the implant overdenture would cost you $ 10000 for the implant treatment and revisits/ repairs for the next 10 years, would you be willing to pay this amount?

- Yes
- No

If the respondent answers **No**, he/she is redirected to Scenario 2

Question 2 *Suppose that the implant overdenture would cost you $ 4000 for the implant treatment and revisits/ repairs for the next 10 years, would you be willing to pay this amount?

- Yes
- No

If the respondent answers **Yes**, he/she is redirected to Scenario 2

Question 3 *Suppose that the implant overdenture would cost you $ 2000 for the implant treatment and revisits/ repairs for the next 10 years, would you be willing to pay this amount?

- Yes
- No

If the respondent answers **Yes**, he/she is redirected to Scenario 2

Question 4 *what is the maximum amount you would be willing to pay for the implant overdenture treatment? (CAD $) _____

SCENARIO 2

Now, please assume that you do not know if you will ever lose all of your teeth. However, imagine that there is a 1 in 5 chance that you will become edentate at a later stage of your life. If you do lose all of your teeth, your dentist will recommend that you get lower two-implant overdentures for better retention and stability. You will be able to get the implant overdenture treatment for approximately $5000 by paying out-of-your-pocket and assume that revisit and repair costs would be $2000 for 10 years after treatment. Now imagine that a private health insurance company approaches you to buy an insurance coverage for mandibular two-implant overdentures. This would cover the treatment and revisits/ repair costs for the rest of your life, if you need it in future.

Question 1 * Would you buy this additional coverage if it costs a monthly amount of $10?

- Yes
- No

Question 2 * Would you buy this additional coverage if it costs a monthly amount of $20?

- Yes
- No

If the respondent answers **No**, he/she is redirected to Scenario 3

Question 3 * Would you buy this additional coverage if it costs a monthly amount of $30?

- Yes
- No

If the respondent answers **No**, he/she is redirected to Scenario 3

Question 2 * Would you buy this additional coverage if it costs a monthly amount of $5?

- Yes
- No

If the respondent answers **Yes**, he/she is redirected to Scenario 3

Question 3 * Would you buy this additional coverage if it costs a monthly amount of $2?

- Yes
- No

If the respondent answers **Yes**, he/she is redirected to Scenario 3

Question 4 *What is the maximum amount you would be willing to pay for this insurance coverage?

(CAD $) _____

SCENARIO 3

Now imagine for the moment that the health ministry is asking you to vote for a health payment program which covers mandibular two-implant overdenture treatment.
This tax-financed health program would pay for overdenture treatment for all Canadian residents who are missing all of their teeth and wish to obtain implant supported overdentures. This may or may not include you in future depending on whether you become edentate. There are currently more than 2 million people in Canada who are edentate and can benefit from this health program.

Question 1 * Would you vote in favor of this health program if you are asked to pay an additional $100 as yearly taxes?

- Yes
- No

Question 2 * Would you vote in favor of this health program if you are asked to pay an additional $200 as yearly taxes?

- Yes
- No

If the respondent answers **No**, he/she is redirected to **Section 'Personal Information'**

Question 3 * Would you vote in favor of this health program if you are asked to pay an additional $300 as yearly taxes?

- Yes
- No

If the respondent answers **No**, he/she is redirected to **Section 'Personal Information'**

Question 2 * Would you vote in favor of this health program if you are asked to pay an additional $50 as yearly taxes?

- Yes
- No

If the respondent answers Yes, he/she is redirected to **Section 'Personal Information'**

Question 3 * Would you vote in favor of this health program if you are asked to pay an additional $20 as yearly taxes?

- Yes
- No

If the respondent answers Yes, he/she is redirected to **Section 'Personal Information'**

Question 4 * What is the maximum you would be willing to pay as additional yearly taxes for the health ministry to pay for this health program? (CAD $) _____

PERSONAL INFORMATION

Please indicate the following about yourself. Once again be assured that the information you provide is confidential and anonymous.
* Indicates Compulsory Field

Question 1 *
Sex
Male
Female

Question 2 *
Age

Question 3 *
Do you currently have any missing teeth?
Yes (please tell us how many)
No

Question 3a

If you are currently missing any teeth, please tell us if you replaced some or all of them?

Question 4 *
Have your heard of dental implants before reading about them in this survey?
Yes
No

Question 5 *
If you were to lose any tooth (or if you are missing teeth), would you (or did you) opt for dental implants to replace your missing tooth/teeth?
Yes
No

Question 6 *

How likely do you think you are to lose all your teeth and need dentures at a later stage of your life? (please indicate you best guess)

	0	1	2	3	4	5	6	7	8	9	10	
0%	○	◉	○	○	○	○	○	○	○	○	○	100%

Question 7 *

How would you rate your oral health status?

- ○ Excellent
- ◉ Very good
- ○ Good
- ○ Fair
- ○ Poor

Question 8 *

What is your highest level of education attained?

- ○ Primary school
- ○ High school
- ○ CEGEP/ college
- ○ University degree
- ○ Graduate University degree or higher

Question 9

Please tell us your annual household income (before taxes and insurance payments). Include your own income and of your spouse/ partner.

- ○ Less than $30,000
- ○ $30,000 to $60,000
- ○ $60,000 to $90,000
- ○ $90,000 to $120,000
- ○ More than $120,000

Question 10 *

Do you currently have a dental insurance plan?

Yes

No

Question 11 *

Do you know anyone personally who is missing all their teeth?

Yes

No

Question 12 *

Do you believe that the Health Ministry should pay for the mandibular two-implant overdentures?

Yes

No

Question 13 *

Now imagine that your government will pay for dental implants.

Do you think only those missing all their teeth should receive this benefit (mandibular two-implant overdenture treatment)

Do you think everyone irrelevant of the number of missing teeth should get this benefit (please be informed that dental implants can be used for single and multiple missing teeth)

Thank you for participating in the survey.

By clicking submit you indicate your acceptance for the study investigators to use your responses as anonymous data in the concerned study.

Submit

APPENDIX II – Response-sheet to record telephonic interview data

Date: _____ Time: _____

☐ Agree to participate in the survey

Scenario 1

☐ $2000	☐ $4000	☐ $6000	☐ $8000	☐ $10,000	OP_____

Scenario 2

☐ $2	☐ $5	☐ $10	☐ $20	☐ $30	OP_____

Scenario 3

☐ $20	☐ $50	☐ $100	☐ $200	☐ $300	OP_____

Sex:	☐ Male	☐ Female
Age:	_____	

Missing teeth:	☐ Yes (how many_____)	☐ No
Replaced missing teeth	☐ Yes	☐ No
Heard of implants	☐ Yes	☐ No
Chose dental implants	☐ Yes	☐ No

Likelihood of edentulism: 0 (not at all likely) to 10 (very likely): _____

Oral Health Status

☐ Excellent	☐ Very good	☐ Good	☐ Fair	☐ Poor

Education

☐ Primary school	☐ High school	☐ CEGEP/Coll	☐ Univ.	☐ Grad. Univ

Income

☐ <30k	☐ 30k-60k	☐ 60k-90k	☐ 90k-120k	☐ >120k

Dental insurance	☐ Yes	☐ No
Know missing teeth:	☐ Yes	☐ No
Govt. pay:	☐ Yes	☐ No
If govt. pay	☐ Only edentulous	☐ Anyone with missing teeth

☐ Wish to enter the lottery