**Title: Does dental indifference influence the oral health-related quality of life of prisoners?**

Running title: Influences on OHQoL of prisoners

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**Abstract**

Objectives:

Prisoners have worse oral health and greater unmet dental treatment needs than the general population. However, little is known about the impact of the mouth or attitudes such as dental indifference and consequent patterns of dental service use in this disadvantaged group.

The aim was to determine whether dental indifference was associated with the oral health-related quality of life (OHQoL) of prisoners using Andersen’s behavioural model of service utilisation as the theoretical framework.

Methods:

The sample was male prisoners aged 20-35 years attending three prisons in the north of England. Participants took part in interviews and oral examinations. The variables were selected to populate Andersen’s model including: predisposing characteristics (socio-economic status), enabling resources (dental indifference and dental attendance patterns before prison), perceived need (perceived treatment need, satisfaction with appearance of teeth, global rating of oral health), evaluated need (number of decayed teeth), health behaviours (use of dental services while in prison) and health outcomes (OHQoL). Structural equation modelling was used to estimate direct and indirect pathways between variables.

Results:

Of the 700 men approached, 659 completed the interview and clinical examination. Worse OHQoL was associated with less dental indifference (ie greater interest in oral health), previous regular use of dental services, perceived need for treatment and use of prison dental services. The number of decayed teeth and predisposing factors such as qualifications and employment did not predict OHQoL.

Conclusions:

Dental indifference was related to the OHQoL of prisoners in addition to previous regular use of dental services, a perceived need for treatment and use of dental services while in prison. Dental services in prisons might incorporate methods to address dental indifference in their attempts to improve oral health. The findings also have general implications for the assessment of population oral health needs.

**Introduction**

Several government policies in the UK have highlighted the need to raise the significance of good oral health among prisoners and improve the quality of prison dental services including their accessibility and acceptability ([1](#_ENREF_1), [2](#_ENREF_2)).

Prisoners have worse oral health and greater unmet dental treatment needs than the general population. A review of 21 studies found a higher prevalence of oral diseases and unmet needs among inmates compared to the general population with similar socio-demographic characteristics ([3](#_ENREF_3)). The most frequently captured data were on dental caries experience, periodontal disease and the utilisation of prison dental services. However, concerns were expressed about the quality of the studies including approaches to sampling, sample size and failure to consider confounding factors such as age and socio-economic status. Four studies have considered the oral health of UK prisoners ([4-7](#_ENREF_4)) and again found their oral health to be poorer than the general population.

A fourth report, of the oral health of a convenience sample of 78 remand prisoners who were awaiting trial or not yet sentenced, enquired about inmates attitudes to their teeth and dental service use. Inmates were found to value their teeth in terms of function, social interaction and aesthetics and expressed preferences for restoration of teeth, rather than extractions. Despite this apparent appreciation of oral health, most reported irregular attendance at the dentist when not in prison and that their last dental attendance was during a previous stay in prison ([4](#_ENREF_4)). This observation is compatible with the UK survey data that suggest that unmet need decreases during accommodation in prison ([5](#_ENREF_5), [6](#_ENREF_6), [8](#_ENREF_8)). This suggests a level of dental indifference among prisoners and begs the question, how much do prisoners value their oral health, and to what extent does the increased oral disease among prisoners impact on their daily lives?

Dental indifference is defined as: “an attitude consisting of significant undervaluing of teeth and lack of interest in oral health manifesting itself in oral neglect, poor compliance with oral care recommendations, a quick fix attitude to dental treatment and poor dental attendance for reasons other than dental anxiety” ([9](#_ENREF_9)). Dental indifference has been highlighted as a reason for non dental attendance among the general population with suggestions that levels of indifference are related to the social and personal circumstances in which people live whereby some people may have more important things to care about than their teeth ([9](#_ENREF_9)).

Two studies have investigated the impact of the mouth on the daily lives of prisoners. A study of 64 inmates in Hong Kong over 60 years of age found 53% had experienced oral health impacts during the previous year with impact associated with employment status before incarceration, smoking and caries experience ([7](#_ENREF_7)). A second study of 84 prisoners in France found high levels of functional limitation, particularly difficulty chewing ([10](#_ENREF_10)). Further research to investigate factors that influence the oral health-related quality of life (OHQoL) of inmates was recommended ([7](#_ENREF_7)).

Information on the dental attitudes of prisoners, the impact of oral disease and how these factors relate to their clinical status would be invaluable in planning dental services for them. Moreover, prisons provide a potentially useful setting to study the effects of attitudinal variables on dental attendance and oral health because in prison factors such as the availability, geographic access and affordability of dentistry are consistent within samples.

While many studies report high prevalence of dental disease among prisoners, few have considered the impact of the mouth or attitudes such as dental indifference and consequent patterns of dental service use in this disadvantaged group. A survey commissioned to describe the oral health of prisoners presented the opportunity to study these relationships. Following a review of appropriate models, the behavioural model developed by Andersen (Figure 1) ([11](#_ENREF_11), [12](#_ENREF_12)) was chosen. This model describes the interrelationships between population characteristics (predisposing factors, enabling resources and need), health behaviours and health outcomes and has been used to investigate variables that explain service use and ways to improve it. It provides a suitable theoretical model to investigate interrelationships between attitudes such as dental indifference, health behaviours (including dental service use) and health outcomes such as OHQoL ([13](#_ENREF_13)). Therefore the aim of this study was to determine whether dental indifference was associated with the OHQoL of prisoners using Andersen’s model as the theoretical framework.

**Method**

**Sample**

Given the demographic profile of prisoners and security categories of prisons in the UK, the sample was composed of male prisoners aged 20-35 years attending three prisons in the north of England namely Her Majesty’s Prison (HMP) Doncaster, HMP Lindholme and HMP Moorland.

A precision estimate of the sample size was made using data from a previous UK study of prisoner oral health ([5](#_ENREF_5)) which found 75% of prisoners had untreated dental caries. Based on this proportion a sample size was estimated at 633 participants to yield a 95% confidence interval of +/- 3.5% on the proportion of prisoners with untreated caries. During the pilot 10% of inmates declined to participate so 700 inmates were approached.

The procedure for sampling involved obtaining the total number of inmates in each of the three prisons aged 20-35 years (n=1269) then weighting the sample to reflect the proportion in each prison. Accommodation of inmates in UK prisons is typically organised by ‘wing’ so the wings of each prison were randomly selected and all the male prisoners aged 20-35 years living on the selected wings were invited to participate.

**Recruitment**

The unwillingness of prisoners to participate in a previous oral health survey ([4](#_ENREF_4)) indicated the importance of ensuring the procedure was acceptable to inmates. This was achieved through the conduct of a pilot study, involvement of Prisoner Liaison Groups, prison health service managers, providing information flyers to all inmates, displaying posters on wings then ensuring sufficient time to discuss with participants and explain the project before obtaining written consent.

Permission was obtained from the prison governors, organisational approval was received from Doncaster East Primary Care Trust and research ethical approval was obtained from a national ethics committee with a remit including studies involving prisoners.

# Procedure

Participants took part in structured interviews and oral examinations in a room on the wing or the prison healthcare centre, depending on the security arrangements at the different prisons. The interviews were conducted by trained researchers. An interview format was chosen over self-administered questionnaires to overcome literacy problems. The examiner had been trained and calibrated by an NHS dental epidemiology programme co-ordinator.

# Variables

The variables were selected to populate Andersen’s behavioural model of service utilisation, which includes: predisposing factors, enabling resources, need, health behaviours and health outcomes ([11](#_ENREF_11), [12](#_ENREF_12)).

Predisposing factors

The predisposing factors described by Andersen included indicators of socio-economic status ([11](#_ENREF_11), [12](#_ENREF_12)). Oral health studies with prisoners have often omitted socio-economic status as traditional measures such as place of residence, income and occupation are unsuitable ([14](#_ENREF_14)). Thus, three questions were included that concerned education: ‘do you have any educational qualification for which you received a certificate?’ (yes, no), professional qualifications ‘do you have any professional, vocational or other work-related qualification for which you received a certificate?’ (yes, no) and employment status ‘were you employed or not employed?’ (yes, no) before incarceration. The wording of these questions was based on those used in the UK adult dental health surveys ([15](#_ENREF_15), [16](#_ENREF_16)).

Enabling resources

Enabling resources include factors that need to be in place for service use by individuals to occur ([11](#_ENREF_11), [12](#_ENREF_12)). Low dental indifference (i.e. high interest in oral health) was regarded as an enabling factor. The dental indifference scale was developed and evaluated to identify those with differing levels of dental indifference with a view to intervening to improve such attitudes ([9](#_ENREF_9)). The scale has 8-items with total scores ranging from 0-8. For example, items include: ‘if I lost a filling in a back tooth and it did not hurt: I would immediately arrange to go to a dentist, I would wait to see if it started hurting or got any worse before going to a dentist or it would not be a problem I would not see a dentist about it’ and ‘if I had a very painful back tooth: I would prefer it to be taken out or I would prefer it to be left alone or I would prefer it to be filled’. Dental attendance orientation before prison was based on the question: ‘before being in prison, in general did you go to the dentist for a regular check-up, an occasional check-up or only when you’re having trouble with your teeth?’ Dental attendance orientation before prison was also regarded as an enabling factor

Need

The Andersen models include both perceived and evaluated need ([11](#_ENREF_11), [12](#_ENREF_12)). The variables chosen to reflect perceived need were interview questions, based on those used in the UK dental health survey ([15](#_ENREF_15)), on perceived dental treatment need: ‘if you went to the dentist tomorrow do you think you would need any treatment or not?’ (need treatment, don’t know, do not need treatment), satisfaction with appearance of teeth (as aesthetics were identified as an important aspect of oral health for inmates ([4](#_ENREF_4)): ‘how do you feel about the appearance of your teeth, are you satisfied or not satisfied with the way they look?’ (satisfied, not satisfied) and the global rating of oral health: ‘how would you rate the health of your teeth, lips, jaws or mouth’ which was scored on a 5-point Likert scale from excellent to very poor.

Evaluated (normative) need was assessed as the number of decayed teeth detected on clinical examination ([17](#_ENREF_17)).

Health behaviours

Oral health behaviours were assessed based on an interview question on the use of dental services while in prison: ‘have you used the prison dental services in this prison?’(yes, no).

Health outcomes

OHQoL was chosen as the health outcome, assessed by the Oral Health Impact Profile 14-item version during the interview ([18](#_ENREF_18)). OHIP-14 assesses the frequency of impacts of oral conditions within the past three months on a 5-point Likert scale from never to very often. Total scores were calculated using the sum of the item codes such that higher scores indicate more frequent impacts (ie worse OHQoL).

**Data analysis**

First, descriptive statistics were generated. Second, structural equation modelling (SEM) was performed based on the Andersen model ([12](#_ENREF_12)). SEM is a powerful statistical technique that allows simultaneous testing of complex interrelationships between variables specified within *a priori* models ([19](#_ENREF_19)). As such, it is currently the best technique for assessing and modifying theoretical models.

Confirmatory Factor Analysis (CFA) was used to identify whether the indicators chosen to measure the predisposing, enabling and perceived need constructs were acceptable by assessing how indicator items (e.g. education) measured their underlying (latent) constructs (e.g. predisposing factors). This initial step tested a first order CFA with predisposing factors, enabling resources and perceived need as the three latent constructs. Scale items (indicators) representing each of the three constructs are detailed in Table 1. Items were not allowed to load on more than one construct nor were error terms allowed to correlate.

Following specification of the measurement model, the next step tested a structural model, which examined the direct and indirect relationships between the constructs as hypothesised in Andersen’s behavioural model. In accordance with the model, it was hypothesised that predisposing factors would predict enabling factors which, in turn, would predict evaluated and perceived need. Enabling factors and need (perceived and evaluated) would predict behavior and these, together with behavior and predisposing factors, would predict health outcome, measured here as OHQoL. The total effects are made up of both the direct effects (a path direct from one variable to another e.g. predisposing → enabling) and indirect effects (a path mediated through other variables e.g. predisposing → need via enabling factors). Whether mediation was present was assessed by testing the significance of the indirect effect using the bias-corrected bootstrap confidence intervals. The bootstrap framework has been advocated as the best approach for testing mediation models ([20](#_ENREF_20)).

The measurement and structural models were examined using AMOS 18.0. Given that many of the indicators were ordinal or categorical in nature, the standard maximum likelihood estimation method could not be used ([19](#_ENREF_19)). Instead, as recommended in the literature, asymptotic distribution free (ADF) estimation was used with bootstrapping. ADF estimation makes no distributional assumptions and can be employed when sample sizes are large ([21](#_ENREF_21)). As recommended, model fit was evaluated using a range of indices from the three fit classes; absolute, parsimony adjusted and comparative (brown)[[1]](#footnote-1). A χ²/df ratio < 3.0, RMSEA values < .06 and a CFI of .90 or above were taken to indicate an acceptable model fit ([22](#_ENREF_22)).

**Results**

**Participants**

Demographic details

Of the 700 inmates approached 659 completed the interview and clinical examination. Their mean age was 28.9 years (SD = 3.34), all were male. Most participants (n = 575, 87.3%) had been sentenced, the remainder were on remand awaiting sentencing. Sentences ranged from 1 month to ‘life’.

Predisposing factors

Over one third of participants had educational (39.8%) or work-related (37.2%) qualifications with nearly two-thirds (63.9%) unemployed before incarceration (Table 1).

Enabling factors

Most prisoners (63.4%) reported only visiting a dentist when having problems with their teeth, 20.8% reported attending for occasional check-ups and 15.8% for regular examinations. The mean dental indifference score was 3.8 (SD = 1.6) with 8.0% reporting low dental indifference (score 0-1), 57.5% reporting moderate dental indifference (2-4) and 34.4% reported high dental indifference (5-8).

Need

Over two-thirds of participants (68.9%) were not satisfied with the appearance of their teeth (Perceived need), three-quarters (75.0%) perceived they needed treatment and over one third (38.1%) rated their oral health as fair or poor. The mean number of decayed teeth was 2.9 (SD = 4.0).

Oral health behaviours and outcomes

Most participants (57.2%) had not used the prison dental service. The mean OHIP-14 score was 17.8 (range 0-60, SD = 12.1) with 94.1% experiencing one or more oral impacts on their life.

**-INSERT TABLE 1 HERE-**

**Confirmatory factor analysis**

The measurement model was a good fit on all of the *a priori* indices (X²/df = 2.192, *p* < .003, CFI = .968, RMSEA (95% CIs) = .043 (.024-.061). The bootstrapped standardised estimates for this 3-factor measurement model can be seen in Figure 2. Factors (latent variables) are in ellipses and items (indicator variables) are in rectangles. As can be seen from Figure 2, all item loadings were significant and in the expected direction. Having educational qualifications, having professional qualifications and being employed were associated with more of the ‘predisposing’ factor. Of these, employment had the lowest factor loading (.264). More dental indifference and having a problem-orientated dental attendance before prison were associated with more of the ‘enabling resources’ factor (i.e. higher score = less enabling). Poorer self-rated oral health, being unsatisfied with the appearance of their teeth and perceiving the need for dental treatment was associated with more of the ‘perceived need’ factor. As can be seen in Figure 2, the correlations between the three latent factors ranged between -.292 and .379, indicating that they had acceptable discriminant validity (i.e. < .85) (14).

**- INSERT FIGURE 2 HERE -**

**The Andersen model**

The model was an acceptable fit to the data on the *a priori* criteria (χ²/df ratio = 2.914, RMSEA =.054 (.042-.066), CFI = .890). The model accounted for 9%, 34%, 5%, 3% and 35% of the variance in enabling resources, perceived need, evaluated need, behavior (use of prison dental services) and OHQoL respectively. The final statistically parsimonious model with all non-significant paths deleted can be seen in Figure 3.

**- INSERT FIGURE 3 HERE -**

Direct effects

All of the direct paths were in the expected direction (Table 2); greater predisposing factor was linked to more enabling resources; more of the enabling resources was linked to lower evaluated and perceived need and the use of prison dental services (behavior); greater evaluated need was linked to greater perceived need and no use of prison dental services; and greater perceived need was linked to worse OHQoL. There were no direct significant pathways between predisposing factors, enabling factors, evaluated need or behavior and prisoners’ OHQoL. Finally, there was no link between perceived need and behavior; that is, the use of prison dental services.

**- INSERT TABLE 2 HERE -**

Indirect effects

There were a number of significant indirect effects between variables within the model (Table 3). These total indirect effects represent the sum of one or more specific paths. Calculation of specific indirect paths can be seen in Appendix 1. In summary, in line with Andersen’s model, predisposing factors predicted both evaluated and perceived need indirectly via enabling factors (Appendix 1, Paths 1 and 2a). Predisposing factors were linked indirectly to behavior (use of dental services) and this effect was primarily mediated by enabling factors and perceived need (Path 3c). Similarly, predisposing factors predicted OHQoL indirectly via enabling factors, perceived need and behavior (Path 4a and 4e). In line with the Andersen model, enabling factors were linked via evaluated need to perceived need (Path 5), and to OHQoL via both perceived need and behavior (Paths 6d and e). Evaluated need predicted behavior via perceived need (Path 7) and, finally, evaluated need was linked to OHQoL via perceived need and behavior (Paths 8b and c).

**- INSERT TABLE 3 HERE -**

**Discussion**

In this study worse OHQoL was associated with less dental indifference (ie greater interest in oral health), previous regular (rather than symptomatic) use of dental services, perceived need for treatment and use of prison dental services. The number of decayed teeth and predisposing factors such as qualifications and employment did not predict OHQoL.

In terms of the impact of oral health, the proportion of inmates in this study experiencing impacts was much higher (94.1%) than that previously reported in a prison population (53%) although inmates in that study were over 60 years of age ([7](#_ENREF_7)). The national adult dental health survey in the UK found 39% of 25-34 year olds had at least one oral impact ([16](#_ENREF_16)). Dental indifference among the prisoners was also greater than in the general population with one-third reporting high dental indifference compared to 18% of adults in Scotland ([9](#_ENREF_9)).

Of particular interest was the relationship between OHQoL and dental indifference, which has not been studied directly before. Participants who were more indifferent to their oral health had better OHQoL. This finding is compatible with the World Health Organisation definition of quality of life as “*an individual’s perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns*” ([23](#_ENREF_23)) and a current definition of OHQoL as “*the impact of oral disorders on aspects of everyday life that are important to patients and persons, with those impacts being of sufficient magnitude, whether in terms of severity, frequency or duration, to affect an individual’s perception of their life overall*.” ([24](#_ENREF_24)). It is also compatible with qualitative data that found that the relevance of oral health varied so that some people with visibly decayed or missing teeth did not experience subjective impacts of the state of their mouth ([25](#_ENREF_25)). All of these observations regard health-related quality of life as the discrepancy between what one expects and one experiences ([26](#_ENREF_26)).

One area where OHQoL might be applied is to supplement the use of clinical measures to assess need ([27](#_ENREF_27)). That is, resources might be prioritised to patients or populations with both normative need and a socio-dental impact. If need is defined as “*the capacity to benefit from treatment*” ([28](#_ENREF_28)) and people are indifferent to that benefit, then subjective assessments that are used to supplement clinical examinations may underestimate need. This underestimation may be important because the condition of the mouth is visible to other people and its appearance may be used in the judgments formed about others. Lay and dental professional people considered good dental appearance to be important ([29](#_ENREF_29), [30](#_ENREF_30)). In studies where participants have attributed personal characteristics to the subjects of photographs, better dental condition has consistently been associated with judgments of greater social and intellectual competence and psychological adjustment ([31-33](#_ENREF_31)).

The potential for such judgments to influence the lives of individuals is considerable. During social interactions more attractive people are rewarded with more visual and social attention, acceptance, positive interactions, help and co-operation ([34](#_ENREF_34)). Appearance was also associated with long-term effects including occupational success and popularity. Therefore people with visibly decayed or missing teeth who are indifferent to oral health may be experiencing social disadvantage without realising it. Problems will therefore arise if these subjective assessments are used to assess need.

This finding may be of particular importance in the rehabilitation of offenders in finding employment, accommodation and in establishing new relationships ([10](#_ENREF_10)). The removal of tattoos has also been used to change the appearance of prisoners as part of their rehabilitation for similar reasons (38, 39). In summary, prisoners tend to have worse clinical dental status that might influence their life chances upon release, yet if OHQoL is used as part of needs assessment for prisoners it may underestimate their treatment needs, especially those with greater capacity to benefit.

The quality of previous dental research in prisons has been criticised for failure to consider confounding factors such as socio-economic status and for the simplicity of the statistical methods employed ([3](#_ENREF_3)). This study was novel in the use of a theoretical model, a sophisticated analytical tool and the assessment of socio-economic status. The use of Andersen’s behavioural model theorised the relationships between population characteristics, enabling factors, need, health behaviours (including dental service use) and health outcomes such as OHQoL. The current findings lend support to Andersen’s behavioural model as a potential tool for understanding the factors linked to the impact of oral health on prisoners’ everyday lives. As such, they highlight the complex relationships between predisposing and enabling factors, need, behaviour and oral health outcomes. Nevertheless, whilst the model tested here did explain 35% of the variance in the oral health quality of life outcome, there are likely to be other important clinical, social and individual influencers on prisoner’s oral health. Previous research with the prison population, for example, indicates that mental health and drug use are key factors in understanding prisoner’s health and quality of life ([35](#_ENREF_35)). Overall, the present findings whilst supportive of Andersen’s model suggest that further conceptual development is dependent on the inclusion of other individual and social/environment variables.

This study has several limitations. Firstly, the data was cross-sectional and, as such, does not allow exploration of the causal processes underlying OHQoL outcomes. Whilst we modelled our data based on the causal ordering hypothesised within Andersen’s behavioural model, such ordering does not imply a causal effect ([36](#_ENREF_36)). In addition, we tested only unidirectional paths between variables. Utilising longitudinal designs, such as a three-wave panel study, would allow examination of bi-directional or reciprocal relationships. Nevertheless, attempting such a study in a prison would be very difficult given variations in lengths of sentence and the impact of security arrangements on sampling ([3](#_ENREF_3)). Secondly, whilst our model was an adequate fit, there may be other equally valid alternative models ([22](#_ENREF_22)). The model and possible alternatives now need to be cross-validated in further longitudinal studies. A third limitation was the assessment of socio-economic status. Socio-economic status is difficult to assess among prisoners, but this difficulty was partly overcome by using educational attainment as an indicator. However, better indicators are required ([37](#_ENREF_37)). A final limitation was the use of wings as sampling units which may have restricted the variance obtained but was employed to minimise disruption for the prison service.

Previous UK dental surveys have found the oral health of prisoners to be poorer than the general population. In this study the mean number of decayed teeth was 2.9 which is consistent with other prison studies ([5](#_ENREF_5), [6](#_ENREF_6), [8](#_ENREF_8)), but higher than among 25-34 year olds in the UK adult dental health survey (mean = 1.1) ([16](#_ENREF_16)). No link was found between perceived need and use of prison dental services, with 42.8% reporting using prison dental services and perceived need for treatment (75.0%) similar to that reported in an earlier UK prison study (71.0%) ([4](#_ENREF_4)). That study also included questions on dental service use and found most inmates to be irregular dental attenders before incarceration. The authors stated that either lack of access, dental anxiety or lack of awareness of dental pain during prolonged periods of drug dependency may account for this pattern of dental service use ([4](#_ENREF_4)). However, the findings of this current study suggest that indifference to oral health may have influenced dental attendance.

Following several recent government policies aimed at reducing the unmet dental needs of prisoners and improving the quality of prison dental services ([1](#_ENREF_1), [2](#_ENREF_2)), many prisons in the UK have commissioned additional dental services. However, these findings suggest that simply increasing the availability of dental care may not meet these aims if prisoners do not value their oral health sufficiently to attend. In the prisons where this study took place appointments to see a dentist were available although the waiting lists for dental treatment were several weeks long. All inmates, regardless of their length of sentence were entitled to see a prison dentist, although inmates of sentences less than six months were only entitled to care for urgent problems. Prison dentists did report patients making appointments but not attending which is a definition characteristic of dental indifference.

**Conclusion**

Dental indifference influenced the OHQoL of prisoners in addition to previous regular use of dental services, a perceived need for treatment and use of prison dental services. These findings suggest that the organisation of dental services need to incorporate methods to address these attitudes if they are to improve oral health. The findings also have more general implications for the assessment of population oral health needs by highlighting the importance of the role of attitudes, such as dental indifference, as well as the assessment of normative and perceived need and impact.

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## References

1. Department of Health. Strategy for modernising dental services for prisoners in england. London: Stationary Office, 2003.

2. Department of Health. Reforming prison dental services in england – a guide to good practice. Am J Public Health. London: Department of Health., 2005.

3. Walsh T, Tickle M, Milsom K, Buchanan K, Zoitopoulos L. An investigation of the nature of research into dental health in prisons: A systematic review. *British Dental Journal* 2007;204: 683 – 89.

4. Heidari E, Dickinson C, Wilson R, Fiske J. Verifiable cpd paper: Oral health of remand prisoners in hmp brixton, london. *British Dental Journal* 2007;202: E1.

5. Jones CM, McCann M, Nugent Z. Scottish prisons' dental health survey 2002. Edinburgh: The Scottish Government, 2004.

6. Jones CM, Woods K, Neville J, Whittle JG. Dental health of prisoners in the north west england in 2000: Literature review and dental health survey results. *Community Dental Health* 2005;22: 113-17.

7. McGrath C. Oral health behind bars: A study of oral disease and its impact on the life quality of an older prison population. *Gerodontology* 2002;19: 109-14.

8. Lunn H, Morris J, Jacob A, Grummitt C. The oral health of a group of prison inmates. *Dental Update* 2003;30: 135-8.

9. Nuttall NM. Initial development of a scale to measure dental indifference. *Community Dentistry & Oral Epidemiology* 1996;24: 112-6.

10. Decerle N, Woda A, Nicolas E, Hennequin M. A description of oral health in three french jails. *Community Dental Health* 2012;29: 274-78.

11. Andersen RM. Behavioural model of families’ use of health services. Research Series No 25. Chicago, IL: Centre for Health Administration Studies, University of Chicago, 1968.

12. Andersen RM. Revisiting the behavioural model and access to medical care: Does it matter? *Journal of Health and Social Behaviour* 1995;36: 1-10.

13. Baker SR. Applying andersen's behavioural model to oral health: What are the contextual factors shaping perceived oral health outcomes? *Community Dentistry and Oral Epidemiology* 2009;37: 485-94.

14. Friestad C. Socio-economic status and health in a marginalized group: The role of subjective social status among prison inmates. *European Journal of Public Health* 2009;20: 653-58.

15. Kelly M, Steele JG, Nuttall N, Bradnock G, Morris J, Pine C, et al. Adult dental health survey: Oral health in the united kingdom 1998. London: The Stationary Office, 2000; 297-309.

16. Fuller E, Steele J, Watt R, Nuttall N. Oral health and function – a report from the adult dental health survey 2009. In: O’ Sullivan I, Lader D, editors. London: The Health and Social Care Information Centre, 2011.

17. World Health Organisation. *Oral health surveys: Basic methods* 4th edn. Geneva: World Health Organisation; 1997.

18. Slade GD. Derivation and validation of a short-form oral health impact profile. *Community Dentistry & Oral Epidemiology* 1997;25: 284-90.

19. Kline RB. *Principles and practice of structural equation modelling.* 2nd edn edn. New York: The Guildford Press; 2005.

20. MacKinnon DP, Lockwood, C. M., Hoffman, J. M., West, S. G., & Sheets, V. A comparison of methods to test mediation and other intervening variable effects. *Psychological Methods* 2002;7: 83-104.

21. Muthen B. Goodness of fit with categorical and other non-normal variables. In: Bollen KA, Long JS, editors: Testing structural equation models. Newbury Park, CA: Sage, 1993; 205–34.

22. Hu LT, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Struct Equat Model* 1999;6: 1-55.

23. Oort F. Using structural equation modeling to detect response shifts and true change. . *Quality of Life Research* 2005;14: 587-98.

24. Locker D, Allen F. What do measures of 'oral health-related quality of life' measure? *Community Dent Oral Epidemiol* 2007;35: 401-11.

25. Gregory J, Gibson BJ, Robinson PG. Variation and change in the meaning of oral health related quality of life: A 'grounded' systems approach *Social Science & Medicine* 2005;60: 1859-68.

26. Carr AJ, Gibson B, Robinson PG. Is quality of life determined by expectations or experience? In: Carr AJ, Higginson IJ, Robinson PG, editors: *Quality of life*; 2002.

27. Sheiham A, Tsakos G. Oral health needs assessment. In: Pine C, Harris R, editors: Community oral health, 2nd Ed edition. New Malden, Surrey: Quintessence Publishing Co. Ltd, 2007; pp 59-79.

28. McIntyre D, Mooney G, Stephen J. Need: What is it and how do we measure it? In: Detels R, Beaglehole R, Lansang MA, Gulliford M, editors: Oxford textbook of public health, 5th edition. Oxford: Oxford University Press, 2009; 1535-48.

29. Linn EL. Social meanings of dental appearance. *J Health Human Behav* 1966;7: 289-95.

30. Jenny J, Proshek JM. Visibility and prestige of occupations and the importance of dental appearance. *J Can Dent Assoc* 1986;52: 987-9.

31. Newton JT, Prabhu N, Robinson PG. The impact of dental appearance on the appraisal of personal characteristics. *Int J Prosthod* 2003;16: 429-34.

32. Eli I, Bar-Tal Y, Kostovetzki I. At first glance: Social meanings of dental appearance. *J Pub Health Dent* 2001;61: 150-4.

33. Feng XP, Newton JT, Robinson PG. The impact of dental appearance on perceptions of personal characteristics among chinese people in the united kingdom. *Int Dent J 2001;51: 282-86* 2001;51: 282-86.

34. Langlois JH, Kalakanis L, Rubenstein AJ, Larson A, Hallam M, Smoot M. Maxims or myths of beauty? A meta-analytic and theoretical review. *Psychol Bull* 2000;126: 390-423.

35. Ginn S. Dealing with mental disorder in prisoners. *BMJ* 2012;345.

36. Holland PW. Causal inference, path analysiand recursive structural equation models. *Sociol Methodol* 1988;18: 449-84.

37. Friestad C. Socio-economic status and health in a marginalized group: The role of subjective social status among prison inmates. *Eur J Public Health* 2010;20: 653-8.

**Table 1.** Results for the study variables (n = 659)

|  |  |
| --- | --- |
| **Variable** | N/% |
| **Predisposing factors** |  |
| Educational qualifications before prison:  1 = Yes  0 = No  Professional or work-related qualifications before prison:  1 = Yes  0 = No  Employment status before prison:  1= Not employed  0 = Unemployed | 262 (39.8)  397 (60.2)  245 (37.2)  414 (62.8)  238 (36.1)  421 (63.9) |
| **Enabling factors** |  |
| Dental attendance orientation before prison:  0 = Regular check-ups  1 = Occasional check-ups  2 = Having symptoms | 104 (15.8)  137 (20.8)  418 (63.4) |
|  | Mean/SD |
| Dental indifference score | 3.8 (1.6) |
| **Need** | N/% |
| Perceived need:  Satisfaction with appearance of teeth:  0 = Satisfied  1 = Not satisfied | 205 (31.1)  454 (68.9) |
| Perceived treatment need:  2 = Need treatment  1 = Do not know  0 = Do not need treatment | 494 (75.0)  63 (9.6)  102 (15.5) |
| Self-rated oral health:  0 = Excellent  1 = Very good  3 = Good  4 = Fair  5 = Poor | 21 (3.2)  74 (11.2)  313 (47.5)  132 (20.0)  119 (18.1) |
|  | Mean/SD |
| Evaluated need:  Decayed teeth | 2.87 (4.0) |
| **Oral health behaviours** |  |
| Use of prison dental services:  0 = Yes  1 = No | 282 (42.8)  377 (57.2) |
| **Oral health outcomes** | Mean/SD |
| OHIP 14 total score | 17.8 (12.1) |

**Pre-disposing characteristics**

**Perceived health status**

**Use of health services**

**Enabling resources**

**Need**

**Population characteristics Health behaviours Outcomes**

**Figure 1.** Andersen’s behavioural model of health service use (1995)

**Figure 2.** Confirmatory factor analysis for the Andersen model

*β* = .664\*\*

Education

*β* = .264\*\*

Employment

*r* = -.292\*\*

*β* = .729\*\*

Professional qualifications

*r* = -.149\*

*β* = .424\*\*

Dental indifference

*β* = .876\*\*

Dental attendance orientation

*r* = .164\*\*

*β* = .566\*\*

Self-rated dental need

*β* = .648\*\*

*β* = .594\*\*

Satisfaction with dental appearance

Self-rated oral health

*Note:* Error terms have been deleted for ease of interpretation. \* *p* < .05, \*\* *p* < .001.

**Figure 3.** Direct and indirect paths for the statistically parsimonious Andersen model

Behaviour: use of prison dental services

OHRQoL

Evaluated need

*Note:* Error and variance terms and indicator items omitted for ease of interpretation. Latent variables in ellipses and observed variables in rectangles. Direct paths = solid lines; indirect paths = dotted lines. All beta coefficients in Tables 2 and 3.

**Table 2**. Direct effects for the Andersen model

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Effect *β* Bootstrap Bias-corrected

SE 95% CI

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Predisposing – Enabling -.291 .070 -.408/-.180\*\*

Predisposing – OHQoL .002 .052 -.091/.086

Enabling - Evaluated need .226 .052 .136/.306\*\*

Enabling - Perceived need .358 .072 .241/.465\*\*

Enabling – Behaviour .140 .070 .037/.261\*

Enabling – OHQoL -.101 .064 -.223/-.014

Evaluated need - Perceived need .380 .044 .311/.455\*\*\*

Evaluated need - Behaviour .113 .053 .036/.215\*

Evaluated need - OHQoL .082 .048 .006/.163

Perceived need - Behaviour -.156 .081 -.290/-.022

Perceived need - OHQoL .582 .066 .476/.691\*\*

Behaviour – OHQoL -.075 .042 -.145/-.004

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*Note:* \* *p* < .05, \*\* *p <* .01, \*\*\* *p ≤* .001; *β* = bootstrapped standardised estimate; SE = standard error; CI = confidence interval.

**Table 3.** Indirect effects for the Andersen model

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Effect *β* Bootstrap Bias-corrected

SE 95% CI

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Predisposing – Evaluated need -.066 .024 -.110/-.028\*\*

Predisposing – Perceived need -.129 .043 -.208/-.068\*\*

Predisposing – Behaviour -.028 .018 -.068/-.005\*

Predisposing –OHQoL -.049 .020 -.084/-.023\*\*

Enabling - Perceived need .086 .021 .056/.126\*\*\*

Enabling – Behaviour -.044 .037 -.109/.008

Enabling – OHQoL .270 .063 .172/.372\*\*

Evaluated need - Behaviour -.059 .031 -.111/-.009\*

Evaluated need - OHQoL .217 .035 .164/.282\*\*

Perceived need - OHQoL .012 .008 .002/.030

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*Note:* \* *p* < .05, \*\* *p <* .01, \*\*\* *p ≤* .001; *β* = bootstrapped standardised estimate; SE = standard error; CI = confidence interval.

**Appendix 1**. Calculation of specific indirect paths for each total indirect effect (numbers represent standardised beta coefficients)

1. Predisposing – enabling – evaluated need = -.291 x .226 = -.066

a. Predisposing – enabling – perceived need = -.291 x .358 = -.104

b. Predisposing – enabling – evaluated need – perceived need = -.291 x .226 x .380 = -.025

3.

a. Predisposing – enabling – behavior = -.291 x .140 = -.041

b. Predisposing – enabling – evaluated need – behavior = -.291 x .226 x .113 = -.007

c. Predisposing – enabling – perceived need – behavior = -.291 x .358 x -.156 = -.260

4.

a. Predisposing – enabling – behaviour – OHQoL = -.291 x .140 x -.075 = -.116

b. Predisposing – enabling – evaluated need – OHQoL = -.291 x .226 x .082 = -.005

c. Predisposing – enabling – evaluated need – behavior – OHQoL = -.291 x .226 x .113 x -.075 = -.082

d. Predisposing – enabling – perceived need – OHQoL = -.291 x .358 x .582 = -.061

e. Predisposing – enabling – perceived need – behavior – OHQoL = -.291 x .358 x -.156 x -.075 = -.335

5. Enabling – evaluated need – perceived need = .226 x .380 = .086

6.

a. Enabling – behavior – OHQoL = .140 x -.075 = .065

b. Enabling – evaluated need – OHQoL = .226 x .082 = .019

c. Enabling – evaluated need – behavior – OHQoL = .226 x .113 x -.075 = -.050

d. Enabling – perceived need – behavior – OHQoL = .358 x -.156 x -.075 = .127

e. Enabling – perceived need – OHQoL = .358 x .582 = .208

7. Evaluated need – perceived need – behavior = .380 x -.156 = .224

8.

a. Evaluated need – behavior – OHQoL = .113 x -.075 = .038

b. Evaluated need – perceived need – OHQoL = .380 x .582 = .221

c. Evaluated need – perceived need – behavior – OHQoL = .380 x -.156 x -.075 = .149

**Figure 1.** Andersen’s behavioural model of health service use (1995)

**Figure 2.** Confirmatory factor analysis for the Andersen model

**Figure 3.** Direct and indirect paths for the statistically parsimonious Andersen model

**Table 1.** Results for the study variables (n = 659)

**Table 2**. Direct effects for the Andersen model

**Table 3.** Indirect effects for the Andersen model

**Appendix 1**. Calculation of specific indirect paths for each total indirect effect (numbers represent standardised beta coefficients)

1. Given that the chi-square statistic (χ²) can be inflated by sample size, we report the χ²/df ratio as the measure of overall goodness of fit. The parsimony-adjusted index was the root-mean-squared error of approximation (RMSEA) with 90% confidence intervals (90%CI). The comparative fit index was the comparative fit index (CFI). [↑](#footnote-ref-1)