The socio-demographic and malocclusion characteristics of adolescents presenting for specialist orthodontic treatment in New Zealand practices

David L. Healey,* Robin D. Gauld† and W. Murray Thomson*  
Specialist Practice, Orthodontics, Christchurch,* Department of Preventive and Social Medicine, Dunedin School of Medicine, The University of Otago, Dunedin† and Sir John Walsh Research Institute, School of Dentistry, The University of Otago, Dunedin,* New Zealand.

Background: There are few reports of the socio-demographic and malocclusion characteristics of those undergoing clinical orthodontic treatment in private specialist practice.
Aim: To describe the pretreatment characteristics of individuals presenting for orthodontic treatment.
Methods: Individuals (N = 174) presenting for orthodontic treatment in 19 private specialist orthodontic practices in New Zealand were randomly selected and examined (at the beginning of a three-year prospective study) and their malocclusions compared using the Dental Aesthetic Index (DAI).
Results: The mean DAI score was 35.8 (SD 8.4). There were no statistically significant socio-demographic differences in DAI score other than by household-based socio-economic status (SES), whereby mean scores were considerably higher in those of low SES. The majority of patients attending for treatment had severe or very severe/handicapping malocclusions. Females had less severe malocclusions than males, on average, although the difference was not statistically significant.
Conclusions: The malocclusion severity threshold for seeking orthodontic treatment appears to be higher in those of lower SES. The study findings highlight the need to improve access to orthodontic treatment for this group.

Introduction
The majority of available information on malocclusion severity has been sourced from population surveys and dental-school-based studies.¹ There is a dearth of recent information on its presentation in orthodontic practice, where the majority of treatment takes place. In addition, the association between socio-economic status (SES) and malocclusion characteristics for those who accept orthodontic treatment has been restricted to investigation in population surveys.

The question of whether socio-economic and ethnic characteristics affect oral health and access to health care has been well researched.²⁻⁵ Past studies have shown that a strong socio-economic gradient exists in which poorer individuals have worse oral health. Any observable difference in malocclusion severity between population-based and clinical samples should assist in determining how much more severe a malocclusion has to be before treatment is sought. Such a difference will be moderated by socio-demographic factors; for example, it is a reasonable assumption that those from lower socio-economic backgrounds would face greater barriers to orthodontic treatment, and that their malocclusion threshold for treatment would be correspondingly more severe.

The literature on SES differences in orthodontic
treatment is equivocal. Deprivation-associated differences in orthodontic treatment uptake in the United Kingdom have been noted; similarly, Proffit et al. observed marked SES differences in the uptake of treatment in US adolescents, as did Foster et al. in a population sample of Taranaki (New Zealand) adolescents. Contrasting with these findings are: (1) an earlier Australian study which found that neither SES nor ethnicity accounted for substantial variability in those seeking orthodontic treatment, and (2) the absence of SES differences in treatment uptake among those in a New Zealand city with a Dental School.

There is a consistently reported gender difference in the uptake of orthodontic treatment, with girls being more highly represented among those treated. Moreover, it has been observed that the uptake of orthodontic treatment is greater in girls because they (and their parents) seek treatment for milder occlusal issues. Clinical samples examining longitudinal changes with orthodontic treatment have frequently reflected this gender bias. Commonly, the female:male ratio among those seeking treatment is approximately 2.1. The prevalence and severity of malocclusion have been widely reported and appear to follow a similar distribution in most population groups, although there may be ethnic differences. The ethnic differences in orthodontic perceptions and uptake in New Zealand have not been extensively investigated, although an epidemiological study found a lower treatment need in Maori.

The aim of this study was to describe the socio-demographic and malocclusion characteristics of individuals presenting for orthodontic treatment at specialist orthodontic practices throughout New Zealand.

Materials and methods

Cross-sectional data were obtained from the baseline assessments in a three-year prospective study conducted in 19 private specialist orthodontic practices in New Zealand. Ethical approval was granted in 2006 by the Multi-regional Ethics Committee (MEC/0611/143). Informed consent was gained in writing from the participants and their parents. The study utilised only those records commonly taken as part of a ‘best practice’ protocol in orthodontic treatment.

The present study was initially promoted at the combined NZDA/NZAO conference ‘The business of smiles’, in September 2006. In December 2006, each of the 68 registered orthodontists in New Zealand was contacted in writing and formally given the opportunity to participate. The selection of patients was performed randomly from the pool of patients awaiting treatment with the orthodontists who accepted the invitation to participate. Inclusion in the study did not alter the provided orthodontic treatment in any way. All records were sent to the University of Otago where they were scored, duplicated and returned to their issuing orthodontist. All data were entered into a secure database by either the principal investigator (PI) or by a research assistant and then checked by the PI.

Included in the study were patients between the ages of 10 and 17 at baseline who were to undergo full upper and lower fixed orthodontic treatment and who consented to take part. Specifically excluded were: patients in two-phase orthodontic treatment (in which there was a separate identifiable skeletal change phase prior to the placement of full fixed appliances); patients about to leave the area or practice; patients outside the age limits <11years or >17 years at start of treatment; surgical cases; and those with major craniofacial abnormalities (such as cleft lip and palate).

Socio-demographic information was obtained from a structured questionnaire that was completed by the participants’ parents or guardians. The questionnaire included information on age, gender, identified ethnic group (New Zealand 2006 Census question), the occupation of both mother and father, and residential address.

Socio-economic status data were collected using an occupationally-based measure and an area-based deprivation measure. The applied occupational measure was the New Zealand Socio-Economic Index of Occupational Status, which allocates an SES score from 10 to 90, with 10 representing the highest SES. Since occupational information was obtained from both parents, the household SES was determined to be the higher of the two occupational ratings. Occupations with scores of 10 to 39 were categorised as ‘Low SES’, while scores of 40 to 59 were categorised as ‘Medium SES’; those scoring over 60 were categorised as ‘High SES’. The area-based measure used was the NZDep2006, which combines Census meshblock-level information on nine variables (telephone, benefit, unemployment,
household income, car access, single parent family, no qualifications, home ownership, and overcrowding).

The Dental Aesthetic Index (DAI)\textsuperscript{17} assesses the relative social acceptability of dental appearance, and it was used to assign a malocclusion score to each participant. It comprises 10 clinician-measured occlusal components, which are weighted, summed, and added to a constant (13) to give a single DAI score. Higher scores represent poorer dental aesthetics.

Following derivation of the DAI score, participants were allocated to orthodontic treatment need categories using the schema of Estioko et al.\textsuperscript{18} in which scores of 25 or lower indicate ‘minor/no’ treatment need, 26 to 31 indicates a definite malocclusion, 32 to 35 a severe malocclusion, and 36 or more a handicapping malocclusion. The DAI assessment was undertaken using study casts rather than the patients themselves.

The principal investigator (DH) underwent training and calibration as part of a pilot study. This entailed the repeat examination of 20 sets of casts and photographs on two occasions eight weeks apart. The intra-class correlation coefficient for the DAI was 0.98, indicating ‘very strong’ agreement.

Statistical analysis was undertaken using the Statistical Package for the Social Sciences, SPSS for Macintosh (IBM SPSS Statistics Version 20). The alpha level for all tests was set at $p < 0.05$. Following the computation of descriptive statistics, bivariate analyses used chi-square tests for categorical dependent variables and analysis of variance (or non-parametric tests as appropriate) for continuous dependent variables.

**Results**

Data were available for 174 participants, of whom 112 (64.4%) were female. Participants ranged in age from 10 to 17 years, and were assigned to one of three age groups of approximately equal size (‘youngest’, 10–12 years; ‘middle’, 13 years; ‘oldest’, 14 years or older). The mean age at treatment commencement was 13.5 years (SD 1.3 years). Most participants (142, or 81.6%) were identified as being of European ethnicity. The second largest identified ethnic group was Maori with 8.6%.

The mean DAI score was 35.8 (SD 8.4). There were no statistically significant socio-demographic differences in DAI score other than by household-based SES, whereby mean scores were higher in those of low SES (Table I). The mean DAI score in the ‘low’ group differed significantly from those of the other two groups (which did not differ). Females had a higher mean DAI score than males, and Europeans a higher score than non-Europeans, but these differences were not significant. One in ten cases were categorised as having ‘minor’ or ‘no’ need for treatment, whereas almost half were in the most severe category. Participants who were from low household SES backgrounds were over-represented in the ‘very severe/handicapping’ category. Proportionally more males were in the more severe malocclusion categories.

**Discussion**

This study examined the socio-demographic and malocclusion characteristics of adolescents presenting for specialist orthodontic treatment. It was found that the majority of patients attending for treatment were categorised with severe or very severe/handicapping treatment needs and that the females attending for orthodontic treatment had a lower malocclusion severity than males. In addition, non-European participants were found to have lower mean DAI scores and were less represented in the more severe malocclusion categories. Overall, the threshold for the severity of malocclusion that leads to treatment being sought appears to be higher in those of lower SES.

The study had some unique features. The sample was recruited through a practice-based network of 19 specialist practitioners spread over a single country, rather than a population-based sample or patients from a single university or hospital department. Accordingly, it is possible to assert that the findings have greater relevance for clinical practice. The appliance type was controlled by limiting the patient selection to only those undergoing treatment with two-arch fixed appliances. No functional appliance therapy or craniofacial/surgery cases were included.

The baseline DAI scores, ranges and malocclusion severity categories observed in this study were remarkably similar to those reported from clinical orthodontic studies conducted in other countries (Table II). The DAI score data differed from those reported from population studies. As anticipated, in comparison to population groups, this sample had more severe malocclusions, with almost two-thirds of the sample categorised as having ‘severe’ or ‘very severe/handicapping’ malocclusions. Surprisingly, there was a small group with ‘minor/no’ malocclusions who
had sought treatment; most of those 17 individuals were female. The mean DAI scale difference between population and clinical samples appeared to be six points, with about twice the proportion of people in the ‘very severe/handicapping’ category in the clinical sample than would be similarly categorised in a population-based sample.

In the current study, the marked SES gradient in malocclusion severity suggested that the threshold for orthodontic treatment-seeking is higher in lower SES groups. In other words, the data suggested that a malocclusion has to be more severe in a low-SES adolescent for treatment to be sought. This is consistent with observations from a recent New...
Zealand population-based study,8 in which low-SES adolescents were less likely to have presented for an orthodontic consultation after their parents had been notified of the possible need.

Epidemiological studies have shown that there are few gender differences in the prevalence of malocclusion.19-21 However, it is noteworthy that, consistent with observations of other orthodontic clinical samples,22,23,11 females in this study were over-represented. Moreover, males had higher mean DAI scores than females, and 88% of those in the ‘minor/no’ treatment need category were female (although none of the gender differences were statistically significant). It has been postulated that proportionally more females accept orthodontic treatment because they seek treatment for milder occlusal issues,11 and the findings from the present study support that premise. It has been a long-held view that aesthetics, rather than concern for function or health, has been the primary driver for orthodontic treatment;24 in fact, it has been estimated that, in 80% of cases, psychological factors rather than the severity of the malocclusion determine the demand for treatment.25 The study findings highlight the differences between population samples22 and clinical samples, reaffirming the greater treatment need in individuals seen in orthodontic practice than in the general population.

There were no notable ethnic differences in malocclusion severity, although the European group had a higher mean DAI score and were more heavily represented in the most severe DAI treatment need category. The latter is consistent with observations in the Taranaki sample,8 which found that non-Maori had higher mean DAI scores and were over-represented in the more severe malocclusion categories. A possible explanation for this is the precocious dental development commonly found in Maori and Pacific individuals,26 who made up the majority of the ‘non-European’ group, leading to lower overall DAI scores. This effect would tend to lead to the natural correction of malocclusion severity at a younger age for those individuals than in less precocious developers, given that DAI scores have been found to reduce naturally (without treatment) with age and development.27,28 Another possible explanation may be found in the greater frequency of representation of Class III skeletal malocclusions within these ethnic groups. Class III malocclusions are more likely to be treated surgically, and surgery was one of the exclusion criteria for the present study.

A number of studies have documented inequalities in oral health care in New Zealand.29,30 In New Zealand, dental care for children and adolescents is State-funded and provided free either by dental therapists or by family dentists under the Adolescent Oral Health Care Scheme until age 18, with universal access. In countries with a State-funded orthodontic treatment system, prioritisation for treatment is generally by malocclusion severity, which ensures that those with the greatest need receive treatment. Without a priority system in place in New Zealand, the influences on the uptake of orthodontic treatment have not been fully investigated. The New Zealand situation is unusual in that there are few third-party funding avenues for orthodontics, and so most treatment by specialist orthodontists is provided in private practices and is paid for directly by the family. Orthodontics is considered to be a largely aesthetic domain, and the State’s contribution to treatment is limited to severe craniofacial conditions such as cleft lip and palate. This is in stark contrast to countries (United Kingdom, Sweden, Denmark, Holland) that fully State-fund orthodontic treatment for those with a qualifying malocclusion or those countries that partially fund care (France, Italy). The greatest contrast occurs with those countries that have little or no State funding (USA, Canada, Australia). Not surprisingly, the uptake of orthodontic services has been found to be related to the level of funding, with uptake lower in less privileged groups.31,13 However, further studies have indicated that familiarity with orthodontic appliances among an adolescent individual’s peer group has a greater influence on the uptake of orthodontic treatment than social class or gender.32,33

Conclusions

The majority of patients attending for orthodontic treatment were categorised with severe or very severe/handicapping treatment needs. Females attending for treatment had less severe malocclusions than males, suggesting a lower care-seeking threshold for females. Conversely, the care-seeking malocclusion threshold was higher in those of lower socio-economic status. The findings highlight the need to improve access to orthodontic treatment for the latter group.

Acknowledgments

This study was supported by a grant from the New Zealand Dental Association. We thank the New
Zealand Association of Orthodontists and its members who gathered the data for the study. This work was undertaken as part of a PhD at the University of Otago.

**Corresponding author**
Prof W.M. Thomson
Dept of Oral Sciences
University of Otago
PO Box 647
Dunedin
New Zealand
Email: murray.thomson@otago.ac.nz

**References**

1. Chew MT, Sandham A. Effectiveness and duration of two-arch fixed appliance treatment. Aust Orthod J 2000;16:98-103.
2. Locker D. Deprivation and oral health: a review. Community Dent Oral Epidemiol 2000;28:161-9.
3. Thomson WM, Ayers KMS, Broughton JR. Child oral health inequalities in New Zealand. A background paper to the National Health Committee. Wellington: 2003.
4. Do LG, Spencer AJ, Slade GD, Ha DH, Roberts-Thomson KF, Liu P. Trend of income-related inequality of child oral health in Australia. J Dent Res 2010;89:595-64.
5. Thomson WM. Social inequality in oral health. Community Dent Oral Epidemiol 2012;40 Suppl 2:28-32.
6. Drugan CS, Hamilton S, Naqvi H, Boyles JR. Inequality in uptake of orthodontic services. Br Dent J 2007;202:E15; discussion 326-7.
7. Profitt WR, Fields HW Jr, Moray LJ. Prevalence of malocclusion and orthodontic treatment need in the United States: estimates from the NHANES III survey. Int J Adult Orthod Orthognath Surg 1998;13:97-106.
8. Foster Page LA, Thomson WM. Malocclusion and uptake of orthodontic treatment in Taranaki 12-13-year-olds. NZ Dent J 2005;101:98-105.
9. Brown DF, Spencer AJ, Tolliday PD. Social and psychological factors associated with adolescents' self-acceptance of occlusal condition. Community Dent Oral Epidemiol 1987;15:70-3.
10. Thomson WM. Orthodontic treatment outcomes in the long term: findings from a longitudinal study of New Zealanders. Angle Orthod 2002;72:449-55.
11. Harris EF, Glassell BE. Sex differences in the uptake of orthodontic services among adolescents in the United States. Am J Orthod Dentofacial Orthop 2011;140:543-9.
12. Chen M, Wang DW, Wu LP. Fixed orthodontic appliance therapy and its impact on oral health-related quality of life in Chinese patients. Angle Orthod 2010;80:49-53.
13. Badran SA, Al-Khateeb S. Factors influencing the uptake of orthodontic treatment. J Public Health Dent 2013;73:339-44.
14. Statistics New Zealand. New Zealand Census of Population and Dwellings 2006. Wellington: Statistics New Zealand, 2006.
15. Davis P, McLeod K, Ransom M, Ongley P, Pearce N, Howden-Chapman P. The New Zealand Socioeconomic Index: developing and validating an occupationally-derived indicator of socio-economic status. Aust N Z J Public Health 1999;23:27-33.
16. Salmond C, Crampton P, King P, Waldegrave C. NZDep: A New Zealand index of socioeconomic deprivation for individuals. Soc Sci Med 2006;62:1474-85.
17. Cons NC, Jenny J, Kohout FJ. DAI: The Dental Aesthetic Index. Iowa City: College of Dentistry, The University of Iowa, 1986.
18. Estioko LJ, Wright FA, Morgan MV. Orthodontic treatment need of secondary schoolchildren in Heidelberg, Victoria: an epidemiologic study using the Dental Aesthetic Index. Community Dent Health 1994;11:147-51.
19. Thilander B, Myrberg N. The prevalence of malocclusion in Swedish schoolchildren. Scand J Dent Res 1973;81:12-21.
20. O’Brien K, McComb JL, Fox N, Wright J. Factors influencing the uptake of orthodontic treatment. Br J Orthod 1996;23:331-4.
21. Thilander B, Pena L, Infante C, Parada SS, de Mayorga C. Prevalence of malocclusion and orthodontic treatment need in children and adolescents in Bogota, Colombia. An epidemiological study related to different stages of dental development. Euro J Orthod 2001;23:153-67.
22. Locker D. Disparities in oral health-related quality of life in a population of Canadian children. Community Dent Oral Epidemiol 2007;35:348-56.
23. Agou S, Locker D, Streiner DL, Tompson B. Impact of self-esteem on the oral-health-related quality of life of children with malocclusion. Am J Orthod Dentofacial Orthop 2008;134:484-9.
24. Plunkett DJ. The provision of orthodontic treatment: some ethical considerations. N Z Dent J 1997;93:17-20.
25. Albino JE, Cunat JJ, Fox RN, Lewis EA, Slakter MJ, Tedesco LA. Variables discriminating individuals who seek orthodontic treatment. J Dent Res 1981;60:161-7.
26. Moananui RT, Kieser JA, Herbison P, Liversidge HM. Advanced dental maturation in New Zealand Maori and Pacific Island children. Am J Hum Biol 2008;20:43-50.
27. Johnson M, Harkness M. Prevalence of malocclusion and orthodontic treatment need in 10-year-old New Zealand children. Aust Orth J 2000;16:1-8.
28. Chi J, Johnson M, Harkness M. Age changes in orthodontic treatment need: a longitudinal study of 10- and 13-year-old children, using the Dental Aesthetic Index. Aust Orth J 2000;16:150-6.
29. Thomson WM, Mackay TD. Child dental carries patterns described using a combination of area-based and household-based socio-economic status measures. Community Dent Health 2004;21:285-90.
30. Thomson WM, Poulton R, Milne BJ, Caspi A, Broughton JR, Ayers KM. Socioeconomic inequalities in oral health in childhood and adulthood in a birth cohort. Community Dent Oral Epidemiol 2004;32:345-53.
31. Germa A, Kaminski M, Nabet C. Impact of social and economic characteristics on orthodontic treatment among children and teenagers in France. Community Dent Oral Epidemiol 2010;38:171-9.
32. Burden DJ. The influence of social class, gender, and peers on the uptake of orthodontic treatment. Eur J Orthod 1995;17:199-203.
33. Breisten B, Burden DJ. Equity and orthodontic treatment: a study among adolescents in Northern Ireland. Am J Orthod Dentofacial Orthop 1998;113:408-13.
34. Scapini A, Feldens CA, Arzenghi TM, Kramer PF. Malocclusion impacts adolescents' oral health-related quality of life. Angle Orthod 2013;83:512-8.
35. Foster Page LA, Thomson WM, Ukra A, Baker SR. Clinical status in adolescents: is its impact on oral health-related quality of life influenced by psychological characteristics? Eur J Oral Sci 2013;121:182-7.