The role of psychosocial factors in predicting orthodontic treatment outcome at the end of 1 year of active treatment

E. Joury*,***, W. Marcenes* and A. Johal*

*Centre for Clinical and Diagnostic Oral Sciences and Department of Oral Growth and Development, Queen Mary’s School of Medicine and Dentistry, University of London, UK and **Department of Oral Medicine, Faculty of Dentistry, Damascus University, Syria

SUMMARY The role of psychosocial factors in predicting orthodontic treatment outcome has not been investigated before. Thus, the current study aimed to test whether psychosocial factors, namely ‘daily hassles’, resiliency, and family environment, can predict orthodontic treatment outcome at the end of 1 year of active treatment. A hospital-based, prospective, longitudinal design was adopted including 145 consecutively selected 12- to 16-year-old male and female adolescents. Baseline psychosocial data were collected by a validated child self-completed questionnaire before the placement of fixed appliances. Thereafter, adolescents were followed up on a monthly basis to collect information relating to their daily hassles and treatment adherence. After 1 year of treatment, orthodontic treatment outcome was measured by the amount of improvement in occlusion achieved. Logistic regression analysis was used. The response rate was 98.6 per cent and the dropout was 5.6 per cent. Maternal support was an important predictor of improvement in occlusion. Adolescents with high levels of maternal support were more likely to achieve a high improvement in occlusion than those with low levels of maternal support (odds ratio = 3.95 per cent confidence interval = 1.53–6.27, \( P = 0.002 \)). Paternal support, maternal and paternal control, daily hassles, and resiliency were not significantly associated with improvement in occlusion (\( P > 0.05 \)). The regression model confirmed the significance of maternal support as a predictor of orthodontic treatment outcome at the end of 1 year of active treatment.

Introduction

The major interest in predicting orthodontic treatment outcome arises from the wide variation in improvement in occlusion achieved. The latter varied between 52 (Kerr et al., 1993) and 77 per cent (Birkeland et al., 1997), indicating a high level of orthodontic treatment failure. This failure that involves a huge amount of wasted resources in terms of finance, skills, and time (Rubin, 1984) has urged researchers to investigate factors that can predict orthodontic treatment outcome. Investigated factors have been confined to biological, behavioural, and health care predictors such as malocclusion severity (Fox et al., 1997), adherence to treatment (Taylor et al., 1996), type of appliance (O’Brien et al., 1993; Teh et al., 2000), and clinician qualification (Richmond et al., 1993).

A new approach in predicting orthodontic treatment outcome has emerged using socioeconomic position (Joury et al., 2011). It highlighted socioeconomic inequality in adolescence response to orthodontic treatment at the end of 1 year of active treatment. Adolescents from a low social class were less likely to achieve a high improvement in occlusion compared with their counterparts from a high social class. This finding was consistent with the socioeconomic inequality found in the medical literature in adolescent response to different treatments. Besides socioeconomic position, psychosocial factors might also play an important role in predicating adolescent health, development, and treatments outcomes including those of orthodontics. These factors according to the ‘stress, appraisal and coping’ theory (Lazarus and Folkman, 1984) include two broad domains, namely, psychological stress and coping resources.

‘Psychological stress’ is seen as the result of the relationship between an individual and their environment, which is appraised by them as taxing or exceeding their resources and endangering their well-being (Lazarus and Folkman, 1984). This psychological stress, in the form of negative ‘daily hassles’ or ‘life events’, might negatively affect adolescent health and treatments outcomes. For example, adolescents with high levels of daily hassles were less likely to have a successful response to diabetes treatment than those with low levels of daily hassles (Hanson and Pichert, 1986). However, these results were not consistent (Delamater et al., 1987). The validity of the daily hassles scales used in these two studies might explain these inconsistent findings. In the former study, although the validity and reliability of the daily hassles scale that the authors developed were reported, they neither provide a full description of the scale development process nor have published this scale separately. In the latter study,
Delamater et al. (1987) used the hassles scale (Kanner et al., 1981) that has been developed and validated for adults. Despite the authors’ efforts to address this issue by excluding items with low face validity for adolescents, the invalidity of this hassles scale for an adolescent population is acknowledged by its developers (Kanner et al., 1991). The findings regarding the relationship between life events and adolescent response to treatments are no more conclusive than those on daily hassles (Chase and Jackson, 1981; Brand et al., 1986; Hanson et al., 1987; Kager and Holden, 1992; Farrell et al., 2004). Similar to daily hassles, the most likely reason for this inconsistency might be the life events scales used in these studies.

‘Coping resources’ such as ‘psychosocial resources’, might positively affect adolescent health and treatments outcomes. They address the stressful situations and include internal (psychological) and external (social) resources.

Among the proliferation of internal resources during adolescence, resiliency was one of the factors that has received wide attention. Resiliency is a broader concept of internal resources reflecting general resourcefulness, sturdiness, and flexibility of functioning in response to varying environmental circumstances (Block and Block, 1980; Luthar et al., 2000). Resilient adolescents have positive belief that they are able to deal with any stressful situation. They also have problem-solving skills, such as the ability to search for information and analyse situations, identify problems, generate solutions, and, finally, select and implement a solution. Furthermore, they have social skills that enable them to draw on social support and communicate successfully with others. These assets make resilient adolescent successful candidates to achieve desired treatment outcomes. Although this has not been tested previously, the available evidence suggests that resiliency might be a potential predictor of adolescent treatment outcomes. For example, a number of studies have highlighted the role of resiliency in predicting wide aspects of adolescent health and development such as drug usage, depression, and problem behaviour (Block et al., 1988; Block and Gjerde, 1990; Huey and Weisz, 1997; Shonk and Cicchetti, 2001; Chuang et al., 2006). Nonetheless, the cross-sectional nature of some of these studies and the absence of longitudinal data in other prospective studies have weakened the possibility of inferring a causal relationship. In addition, having the same rater (teacher or mothers) scoring both the child’s resiliency and behaviour problems might have inflated the observed correlation. This is because no significant correlations were found between resiliency and the child’s problem behaviour when each was reported by a different rater (Huey and Weisz, 1997).

External (social) resources imply that there are people from whom one receives support and guidance. One of the most relevant social resources in adolescence is the family environment. The most important constructs of family environment are parental support and control (Rohner and Rohner, 1981). Parental support might take different forms: instrumental, informational, and emotional. Of these, emotional support is most strongly and consistently associated with positive health outcomes (Israel and Rounds, 1987). Emotional support is an expression of empathy, love, trust, and care (Israel, 1982). It reflects the degree of help parents could provide to their adolescents as well as the extent to which adolescents are encouraged to express and confide their feelings directly and discuss their personal problems. Furthermore, Israel and Rounds (1987) proposed that individuals who provide emotional support are more likely to be providers of instrumental and informational support. With respect to parental control, moderate levels of parental control provide important guidance to adolescent behaviour by setting limits and structure and providing positive teaching (Baumrind, 1991).

On the other hand, high and low levels of parental control are considered negative. This is because while high levels of parental control include negative techniques to control adolescent behaviour, such as verbal or physical punishment, low levels of parental control deprive the adolescent of important guidance on their behaviour. Available evidence suggests strongly that parental support might have an important causal effect on adolescent response to treatments. Findings were consistent in both cross-sectional and prospective longitudinal studies and across response to different treatments. Adolescents with high levels of parental support were more likely to have a successful response to diabetes treatment than their counterparts with low levels of parental support (Anderson et al., 1981; Miller-Johnson et al., 1994; Jacobson et al., 1994). These results were duplicated in relation to adolescent haemodialysis treatment outcome (Christensen et al., 1994). The estimated 5-year mortality rates among adolescents with low levels of parental support were nearly three times higher than estimated mortality among adolescents with high levels of parental support. Despite these consistent findings, some contradictory results have emerged (Gowers et al., 1995). Nonetheless, the non-standardized method of assessing response to diabetes treatment in this study might have compromised the validity of its results. Parental control did not show such a significant relationship in the aforementioned studies. The authors concluded that the affective tone in the family relationship rather than rules and control had the most important influence on adolescent treatment outcome. Yet, parental control is still considered to be an important construct of family dynamics to be addressed (Baumrind, 1991). Little is known about the relationship between family demographic variables such as family structure and size and birth order and adolescent treatment outcome. These demographic variables might affect parental resources in terms of time, energy, attention, and benevolence and thereby are likely to affect adolescent treatment outcome. However, family structure showed contradictory results in its association with adolescent...
response to treatments (Anderson et al., 1981; Hanson et al., 1988; Overstreet et al., 1995; Reyno and McGrath, 2006). It is very likely that the absence of reconstituted families (step-parent families) in some of these studies has obscured important differences among different types of family structure. Reconstituted families were identified as a potential risk for child health and well-being (Creighton, 1985). Step-parents are less likely than biological parents to ‘invest’ in their step-children, since they expect them to yield little returns (Daly and Wilson, 1988). Single-parent families could still be considered a risk for adolescent treatment outcome due to the excessive emotional and financial constraints that may limit the resources of the parent who took responsibility for child rearing (Montgomery et al., 1996). With respect to family size, available evidence suggests that adolescents from families with more than three children are less likely to achieve successful treatment outcome compared with those from families with three or fewer children (Reyno and McGrath, 2006).

The above-mentioned psychosocial factors have not been used before to predict orthodontic treatment preliminary or final outcome. Therefore, the current study aimed to test whether daily hassles, resiliency, and family environment (parental support and control) can predict orthodontic treatment outcome at the end of 1 year of active treatment. It has been hypothesized that:

1. Adolescents with high levels of daily hassles are less likely to achieve a high improvement in occlusion than their counterparts with low levels of daily hassles.
2. Adolescents with high levels of resiliency are more likely to achieve a high improvement in occlusion than their counterparts with low levels of resiliency.
3. Adolescents with high levels of parental support are more likely to achieve a high improvement in occlusion than their counterparts with low levels of parental support.
4. Adolescents with moderate levels of parental control are more likely to achieve a high improvement in occlusion than their counterparts with high or low levels of parental control.

Patients commencing orthodontic treatment between November 2004 and March 2006 planned to receive fixed appliance therapy by Specialist Registrars were consecutively selected from the Orthodontic Clinic at Barts and The London Hospital. The inclusion criteria were male and female patients, aged 12–16 years old, who demonstrated one or more of the following anterior malocclusion traits, all of which were judged suitable for correction with fixed appliances alone: upper anterior crowding or spacing, increased overjet or reverse overjet, and/or anterior crossbite. The following British Standards Institute (1983) definitions were applied to these malocclusal traits. Upper anterior crowding and spacing were defined as having a disproportion of more than 2 mm between the size of the upper anterior teeth (incisors and canines) and the space available in the arch. The size of the upper anterior teeth was measured as the sum of the mesio-distal crown diameters. The space available in the arch for upper anterior teeth was measured from the mesial surface of the upper right first premolar to the mesial surface of the upper left first premolar. Increased overjet was defined as a horizontal distance of more than 3 mm between the tips of the upper incisors and the labial surface of the lower incisors. Reversed overjet was defined as a horizontal distance of 0 mm or less between the tips of the upper incisors and the labial surface of the lower incisors. Anterior crossbite was defined as one to three upper incisor(s) and/or canine(s) in an edge-to-edge or lingual occlusion. The exclusion criteria were as follows: patients who had previously received orthodontic treatment, required removable or functional appliances or adjunctive orthodontic treatment, and those with learning difficulties or with systemic and/or developmental disorders.

Data were collected by three instruments: the child questionnaire, the adherence to orthodontic treatment form, and a clinical form.

The child questionnaire included demographic characteristics and psychosocial scales that were completed by the child. Demographic data covered age, gender, ethnicity, family structure, family size, and birth order according to the UK Census 2001. Psychosocial scales included daily hassles, resiliency, and parent/guardian(s) support and control scales. These scales were selected based on the steps recommended by Bowling (2002). First, the literature was reviewed following a systematic review search strategy to identify scales that have been developed, tested, and validated on adolescents of the same age group of the current study. Second, the psychometric properties of the identified scales were assessed, namely, validity (convergent validity) and reliability (internal consistency >0.70 and test–retest reliability >0.70). Third, the cultural acceptability of the scales with respect to the adolescent population to be studied was assessed. Finally, the scale length and the scoring system that should be easily amendable to statistical analysis were taken into account.

Subjects and methods

Ethical approval was obtained from the Local Research Ethics Committee (REC: P3/04/Q0605/59). Written consent was obtained from the child and a parent/guardian.

A hospital-based, prospective, longitudinal design was adopted. A minimum sample size of 126 patients distributed into 2 groups was proposed to demonstrate a 2.5-fold or greater odds ratio in explanatory variables. The level of significance was set at 5 per cent. Assuming a maximum 15 per cent dropout, a total number of 145 patients were required.
Based on these steps, the current study selected the children hassles scale (CHS; Kanner et al., 1991) to measure daily hassles, the resiliency attitudes and skills profile (RASP; Hurttes and Allen, 2001) to measure resiliency, and the family environment scale (FES; Moos and Moos, 1981) to measures parent/guardian support and control. The CHS consists of a list of 25 hassles relating to areas of family, school, friends, and play in the child’s life that are considered to be sources of daily hassles. Youngsters were asked to check which hassles occurred during the preceding month and to rate whether they ‘didn’t feel bad’, ‘felt sort of bad’, or ‘felt very bad’ as a result. To prevent respondents from rating items that had not occurred in the last month a ‘didn’t happen’ option was also included. The RASP includes 34 items that reflect general resourcefulness, such as, problem-solving and social skills, humour, and insight. Each item has a four-point scale ranging from ‘strongly agree’ to ‘strongly disagree’. With respect to FES, parent/guardian support items were extracted from the family cohesion and expressiveness subscales. These four items assess the degree of help and support parent(s)/guardian(s) could provide to their adolescent as well as the extent to which adolescents are encouraged to express and confide their feelings directly and discuss their personal problems. Parent/guardian control items were extracted from the system maintenance dimension. These two items indicate the extent of parent(s)/guardian(s) rule, strictness, and punishment harshness. Due to the reported low reliability (Bloom, 1985; Bloom and Naar, 1994), a four-point scale ranging from ‘a great deal’ to ‘not at all’ was used instead of the original true–false format. Furthermore, the items were changed into didactic questions that related to the mother or the female guardian and to the father or the male guardian. If the child came from a single parent–headed family, the family environment information of the other parent was considered missing.

The adherence to orthodontic treatment form was designed to collect information on patients’ attendance, punctuality, and appliance breakages (Fox et al., 1997). This form was completed by the child’s clinician, in relation to the treatment visit.

The clinical form was developed to collect information on the index of treatment complexity, outcome, and need (ICON; Daniels and Richmond, 2000), the size of the overjet, the type of included anterior malocclusion traits, the type of fixed appliances the patient would receive, and the name of the clinician who was to carry out the orthodontic treatment. The latter information was collected to construct a variable that can reflect differences in clinicians’ overall skills. A trained and calibrated examiner (EJ) collected these clinical data by conducting a standardized clinical examination (to score the ICON and measure the overjet) and extracting relevant information from the patient’s hospital notes (for the type of fixed appliance and the clinician’s name).

Data collection process included baseline, monthly follow-up, and 1-year follow-up data collection. This period of fixed appliance treatment is considered sufficient to achieve an improvement in different malocclusion traits (Profitt et al., 2007) and may serve as an indicator of the amount of final improvement that could be anticipated. This is evident since orthodontic treatment takes place in progressive stages where the successful completion of one stage is a predictor and mandatory for the initiation and success of subsequent stages (Profitt et al., 2007).

Baseline data collection was carried out before placement of the fixed appliances and included completing the child questionnaire and the clinical form. Thereafter, the patients were followed up on a monthly basis to collect information related to their daily hassles and adherence to orthodontic treatment. In the instance of a failed or cancelled appointment, the patient was posted the daily hassles questionnaire, with a self-addressed stamped envelope, to ensure follow-up data collection, while adherence was scored only with respect to patient’s attendance.

After 1 year of active orthodontic treatment, the data collection carried out at baseline was repeated in addition to collecting adherence information. If the patient did not attend this appointment, follow-up data collection was performed at the patient’s next attended appointment.

The improvement in occlusion was calculated using the ICON’s four components: crossbite, upper arch crowding/spacing, anterior vertical relationship, and buccal segment antero-posterior relationship. The validity of these components in assessing improvement in occlusion during orthodontic treatment has been discussed (Joury et al., 2011). The improvement formula suggested by Daniels and Richmond (2000) was adopted and expressed as follows: (pre-treatment ICON score for four components) – 4(1-year treatment ICON score for four components). Orthodontic treatment outcome at the end of 1 year of active treatment was considered successful if the patient achieved a high improvement in occlusion (a score equal to or higher than the median) and unsuccessful if the patient achieved a low or no improvement in occlusion (a score lower than the median). Malocclusion severity/treatment complexity was calculated as proposed by Daniels and Richmond (2000) by summing the ICON’s pre-treatment five weighted scores. The cut-off points suggested by the authors were used to reflect mild, moderate, difficult, and very difficult cases. As daily hassles and adherence information were collected on a monthly basis, summary scores were calculated. For daily hassles, a summary score using the mean of monthly scorings (Altman, 1991) was used. With respect to adherence, calculating summary scores and constructing a composite adherence indicator have been described (Journey et al., 2011).
Statistical analysis

Statistical analysis was carried out using SPSS version 17.0 (SPSS Inc., Chicago, IL, USA) and included the following steps. First, the validity and reliability of clinical and non-clinical data were assessed. Second, the effect of explanatory variables on improvement in occlusion was assessed using simple logistic regression analysis. Third, explanatory variables that were significant at the 0.2 level (Altman, 1991) were selected to enter a regression model. This step aimed to ensure that the observed relationship between psychosocial factors and improvement in occlusion would persist in the presence of demographic and known predictors of orthodontic treatment outcome. This, in turn, would confirm the significance of psychosocial factors as predictors of orthodontic treatment outcome at the end of 1 year of active treatment.

Results

A response rate of 98.6 per cent was obtained, with a dropout of 5.6 per cent. The total number of subjects who were followed up for 1 year was 135, maintaining the power of the study. There were no missing data due to failure in collecting relevant information. Males comprised 33.3 per cent of the sample. The ICON scores of improvement in occlusion ranged from −155 to 19. The mean was −37.4 ± 30.8 (SD). Cohen’s unweighted kappa coefficient for the presence of a high versus a low/no improvement in occlusion was 1, indicating perfect agreement. Principle components analysis revealed two components in paternal and maternal support and control items. Parental support items loaded highly on component 1 while parental control items loaded on component 2. Paternal support and control items had a Cronbach alpha coefficients (α) of 0.91 and 0.81, and intraclass correlation coefficients (ICC) of 0.95 and 0.91, respectively. Similarly, maternal support and control items had good reliability (α = 0.84, 0.58; ICC = 0.83, 0.84, respectively). The α coefficient of the CHS was 0.88 and the ICC was 0.92. Regarding the RASP scale, one component was extracted from the 34 items that had good reliability (α = 0.88; ICC = 0.92).

With respect to orthodontic treatment, adolescents were treated by 12 Specialist Registrars who were all at the same level of orthodontic training. It was expected that these 12 clinicians might reflect different levels of skills. The frequency distribution of clinicians suggested combining these clinicians into a smaller number of groups. As there were no specific data collected regarding clinician’s clinical and communicational skills, clinicians with similar levels of skills in terms of the percentage of success achieved were grouped together. The latter was an expression of the clinician’s percentage of patients achieving a high improvement in occlusion. The validity of including such a variable, combined based on the percentage of improvement in occlusion achieved, in a model that predicts this improvement should be interpreted within the context of the current study. This study aimed to control for rather than to test the effect of clinician skills on improvement in occlusion. Thus, including such a variable satisfies this aim as it corrects for differences in improvement in occlusion observed due to differences among clinicians. Needless to say, this variable cannot be used in any discussion of the effect of clinician skills on improvement in occlusion. Based on the overall average of success (50.4 per cent), clinicians were grouped into those with poor (39 per cent and below), moderate (40–50.3 per cent), high (50.4–60 per cent), and very high skills (61 per cent and above).

Maternal support showed an important impact on adolescent orthodontic treatment outcome at the end of 1 year of active treatment. Adolescents with high levels of maternal support were more likely to achieve a high improvement in occlusion compared with their counterparts with low levels of maternal support [odds ratio (OR) = 3.95 per cent confidence interval (CI) = 1.53–6.27, P = 0.002; Table 1]. With respect to parental support, adolescents with high levels of parental support were more likely to achieve a high improvement in occlusion compared with their counterpart with low levels of parental support. The odds ratio was 1.8 (95 per cent CI = 0.89–3.49) and the difference between the former (57.1 per cent) and the latter (43.1 per cent) was significant at the 0.2 level (P = 0.104; Table 1).

The difference in improvement in occlusion between adolescent with low levels of daily hassles (55.6 per cent) and high levels of daily hassles (40 per cent) was statistically significant at the 0.2 level. Adolescents with high levels of daily hassles were less likely to achieve a high improvement in occlusion compared with their counterparts with low levels of daily hassles (OR = 0.5, 95 per cent CI = 0.26–1.10, P = 0.090; Table 1).

With respect to paternal support, paternal and maternal control, and resiliency, the differences between groups were small and not statistically significant (Table 1).

From the demographic, behavioural, and clinical variables included in this study, ethnicity, adherence, malocclusion severity/treatment complexity, type of anterior malocclusion, and clinician’s skills were significant at the 0.2 level (Table 2).

A regression model was performed to confirm the significance of maternal support, parental support, and daily hassles. This model, adjusted for ethnicity, adherence, malocclusion severity/treatment complexity, type of anterior malocclusion, and clinician’s skills, confirmed the significance of maternal support as a predictor of improvement in occlusion (Table 2). The significance of parental support and daily hassles was not confirmed (Table 3).

Discussion

Maternal support played an important role in predicting orthodontic treatment outcome after 1 year of active
In contrast, paternal support and parental control were not significant predictors. These observations are consistent with other studies that have shown affective tone in the family relationship rather than rules and control has the most important influence on adolescent treatment outcome (Jacobson et al., 1994). It is possible that adolescents during the course of treatment might need love and support rather than rules and discipline to boost their capacity, biologically and behaviourally, to achieve a successful outcome. In addition, the theoretical basis of these two family environment constructs could also explain these findings. Parental support, as part of social support, has a well-established and tested theory elucidating how this construct might affect health outcomes (Israel, 1982). In contrast, parental control is not supported by a theoretical basis. Some authors suggest that the effect of parental control might be conditioned. For example, Luthar et al. (2000) proposed that the protective role of parental control in child’s successful adaptation might be conditional on levels of child adversity (socioeconomic position). While parental control might be protective for children of low social class, it might not be protective for children of middle or high social class. The distinct role of maternal support compared with that of the father in predicting adolescent treatment outcome was a new and significant finding. Previous studies in the medical literature have asked adolescents to rate their perceived parental support without specifying the source of this support (Jacobson et al., 1994). Thus, it is very likely that the observed significant relationship was due to adolescent perceived support from the mother. However, such a possibility could not be elucidated without using such didactic questions as employed in the current study. This distinct maternal role was expected based on the Darwinian understanding of family where mothers are considered the main support providers (Daly and Wilson, 1988).

The relationship between levels of daily hassles and orthodontic treatment outcome at the end of 1 year of active treatment was not statistically significant at the 0.05 level. Previous studies that have found a significant relationship between daily hassles and adolescent response to treatment have been criticized based on measurement issues (hassles scales validity and possible confounding between some hassles items and treatment outcome). It could be argued
that the current study did not use the ‘life events’ approach to measure stress that might have shown a significant relationship with improvement in occlusion at the end of 1 year of active treatment. Although adopting such an approach was planned in the current study, issues raised by two mothers in the pilot study regarding the sensitivity of some items in the life events scale led to the exclusion of this scale from the study questionnaire. However, despite

<table>
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<th>Frequency of high initial improvement in occlusion</th>
<th>OR (95% CI)</th>
<th>P Value</th>
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<td>13</td>
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<td>Youngest child</td>
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<td><strong>Adherence indicator</strong></td>
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<tr>
<td>High</td>
<td>84</td>
<td>50 (73.5%)</td>
<td>1</td>
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<tr>
<td>Low</td>
<td>51</td>
<td>18 (35.3%)</td>
<td>0.4 (0.18–0.76)</td>
<td>0.007</td>
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<tr>
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<td><strong>Malocclusion severity/treatment complexity</strong></td>
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</tr>
<tr>
<td>Very difficult</td>
<td>70</td>
<td>37 (52.9%)</td>
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<tr>
<td>Difficult</td>
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<td>17 (39.5%)</td>
<td>0.6 (0.27–1.26)</td>
<td>0.170</td>
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<td>14</td>
<td>8 (57.1%)</td>
<td>1.2 (0.37–3.79)</td>
<td>0.769</td>
</tr>
<tr>
<td>Mild</td>
<td>8</td>
<td>6 (75%)</td>
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<tr>
<td>Two or three types</td>
<td>102</td>
<td>56 (54.9%)</td>
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<tr>
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<td>14</td>
<td>4 (28.6%)</td>
<td>0.3 (0.10–1.12)</td>
<td>0.075</td>
</tr>
<tr>
<td>Anterior crossbite</td>
<td>13</td>
<td>7 (53.8%)</td>
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<td>1 (16.7%)</td>
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<td>One arch</td>
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<tr>
<td>Two arch</td>
<td>123</td>
<td>62 (50.4%)</td>
<td>1 (0.31–3.33)</td>
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<td><strong>Clinician’s skills</strong></td>
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<tr>
<td>Poor</td>
<td>37</td>
<td>12 (32.4%)</td>
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<tr>
<td>Moderate</td>
<td>39</td>
<td>17 (43.6%)</td>
<td>1.6 (0.63–4.10)</td>
<td>0.318</td>
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<tr>
<td>High</td>
<td>31</td>
<td>18 (58.1%)</td>
<td>2.9 (1.07–7.77)</td>
<td>0.036</td>
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<td>28</td>
<td>21 (75%)</td>
<td>6.3 (2.09–18.7)</td>
<td>0.001</td>
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<tr>
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</table>
Table 3  Frequency distribution, unadjusted odds ratio (OR), adjusted OR, and 95% confidence interval (95% CI) to predict odds of high improvement in occlusion (n = 135).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Base</th>
<th>Frequency of high initial improvement in occlusion</th>
<th>Unadjusted OR (95% CI)</th>
<th>P Value</th>
<th>Adjusted OR (95% CI)</th>
<th>P Value</th>
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<tbody>
<tr>
<td>Maternal support</td>
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<tr>
<td>Low</td>
<td>62</td>
<td>22 (35.5%)</td>
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<tr>
<td>High</td>
<td>73</td>
<td>46 (63%)</td>
<td>3 (1.53–6.27)</td>
<td>0.002</td>
<td>5.1 (1.55–16.99)</td>
<td>0.007</td>
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<td>Parental support</td>
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<tr>
<td>Low</td>
<td>65</td>
<td>35 (53.7%)</td>
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<tr>
<td>High</td>
<td>59</td>
<td>27 (45.8%)</td>
<td>0.7 (0.36–1.47)</td>
<td>0.369</td>
<td>0.5 (0.17–1.75)</td>
<td>0.305</td>
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<td>Daily hassles</td>
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<tr>
<td>Low</td>
<td>90</td>
<td>50 (55.6%)</td>
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<td>High</td>
<td>45</td>
<td>18 (40%)</td>
<td>0.5 (0.26–1.10)</td>
<td>0.090</td>
<td>0.9 (0.39–2.52)</td>
<td>0.982</td>
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<tr>
<td>White</td>
<td>45</td>
<td>27 (60%)</td>
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<tr>
<td>Mixed</td>
<td>8</td>
<td>7 (87.5%)</td>
<td>4.7 (0.53–41.2)</td>
<td>0.166</td>
<td>1.4 (0.24–7.96)</td>
<td>0.726</td>
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<tr>
<td>Asian</td>
<td>56</td>
<td>25 (44.6%)</td>
<td>0.5 (0.24–1.19)</td>
<td>0.126</td>
<td>0.4 (0.14–1.20)</td>
<td>0.106</td>
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<tr>
<td>Black</td>
<td>26</td>
<td>9 (34.6%)</td>
<td>0.4 (0.13–0.96)</td>
<td>0.042</td>
<td>0.5 (0.13–1.99)</td>
<td>0.330</td>
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<tr>
<td>Adherence indicator</td>
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<tr>
<td>High</td>
<td>84</td>
<td>50 (73.5%)</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>51</td>
<td>18 (35.3%)</td>
<td>0.4 (0.18–0.76)</td>
<td>0.007</td>
<td>0.3 (0.12–0.83)</td>
<td>0.019</td>
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<td>Malocclusion severity/treatment complexity</td>
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<tr>
<td>Very difficult</td>
<td>70</td>
<td>37 (52.9%)</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Difficult</td>
<td>43</td>
<td>17 (39.5%)</td>
<td>0.6 (0.27–1.26)</td>
<td>0.170</td>
<td>0.5 (0.18–1.49)</td>
<td>0.221</td>
</tr>
<tr>
<td>Moderate</td>
<td>14</td>
<td>8 (57.1%)</td>
<td>1.2 (0.37–3.79)</td>
<td>0.769</td>
<td>2.1 (0.42–10.54)</td>
<td>0.370</td>
</tr>
<tr>
<td>Mild</td>
<td>8</td>
<td>6 (75%)</td>
<td>2.7 (0.51–14.2)</td>
<td>0.247</td>
<td>8.4 (0.57–125.45)</td>
<td>0.122</td>
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<tr>
<td>Type of anterior malocclusion</td>
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<tr>
<td>Two or three types</td>
<td>102</td>
<td>56 (54.9%)</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Increased overjet</td>
<td>14</td>
<td>4 (28.6%)</td>
<td>0.3 (0.10–1.12)</td>
<td>0.075</td>
<td>0.9 (0.17–4.74)</td>
<td>0.889</td>
</tr>
<tr>
<td>Anterior crossbite</td>
<td>13</td>
<td>7 (53.8%)</td>
<td>1 (0.30–3.05)</td>
<td>0.943</td>
<td>0.4 (0.05–2.67)</td>
<td>0.325</td>
</tr>
<tr>
<td>Anterior crowding</td>
<td>6</td>
<td>1 (16.7%)</td>
<td>0.2 (0.02–1.46)</td>
<td>0.105</td>
<td>0.4 (0.03–6.26)</td>
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<tr>
<td>Moderate</td>
<td>39</td>
<td>17 (43.6%)</td>
<td>1.6 (0.63–4.10)</td>
<td>0.318</td>
<td>2.4 (0.73–7.90)</td>
<td>0.149</td>
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<td>High</td>
<td>31</td>
<td>18 (58.1%)</td>
<td>2.9 (1.07–7.77)</td>
<td>0.036</td>
<td>4.3 (1.23–15.16)</td>
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<tr>
<td>Very high</td>
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<td>6.3 (2.09–18.7)</td>
<td>0.001</td>
<td>9.7 (2.42–38.52)</td>
<td>0.001</td>
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</tbody>
</table>

This exclusion, it is unlikely that the life events approach would have shown a different relationship with improvement in occlusion than that of the daily hassles approach. For example, Rowlison and Felner (1988) reported that daily hassles showed more significant associations with a number of adolescent health and behavioural outcomes than life events. With respect to other adolescent adaptational and health outcomes, daily hassles showed similar associations to those of life events. Thus, in summary, it seems that stress is unlikely to play an important role in predicting adolescent improvement in occlusion at the end of 1 year of active treatment. Indeed, evidence is beginning to emerge for a non-significant relationship between stress and different health outcomes. For example, Sanders et al. (2007) found that perceived stress was not significantly related to tooth loss, whereas coping resources showed an important impact. This is consistent with the argument of Antonovsky (1987) that coping resources rather than stress are what differentiate individuals and have an impact on their health.

Resiliency was not a significant predictor of orthodontic treatment outcome at the end of 1 year of active treatment. There could be three reasons for this lack of significance. The first could be due to the fact that broad psychological resources, such as resiliency did not show consistent findings in its relationship with health outcomes. This is because they aggregate various coping resources such as problem solving, optimism, and social skills and hence, there is no specific psychological mechanism by which they are likely to operate and relate to health or treatment outcomes. However, studies that have used specific psychological resources, such as problem solving, optimism, or locus of control, have also failed to show consistent findings (Taylor and Seeman, 1999). It is also likely that resiliency, despite being a predictor of different aspects of adolescent health, might not be related to all outcomes. For example, resiliency played a less important role in academic adjustment (Shonk and Cicchetti, 2001) than that in adolescent drug usage, depression, and problem behaviour. Thus, it is also possible that resiliency might be less relevant to adolescent orthodontic treatment outcome. The second reason for the lack of significance could be due to a measurement issue. Despite the presence of a number of adolescent resiliency self-completed questionnaires,
previous studies have not used any of these questionnaires to test the relationship between resiliency and different adolescent health outcomes. They relied on a relatively complicated method to measure resiliency that was not feasible in the current study (Block and Block, 1980). The third reason might be that the effect of resiliency may have shown a protective impact on orthodontic treatment outcome only at high levels of stress. This possibility was checked in the current study and no significant interaction terms were found.

The main methodological strengths of the current study include, first, adopting a prospective and longitudinal design that elucidated a temporal relationship between psychosocial factors and improvement in occlusion. Despite this strength, caution must be exercised in drawing a causal relationship. This is due to the observational nature of the current study. Adopting a randomized clinical trial design would have had addressed this issue. However, conducting ethically acceptable randomized clinical trials to test the effect of psychosocial factors such as the effect of increasing maternal support levels on treatment outcome requires the presence of preliminary evidence from observational studies, such as the current study (Rothman and Greenland, 1998). Furthermore, the adopted longitudinal design, using repeated measures, served an important purpose that was related to further assuring the temporal relationship between psychosocial factors and improvement in occlusion. The stability of collected psychosocial data indicated that the observed relationships were not subject to reverse interpretation. The ICCs between resiliency, maternal and parental support, and control measured at baseline and at 1-year follow-up were 0.67, 1.00, 1.00, 1.00, 1.00, respectively. Second, this study represents a departure in oral epidemiology from identifying solitary risk or protective factors into exploring the collective effect of a number of risk and protective factors on treatment outcome. Third, the low dropout rate (5.6 per cent) experienced in the current study suggests that the loss of information was unlikely to bias the remaining data. This was further confirmed by conducting sensitivity analysis.

Despite the strengths of this study, a number of potential limitations exist. The first pertained to the assessment of improvement in occlusion during the first year of active orthodontic treatment. Although this improvement in occlusion may serve as an indicator of the amount of final improvement anticipated, yet more profound evidence can be drawn from assessing improvement in occlusion at the end of treatment. It could be argued that orthodontic treatment during the later stages might rely heavily on patient adherence, such as, appliance maintenance, use of inter-maxillary elastics, or anchorage reinforcement. In other words, predictors and findings after 1 year of active treatment cannot be extrapolated to the end of active treatment. Nonetheless, current evidence does not support this assumption. For example, Albino (2000) in his review reported that adherence during the early stages of orthodontic treatment was found as a predictor of long-term adherence. Therefore, it could be inferred that adolescents who could not achieve a considerable amount of improvement in occlusion in their first year of treatment, when adherence and motivation are likely to be at their highest levels, are unlikely to show greater improvement at the end of treatment. The second possible limitation might relate to differences in patient’s baseline characteristics in relation to malocclusion severity/treatment complexity, type of anterior malocclusion, and clinician’s skills. Although some of the factors that might affect the outcome without being the focus of the study were controlled in the current study design, such as the use of removable and functional appliance, others, however, such as the above-mentioned clinical factors, were not controlled in the study design. Thus, it was important to adjust statistically for their effect. Indeed, further analysis confirmed the significance of maternal support after controlling statistically for the effect of these factors. A third potential limitation might be the inability of generalizing the findings of the current study to other adolescent populations in different settings. As in any other hospital-based analytical study, the current study’s findings cannot be extrapolated to other adolescent populations with different demographic and clinical characteristics than that of the current study’s adolescent population.

In conclusion, the current study provides evidence of the importance of maternal support as a predictor of orthodontic treatment outcome at the end of 1 year of active treatment. Adolescents with high levels of maternal support are more likely to achieve a high improvement in occlusion compared with those with low levels of maternal support. This could be used as a means to identify adolescents who may be at risk of poor orthodontic treatment outcome, i.e. those with low levels of maternal support. These adolescents may need special interventions to enhance their chances of achieving a successful outcome. Daily hassles, resiliency, paternal support, and parent control were not significant predictors of orthodontic treatment outcome at the end of 1 year of active treatment.

**Funding**

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**References**


Hanson C L, Henggeler S W, Burghen G A 1987 Model of associations between psychosocial variables and health-outcome: measures of adolescents with IDDM. Diabetes Care 10: 752–758


Hanson S L, Pichert J W 1986 Perceived stress and diabetes control in adolescents. Health Psychology 5: 439–452


