A 10-year trend analysis of patients seeking orthodontic treatment at a dental hospital in Thailand

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Abstract

Background: The trends of patients seeking orthodontic treatment vary in many studies. However, no study has reported a long-term trend analysis of orthodontic patients in Thailand.

Objective: To date, there has been no information regarding the trend of age group patients seeking orthodontic treatment in Thailand. This study aimed to determine the changes in the proportion of various age-group patients seeking orthodontic treatment at the Dental Hospital at Prince of Songkla University in southern Thailand from 2008 to 2018.

Methods: This single-center retrospective study consisted of 5,775 patients who presented at the hospital for orthodontic diagnosis and treatment from 2008 to 2018. The analyzed data were the number, gender, and age groups of the patients. A time series analysis was used for any significant trends in the number of patients regarding gender and age group over the 10-year study period.

Results: The results were statistically significant in female patients (p = 0.000), children <12 years old (p = 0.009), and young adults aged 19-35 years (p = 0.000) in a quadratic time series analysis. An increasing trend was found in children <12 years old. On the other hand, female and young adult patients demonstrated a decreasing trend.

Conclusion: "Female" and "young adult" patients were the major groups of patients seeking orthodontic treatment. However, a time series model revealed decreasing trends in "female" and "young adult" patients, while "children <12 years old" demonstrated an increasing trend over the 10-year study period.

Keywords: Orthodontic patients, Time series analysis, Trend analysis

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INTRODUCTION

The current trends of orthodontic treatment have changed during the past few decades in different aspects.[1-4] A retrospective study of 14,510 samples from 2005 to 2015 at Seoul National University, Korea, found a seasonal variation in the number of patients and a decreasing trend in patient age.[1] Another study of 7,476 samples from 2008 to 2012 indicated a change that included a decreasing number of patients after 2010 and an increase in the average age of orthodontic patients.[3] Many studies also reported the proportion of adults seeking orthodontic treatment has been on the rise[2,5-7] including statistics from the United States that revealed adult cases increased from 15.4% in 1981 to 24% in 2014.[8]

Gender distribution among orthodontic patients is possibly affected by various factors including socio-economic development, social norms, or even a decreased rate in population growth.[1] An increasing trend was seen in the proportion of male patients.[1] But some studies found no statistically significant change in gender distribution.[2-4]

In Thailand, the demand for orthodontic treatment is increasing.[9] At the present, no study has reported on the trends of orthodontic patients conducted in a local context. Hence, this retrospective study aimed to determine the changes in gender and age of patients seeking orthodontic treatment at the Dental Hospital at Prince of Songkla University in southern Thailand from 2008 to 2018 using a time series analysis.

MATERIALS AND METHODS

This was a single-center retrospective cohort study comprised of 5,775 patients who presented to the Orthodontic Clinic from 2008 to 2018 at the Dental Hospital on the campus of Prince of Songkla University for orthodontic diagnosis and treatment. Patients who had incomplete data of age and gender were excluded. The institutional review board of Prince of Songkla University, Faculty of Dentistry for the Protection of Human Subjects reviewed and approved the research protocol (number EC6103-11-P-LR).

Statistical analysis

Descriptive analysis was used to summarize the demographic data, including gender and age. The patients were divided into five groups by age. Group 1 included children <12 years old. Group 2 included adolescents aged 13 to 18 years. Group 3 included young adults aged 19 to 35 years. Group 4 included adults aged 36 to 55 years, and Group 5 included elderly patients >55 years old. The numbers of patients regarding gender and age group were plotted against the month patients presented at the Dental Hospital from 2008 to 2018. The statistical program by Minitab (Minitab, LLC, State College, PA, USA) version 16 was applied to obtain the trend analysis plots. The *F*-test evaluated statistically significant changes in the trends between the variables with the level of significance set at $p < 0.05$.

RESULTS

Over the 10-year study period, the total number of patients seeking orthodontic treatment was 5,775. The average number of patients was 565.2 per year. Among those patients seeking treatment, 22.7% were male, and 77.3% were female. The most common age group of patients was Group 3 (53.1%) followed by Group 2 (30.9%), Group 1 (10.5%), Group 4 (5.4%), and Group 5 (0.1%) [Table 1].

The total number of time points used in this study was 134 months. The patterns of the plotted data revealed trend components in the linear and quadratic time trend models. Group 1 ($p = 0.004$) and Group 3 ($p = 0.029$) demonstrated statistical significance with the *F*-test in the linear time series analysis for the hypothesis test. The quadratic time series analysis

for the hypothesis test (*F*-test) showed *F*, Group 1, and Group 3 with statistical significance at $p = 0.000$, $p = 0.009$, and $p = 0.000$, respectively.

Considering whether a linear or quadratic time trend model is the most suitable for the trend analysis in this study, mean square deviation (MSD) and mean absolute deviation (MAD) were used to compare the fits of different time series models. These two parameters demonstrated the amount of error or deviation from the trend line or the models. Therefore, smaller MAD and MSD values indicated greater validity of the trend analysis. The quadratic trend analysis exhibited smaller MAD and MSD values among the *F*, Group 1, and 3 variables [Table 2]. Therefore, a quadratic time trend model was chosen for the analysis in this context. The female and Group 3 (young adult patients) demonstrated a decreasing trend, while Group 1 (children <12 years old) revealed an increasing trend [Figures 1-3].

DISCUSSION

This study aimed to determine the characteristics of orthodontic patients and to define the trends of patients seeking orthodontic treatment at the Dental Hospital in southern Thailand over a decade from

Table 1: Number of patients seeking orthodontic treatment at the Dental Hospital from 2008 to 2018.

Characteristics		n (%)	Total
Gender	Female (F)	4,466 (77.3)	5,775
	Male (M)	1,309 (22.7)	
Age group	Group 1	606 (10.5)	5,775
	Group 2	1,782 (30.9)	
	Group 3	3,067 (53.1)	
	Group 4	312 (5.4)	
	Group 5	8 (0.1)	

Table 2: Mean square deviation, mean absolute deviation and R2 prediction between the linear trend method and quadratic trend analysis.

Variables	MSD		MAD		R^2 prediction	
	Linear	Quadratic	Linear	Quadratic	Linear	Quadratic
*F**	229.96	197.71	11.49	10.43	0.00	11.45
Group 1*	14.18	14.05	2.81	2.81	3.05	2.20
Group 3*	101.08	75.04	8.08	6.61	0.73	25.46

**F*-test statistically significant at $p < 0.05$. MSD: mean square deviation; MAD: mean absolute deviation.

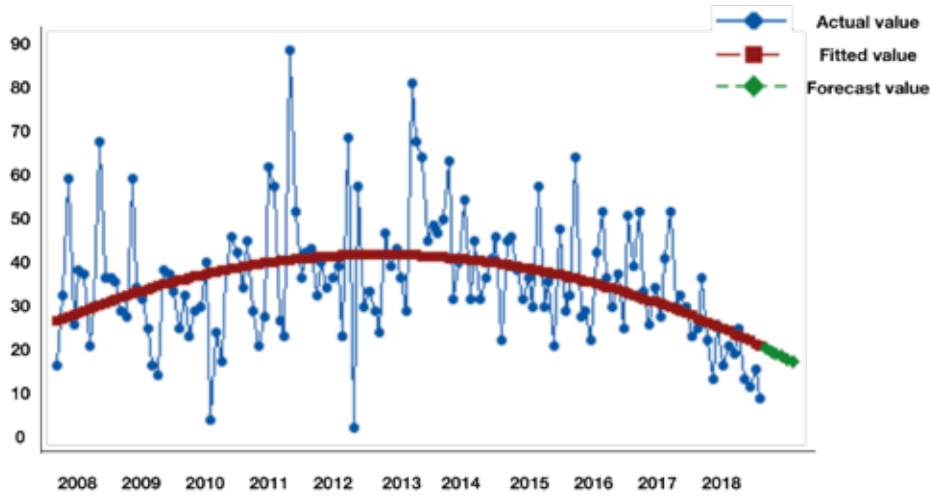

Figure 1: Trend analysis plot for female patients during 2008-2018.
*each actual value demonstrates "monthly" timepoint

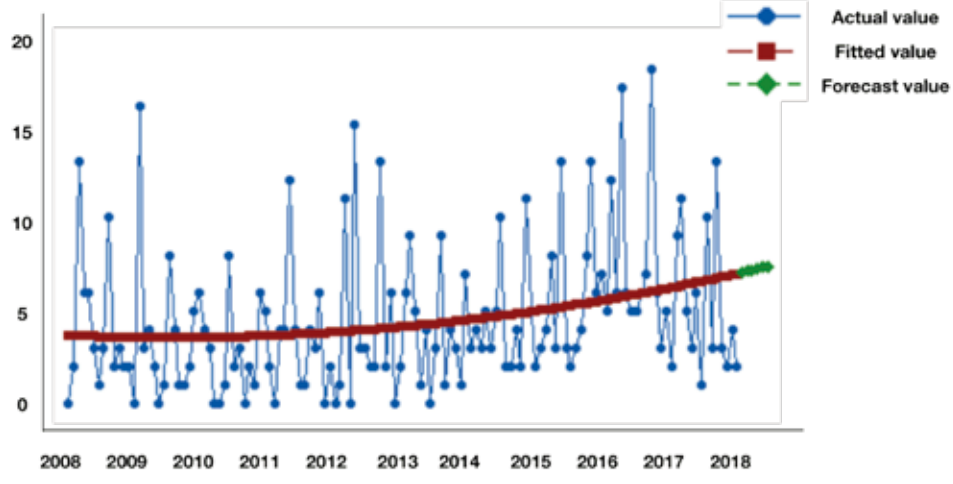

Figure 2: Trend analysis plot for children during 2008-2018.
*each actual value demonstrates "monthly" timepoint

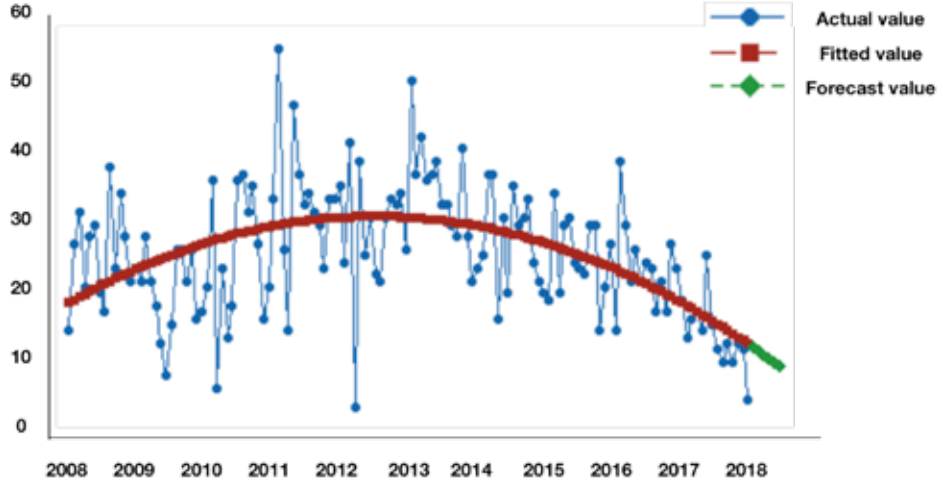

Figure 3: Trend analysis plot for young adult patients during 2008-2018.
*each actual value demonstrates "monthly" timepoint

2008 to 2018 using a time series analysis. As in other studies,[10-13] there was a greater number of female patients than male patients in a ratio of about 3:1, and almost 50% of the general population were young adult patients seeking orthodontic treatment. This reflects the current social value of dentofacial esthetics.[3,10,14]

To our knowledge, this is the first study that examined the current trend of Thai patients seeking orthodontic treatment. Unexpectedly, a seasonal variation was not shown in the number of patients and their ages contrary to earlier studies reports.[1,3] However, the trends of patients sorted by gender and age group were demonstrated. In both linear and quadratic trends analysis, every variable was considered. But since the quadratic analysis indicated more minor errors and greater validity than the linear, this study focused only on the quadratic statistically significant variables, which were female, children, and young adult groups (p<0.05). Neither the proportions of males nor elderly patients demonstrated any increasing trends during the 10-year study period. This finding was also contrary to other studies[1-3,15] ,which reported a growing trend among male and adult patients. These circumstances possibly resulted from the limitation that this was a single-center study.

Socio-economic development and the social value of dentofacial esthetics possibly affected orthodontic needs in female and young adult patients. Also, women may be more interested in dentofacial esthetics that men and consequently seek orthodontic treatment more frequently.[14] However, this study found a decreasing trend in female patients and young adult patients, which was contrary to the trends published in previous studies.[3,10] The long waiting period of over two years for orthodontic treatment at this dental hospital possibly played a role in the decreasing number of female and young adult patients. These results may have a beneficial influence on future orthodontic service strategies.

Nowadays, parents have an increased interest in their children's oral health [16-18] and the number of patients who were <12 years old gradually increased overtime. This phenomenon was possibly associated with the mission of this dental hospital to serve as a tertiary care dental center. Therefore, many children <12 years old were referred from pedodontists in southern Thailand. In addition, recent technological breakthroughs have made access easier for preadult orthodontic care. These results followed previous studies in dental hospitals [1,10,19] but contrary to some studies that found the number of children gradually decreased probably due to an aging society. [2,3]

A time-series analysis was shown to be effective for a trend analysis study [1-3,10,11,15,19,20] and also provided clinicians with some insights into current trends of dental and medical perspectives. This method was simple, which simply relied on time point settings for the analysis. The accuracy of the quadratic trend analysis in this study was evaluated by MSD and MAD, which demonstrated lower values than the linear trend analysis. It meant that the quadratic trend method was more reliable and accurate than the linear method. However, when focusing on the prediction ability from an R^2 prediction, the quadratic analysis showed bare values and was unsuitable for further prediction. Therefore, it might be desirable for the time series analysis to be performed again in the future with more time points. Also, the expansion of variables and subject bases would be beneficial in further study.

This study has some limitations. First, the sample frame was limited to a single center in southern Thailand. Therefore, this could affect the interpretation of the results, and no generalized conclusion could be drawn from this study. Second, due to incomplete data records, only gender and age were used. In a future study, more variables should be collected, such as the patient's place of residence, education, type of malocclusion, type of treatment, and type of appliance.

CONCLUSION

"Female patients" and "young adult patients" were the major groups of patients seeking orthodontic treatment at the Dental Hospital of Prince of Songkla University in southern Thailand during 2008-2018. This 10-year time-series analysis revealed a significantly decreasing trend in "female" and "young adult patients". The number of "children under the age of 12 years" increased during the 10-year study period.

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