# Physical Fitness Course in the Dental Curriculum and Prevention of Low Back Pain

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*Abstract:* Physical and psychosocial stressors in dental schools are associated with adverse health outcome, including low back pain. The aim of this study was to evaluate the physical fitness course included in a dental school's curriculum with regard to prevention of low back pain. Ninety first-year and sixty-two final-year dental students completed an anonymous questionnaire on physical fitness habits and low back pain. Fifty voluntarily participated in the Åstrand bicycle ergometer test. The questionnaire revealed that 37 percent of the students have weekly physical exercise only during the physical fitness course included in the curriculum and 62.5 percent of the students reported low back pain. Final-year dental students had significantly more low back pain than first-year dental students ($r=0.21$, $\chi^2=7.91$, $p=0.005$). Female students had significantly more low back pain than male students ($r=0.28$, $\chi^2=6.61$, $p=0.0101$). The Åstrand test revealed that students who attended the physical fitness course had significantly better physical fitness ($p=0.008$) than those who did not. Students who exercised more regularly had significantly less low back pain ($r=-0.19$, $\chi^2=11.89$, $p<0.01$) than those who did not. We conclude that participation in a physical fitness course leads to improved low back health for dental students and may prevent low back pain among final-year dental students.

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Work-related musculoskeletal disorders (WRMSDs) are associated with multifactorial risks (physical, psychosocial, work-organizational, and sociocultural) as the types and levels of risks vary according to individual traits and occupational demands. The best-established risk factors for WRMSDs are reported to be awkward and prolonged posture, bending and twisting, vibration, and repetitive forces.[1] The prevalence of musculoskeletal complaints in dentists is high although relatively few studies have focused on this profession.[2] Myers and Myers carried out a study among dentists, investigating work stress, general health, and health-related behavior and found that the main health complaint—causing chronic complaints, need for medical care, and absenteeism in dentists—was low back pain, which was reported by 62 percent of dentists in the study.[3] Similar prevalences of musculoskeletal disorders have been reported among dentists although all studies have led to almost the same conclusion: musculoskeletal disorders comorbidity among dentists is higher than in the average population.[4-7]

Adverse musculoskeletal and general health outcomes caused by practicing dentistry have highlighted the need for ergonomic training among dentists and dental students. Since 1995, the dental curriculum in the United States includes didactic training on work posture biomechanics and occupational stress.[8] Numerous efforts have been made in the development of ergonomic advice and intervention in order to decrease the negative influence of dental practice on a dentist's health. Dentists' workday schedule and work posture, because of a demanding work field (narrow oral cavity), allow only limited ergonomic interventions to prevent work-related musculoskeletal disorders.[4]

Prospective studies and other medical literature have strongly suggested that exercise has a potentially beneficial effect in preventing low back pain.[9-11] Because of its ability to improve musculoskeletal and cardiovascular function, physical exercise may be useful for improving back function and preventing development of work-related musculoskeletal disorders. There is scientific evidence to support and

recommend the use of general physical exercise to prevent chronic low back pain.[12]

As dentistry is a demanding profession with limited effectiveness of ergonomic interventions, improvement of physical fitness and health-related behavior may be useful in preventing work-related musculoskeletal disorders among dentists and dental students. The literature reveals that physical and psychosocial stressors in dental schools are associated with adverse health outcomes.[13] At most dental schools, students do not perform any clinical work until they have advanced to the clinic training level in their third year or later. Dental students at clinic level perform the same type of physical work as practicing dentists. A few studies that focused on musculoskeletal disorders among dental students found the prevalence of musculoskeletal pain in 44 to 71 percent of all dental students.[14-17] Only one study examined the physical fitness habits of dental students and failed to find significant correlation with the presence or absence of musculoskeletal pain.[14] Some studies suggest that ergonomic advice on improving physical activity should be offered before the individual begins his or her working career or during education.[18,19] While dental educators have provided education to address ergonomic training at the didactic level, the reinforcement of biomechanics at the physical workout level has been overlooked. Most dental schools do have a physical fitness course as an elective implemented in general education courses, with some variety of frequency and types of exercises between universities and schools. The nature and duration of such a course are the same for all students attending the same school.

The aim of this study was to investigate physical fitness habits among dental students and the effectiveness of their physical exercise and to evaluate a physical fitness course included in our dental school's curriculum with regard to prevention of low back pain. Such a study could be useful for future planning and improving early preventive ergonomic programs in dentistry.

# Materials and Methods

A questionnaire was used to identify students' physical fitness habits and low back pain, and the Åstrand ergometer bicycle test was used for the objective evaluation of the students' physical fitness. For the purpose of this study, first-year and final-year students from the School of Dental Medicine, University of Zagreb, Croatia, were examined. The study was approved by the Ethical Committee of the School of Dental Medicine, University of Zagreb, Croatia. All experimental procedures were conducted in accordance with the Declaration of Helsinki's recommendations as a guide for physicians in biomedical research involving human subjects. All participants signed a written informed consent.

All ninety-nine first-year and eighty-eight final-year students were invited to complete the questionnaire designed for this study. The questionnaire collected general information such as gender, age, height, weight, and eating, sleeping, alcohol, and smoking status. Data regarding health-related behavior and physical fitness habits were collected through a structured group of questions in the questionnaire. The purpose of these questions was to define the frequency and effectiveness of exercise among dental students (number and duration of exercise sessions per week). Students were also asked whether they were attending the physical fitness course included in the dental school's curriculum. Low back pain symptoms were registered by a checklist included in the questionnaire. Participants with positive self-reported low back pain symptoms were examined with the Oswestry Disability Index[20] (ODI) questionnaire, version 2.0.

Fifty dental students in the study volunteered to participate in the Åstrand ergometer bicycle test. The test was carried out under standardized conditions as follows: the subjects were free from infection, and two hours before the test the subjects abstained from eating, smoking, coffee drinking, or strenuous exercise. The participants bicycled on a fitness computer at a constant pace, performing three times a six-minute ride. Each performance was on a different submaximal load (50W, 100W, 150W). Between performances, the subjects rested for ten minutes or until the heart rate was established as at rest. Instructions were given and the test performance supervised by the same examiners (KP and MV). Values of the heart rate established at least at 120 beats per minute on at least one submaximal load were used in the further analysis for predicting maximal oxygen consumption ($VO_{2max}$). $VO_{2max}$ was estimated from the known linear relation between heart rate and oxygen consumption at submaximal workloads, with corrections for age, gender, body weight, and heart rate on the different loads, according to a nomogram that has been developed.[21]

The collected data were analyzed regarding the following three concerns: low back pain among

first- and final-year dental students, low back pain and physical fitness habits among dental students, and a physical fitness course in the curriculum related to low back pain among dental students. Answers collected by the questionnaire were coded into categories regarding physical fitness habits: not exercising at all, exercising at least thirty minutes once a week, exercising at least thirty minutes twice a week, exercising at least thirty minutes three times a week, and attending the school's physical fitness course. Students who reported exercising less than thirty minutes were included in the "not exercising" group.

Descriptive statistics were used to present physical fitness habits. Spearman's rank correlation coefficient and chi-squared test were used to reveal association between reported low back pain symptoms and physical fitness habits. $VO_{2max}$ of each participant was compared to age and gender standardized $VO_{2max}$ values for categorization of an individual's physical fitness.[21] The Kolmogorov-Smirnov test was used to test normality of the $VO_{2max}$ data. Student's t-test and chi-squared test were used in analyzing $VO_{2max}$ data as objectively evaluated physical fitness and reported physical fitness habits. All analyses were performed using Statistica software (Statistica 8, StatSoft, Inc.).

# Results

## Questionnaire

A total of 154 dental students completed the questionnaire (response rate 82.4 percent). Of these, ninety-two were first-year (response rate 92.9 percent) and sixty-two final-year (response rate 70.5 percent) students. Two first-year students were excluded, one due to clearly intentionally misleading answers and another due to age limit. The final sample consisted of ninety first-year dental students (thirty-five male and fifty-five female), average age 19.3±0.8 years, and sixty-two final-year dental students (twenty male and forty-two female), average age 23.6±2.5. All participants were Caucasians. The sociodemographic variables of the participants are presented in Table 1.

Physical fitness habits of the participants are presented in Table 2. Of the students not attending the physical fitness course, none reported exercising twice or more per week. Of the students attending the physical fitness course, none reported exercising once a week. Of the examined students, ninety-five (62.5 percent) reported low back pain. Of these, forty-eight (53.3 percent) were first-year and forty-seven (75.8 percent) final-year students. Subjects who were positive in self-reported low back pain symptoms scored minimal or moderate disability (95.7 percent and 4.3 percent, respectively) with the ODI questionnaire. Final-year students had significantly more low back pain than first-year students ($r=0.21$, $\chi^2=7.91$, $p=0.005$). Female students had significantly more low back pain than male students ($r=0.28$, $\chi^2=6.61$, $p=0.0101$). Physical fitness habits and low back pain of the participants are presented in Table 3. First-year students who were attending the physical fitness course had significantly less low back pain than first-year students who were not attending the course ($p=0.014$). Final-year dental students who were attending the physical fitness course had significantly less low back pain than final-year students who were not attending the course ($p=0.022$). Subjects who exercised more regularly (two or three times a week

**Table 1. The sociodemographic variables of first- and final-year students participating in study, School of Dental Medicine, University of Zagreb, Croatia (N=152)**

| Descriptor | | First-Year | Final-Year |
|---|---|---|---|
| Total number of students | | 90 | 62 |
| Response rate | | 93.0% | 70.5% |
| Ethnicity by number | Caucasian | 90 | 62 |
| | Other | 0 | 0 |
| Gender: number of female students | | 55 | 42 |
| Gender: number of male students | | 35 | 20 |
| Age (mean±SD) of female students | | 19.3±0.8 | 23.1±0.7 |
| Age (mean±SD) of male students | | 19.4±1.0 | 23.6±1.3 |
| Body mass index, female students, kg $m^{-2}$ | | 20.6±2.0 | 20.8±2.2 |
| Body mass index, male students, kg $m^{-2}$ | | 23.3±2.5 | 24.2±2.0 |

**Table 2. Physical fitness habits of first- and final-year students in study, School of Dental Medicine, University of Zagreb, Croatia (N=152)**

| | First-Year (N=90) | | Final-Year (N=62) | | Total (N=152) | |
|---|---|---|---|---|---|---|
| Physical Fitness Habit | N | % | N | % | N | % |
| Not attending the physical fitness course in the school's curriculum | 13 | 15% | 13 | 21% | 26 | 17% |
| Not exercising at all | 8 | 9% | 8 | 13% | 16 | 10% |
| Exercising once a week | 5 | 5% | 5 | 8% | 10 | 7% |
| Attending the physical fitness course in the school's curriculum | 77 | 85% | 49 | 79% | 126 | 83% |
| Exercising only in the course | 40 | 44% | 17 | 26% | 57 | 37% |
| Exercising two times a week | 25 | 28% | 15 | 24% | 40 | 26% |
| Exercising three times a week | 12 | 13% | 17 | 28% | 29 | 20% |

**Table 3. Low back pain and physical fitness habits of first- and final-year students in study, School of Dental Medicine, University of Zagreb, Croatia (N=152)**

| | First-Year (N=90) | | Final-Year (N=62) | |
|---|---|---|---|---|
| | No Back Pain | Back Pain | No Back Pain | Back Pain |
| Not attending the physical fitness course in the school's curriculum (*p=0.141) | 2 (2%) | 11 (12%) | 0 | 13 (21%) |
| Attending the physical fitness course in the school's curriculum (*p=0.018) | 40 (45%) | 37 (41%) | 15 (24%) | 34 (55%) |
| | **p=0.014 | | **p=0.022 | |

*Note:* P value for $\chi^2$ test, significant if p<0.05, *p when first year is compared to final year, **p when not attending is compared to attending.

for at least thirty minutes) had significantly less low back pain (r=–0.19, $\chi^2$=11.89, p=0.0006).

## Åstrand Ergometer Bicycle Test

Among the fifty students who volunteered for the Åstrand ergometer bicycle test, one was excluded on the grounds of medical contraindication to performing six-minute submaximal bicycle ergometry. This exclusion left a group of forty-nine students (twenty-seven male and twenty-two female) available for test. Nine students (six male and three female) were unable to complete the ergometry test. Forty students (twenty-one male and ninety female) (80 percent total) completed the test. Frequency distributions of $VO_{2max}$ were normal for the group of all participants as well as among gender groups.

Cross-tabulation of mean predicted $VO_{2max}$ values by gender and weekly physical exercise is shown in Table 4. Of the sixteen students (twelve male and four female) who attended the physical fitness course included in the dental school's curriculum and who were exercising two or three times a week, eight (50 percent) met the objective criteria for "good physical fitness" according to age and gender standardized $VO_{2max}$ values for categorization of individual physical fitness ($VO_{2max}$ ≥52 $mlO_2$ $min^{-1}kg^{-1}$ for males, and $VO_{2max}$ ≥48 $mlO_2$ $min^{-1}kg^{-1}$ for females). Of the twenty-four students (nine male and fifteen female) who did not attend the physical fitness course and who were exercising only once a week or not exercising, seven (30 percent) met the objective criteria for "good physical fitness" according to age and gender standardized $VO_{2max}$ values for categorization of individual physical fitness. Of the nine students (six male and three female) who did not complete the ergometry test, seven were not exercising at all. Their inability to complete the ergometry test confirmed their poor physical fitness.

The Åstrand test revealed that the influence of attending the physical fitness course on the students'

**Table 4. Mean predicted $VO_{2max}$ ($mlO_2$ $min^{-1}kg^{-1}$) by determinant and gender**

| | Mean $VO_{2max}$ ($mlO_2$ $min^{-1}kg^{-1}$) ±SD | | |
|---|---|---|---|
| Physical Fitness Course in the School's Curriculum | Male (N=21) | Female (N=19) | Total (N=40) |
| Not attending | 41.27±8.36 | 41.69±8.65 | 41.54±8.36 |
| Attending | 51.27±10.26 | 46.75±13.99 | 50.14±10.98 |
| | p=0.027 | p>0.05 | p=0.008 |

P value for Student's t-test, significant if p<0.05.

physical fitness was different for the male and female groups. The test also revealed that male students who attended the physical fitness course and exercised regularly had significantly better physical fitness than male students who exercised once a week or not at all (p=0.027). However, the test revealed no significant difference in the physical fitness of the female students who did or did not attend the physical fitness course.

# Discussion

## Low Back Pain Among Dental Students

A review of the literature on the prevalence of musculoskeletal symptoms in dentists, dental hygienists, and dental students shows that the prevalence of general musculoskeletal pain ranges between 64 percent and 93 percent, with the back as the most prevalent region of pain (36 to 60 percent).[22] The results of our study on low back pain prevalence in dental students are in agreement with the literature. Few studies have focused on musculoskeletal disorders among dental students only.[14-17] Our results show that final-year dental students have significantly more low back pain than first-year dental students. Rising et al. found a trend of an increasing number of dental students with low back pain in accordance with year in dental school, although not significant.[15] Our results show that advancing to the final year in dental school significantly increases the risk of low back pain for the dental student.

Another factor for increased risk of low back pain for the dental students in our study was the female gender. Female students had significantly more low back pain than male students. Although some studies on musculoskeletal pain among dental students did not report gender differences,[15,17] our findings are supported in most of the literature. De Carvalho et al. found that the occurrence of musculoskeletal disorders was higher among female than male dental students.[14] Epidemiological, clinical, and experimental evidence points to gender differences in musculoskeletal pain showing that women more often than men have musculoskeletal problems.[23-25]

## Low Back Pain and Physical Fitness Habits

Epidemiological studies have examined the prevalence of back pain related to physical fitness and found that high fitness is related to positive back health and may have a protective effect against back pain.[9,10,26] There are few published data on the physical fitness habits of dental students.[14] In our study, results on the physical fitness habits of dental students are quite encouraging, showing that 90 percent of all students reported some kind of regular exercise, with 83 percent exercising more than thirty minutes two or more times a week. Unfortunately, 7 percent of the dental students in our study exercise only once a week, which is insufficient to achieve positive exercise effects. In our study, all students effectively exercising were attending the physical fitness course in the dental curriculum and had significantly less low back pain than students who were not attending the course.

## Physical Fitness Course

De Carvalho et al. reported that 52 percent of dental students had regular physical exercise, but did not specify what part (if any) of that exercise was done on a physical fitness course included in the dental curriculum.[14] In our study, the effectiveness of exercising in the physical fitness course in the school's curriculum was tested by the Åstrand ergometer bicycle test. Although none of our study groups showed predicted maximal oxygen consump-

tion ($VO_{2max}$) for good physical fitness according to the objective criteria, the difference in mean $VO_{2max}$ among students who attended and those who did not attend the physical fitness course was significant. The Åstrand test revealed that students who attended the physical fitness course and regularly exercised (for a minimum of thirty minutes, two or three times a week) had significantly better physical fitness than students who exercised once a week or not at all. Other studies are in agreement with our findings.[27-29] This observation stands for all our tested students and for the male students group, but not significantly for the female students group. Biological and physical factors might account for these differences because in our study female students had more low back pain than male students, which could delimit females during their performance in the bicycle ergometer test. Results on mean predicted $VO_{2max}$ for female dental students who attended the physical fitness course, although not significant, are higher than those for female dental students who were not attending the course. Additionally, this difference may point to the eventual need to adjust the course for female students, as Østerås and Hammer concluded that implementation of an individual pragmatic approach may be a promising component of a strategy aimed at preventing musculoskeletal disorders in the workplace.[30]

The main findings in our study indicate that attending the physical fitness course in the school's curriculum correlates with positive low back health among dental students. Taking physical exercise for two or three days a week for at least thirty minutes was related to decreased presence of low back pain symptoms among dental students. In a study by de Carvalho et al., no statistically significant correlation was determined between students' practice of physical exercise and the presence of pain.[14] They reported 52 percent of dental students took regular physical exercise but did not specify what frequency and duration of exercise are meant by "regular" in their study. Although they defined the kind of physical exercise among their participants, lack of data on frequency, duration, and effectiveness of exercise contributed to their conclusion that there was no significant correlation between the practice of physical exercise and the presence of pain. Our finding that physical fitness habits are associated with improved low back health is supported in the literature.[9-11]

Our findings show that regularly attending the physical fitness course in the school's curriculum is sufficient to achieve a positive influence of physical exercise on prevention of low back pain in dental students. This is a new observation since there are no published data on the effectiveness of physical fitness courses included in the dental curriculum. The physical fitness course included in our curriculum offers a variety of physical fitness workouts for dental students: from team sports (volleyball, basketball, indoor soccer, handball) to aerobics, swimming, table tennis, dancing, walking, and ice skating. These are highly aerobic sports that place significant strain on cardiorespiratory systems with positive and beneficial effect. To complete the semester course, the student is obliged to attend at least ninety minutes of a selected sport each week. In our study, 37 percent of the dental students exercised only during this fitness course. This finding highlights the significance of the course for maintaining healthy physical fitness habits of dental students. Improving the individual's physical fitness may indirectly contribute to the prevention of low back pain.

# Conclusion

Our study indicates that attending a physical fitness course leads to improvement of low back health in dental students. Encouraging dental students to take a physical fitness course included in a dental school's curriculum may prevent low back pain among dentists in the future. A physical fitness course included in the school's curriculum should offer regular physical fitness workout. There is a need to accentuate the importance of including a physical fitness course in a dental school's curriculum.

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