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COVID-19 Restrictions Decreased DPT Students' Health Outcomes

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Introduction: The COVID-19 pandemic has presented increased constraints on physical activity leading to the adoption of more sedentary lifestyles for populations worldwide, including graduate students. The detrimental effects of a sedentary lifestyle include increasing the risk for cardiovascular disease. Cardiovascular (CV) disease has conventionally been a pathology associated with older adults, but recent evidence has shown that younger individuals are developing CV issues. The COVID-19 restrictions created an additional barrier furthering graduate students' sedentary lifestyles and possibly increasing their risk for cardiovascular disease.

Purpose: The purpose of the present study is to determine the effects of COVID-19 restrictions on The University of Texas at El Paso's (UTEP) Doctor of Physical Therapy (DPT) students' health outcomes. The proposed study's objectives are: to determine differences in fitness capacity, body composition, physical activity levels, and perceived stress during and after strict COVID-19 restrictions. We hypothesize that COVID-19 quarantine restrictions will produce detrimental effects of DPT students' health outcomes.

Subjects: Using convenience sampling, 18 participants were recruited via online meetings and emails from UTEP's DPT class of 2023. Following the first round, 2 participants dropped out, leaving 16 subjects for data analysis.

Materials/Methods: This longitudinal study required 2 visits (during strict restrictions (Nov. 2020) and 8 months after restrictions were lifted (July 2021)). Primary outcome measures were cardiorespiratory fitness levels, measured via maximal oxygen consumption (VO_{2max}), body composition measured via Dual Energy X-ray Absorptiometry, and blood markers measured via blood samples. Secondary outcome measures were the International Physical Activity Questionnaire to assess physical activity levels, the Perceived Stress Scale (PSS) to evaluate overall stress levels. A paired t-test for each variable was performed to determine differences in health outcomes.

Results: VO_{2max} (41.66 ± 8.43 ml/Kg/min vs. 36.95 ± 6.56 ml/Kg/min, $p=0.013$), BMI (25.20 ± 3.29 kg/m² vs. 24.44 ± 2.94 kg/m², $p=0.016$), and moderate physical activity (936 ± 733 min/week vs. 387.81 ± 517.24 min/week, $p=0.01$) increased. Total cholesterol levels decreased (360 ± 86 mg/dL vs. 246 ± 70 mg/dL, $p=0.002$). No significant changes in participants' fat mass or perceived stress levels were observed.

Conclusion: Following the ease of restrictions, significant increases in CV capacity and moderate exercise time were likely observed due to increased gym access, more in-person learning, and increased social interaction. While BMI increased, body fat % remained statistically unchanged, suggesting BMI gains stemmed from increased muscle mass. Moreover, the PSS revealed similar but insignificant differences in scores, suggesting students' stress was not related to the restrictions. Results from the blood markers revealed decreased total cholesterol levels, though mean values during both visits were above healthy levels.

Clinical Relevance: The results of this study suggest that easing the COVID-19 restrictions had a positive impact on DPT students' health and potentially mitigate CV risk factors; reflecting the importance of accessibility for students' health and how similar educational programs react to future health crises.

Introduction

The COVID-19 pandemic has presented increased constraints on physical activity and increased sedentary lifestyles for populations worldwide, especially graduate students.¹ Participation in physical activity at gyms or outside locations was no longer possible due to “stay-at-home” orders. Additionally, graduate students were greatly affected as in-person classes were converted to online classes at home. Now, graduate students were asked to increase their sedentary time and physical inactivity during the strict pandemic quarantine periods.

Furthermore, recent evidence has shown that individuals are developing cardiovascular diseases at a younger age.² One of the many factors contributing to this epidemic may be the increased time constraints placed on young adults.³ Specifically, the sedentary activity of full-time students may be causing major detrimental effects to their health, including increasing the risk for cardiovascular diseases.⁴ Therefore, the COVID-19 restrictions created an additional barrier furthering graduate students’ sedentary lifestyles and possibly increasing their risk for cardiovascular disease.

As a result, the purpose of the present study is to determine the effects of COVID-19 restrictions on The University of Texas at El Paso’s (UTEP) Doctor of Physical Therapy (DPT) students’ health outcomes. The proposed study’s objectives are to determine differences in fitness capacity, body composition, physical activity levels, and stress levels during and after strict COVID-19 restrictions. We hypothesize that COVID-19 quarantine restrictions will produce detrimental effects of DPT students’ health outcomes.

Methods

Using convenience sampling, 18 participants (9 females and 9 males) from the University of Texas at El Paso Doctor of Physical Therapy class of 2023 were recruited via online meetings and emails. Further demographic information is outlined below in Table 1.

Table 1: Participant Demographic Information

	n	Age		BMI (kg/m ²)		Height (cm)		Weight (kg)				Tested COVID +
								Visit 1		Visit 2		
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Males	9	23.78	0.97	25.56	2.58	176.3	4.97	81.75	10.10	84.39	11.22	
Females	9	25.78	4.52	23.51	3.38	164.1	7.41	61.36	6.94	62.1	7.31	1

Subjects were asked to attend 2 lab visits with the first in November 2020, when COVID quarantine restrictions were in place for at least 7 months, and the second 8 months later in July 2021, 4 months after COVID restrictions were lifted. Visits scheduled during COVID-campus restricted conditions followed all Center for Disease Control (CDC) and UTEP Recovery Task Force recommendations, including but not limited to, screening before coming to campus, social distancing, face mask use, and frequent hand hygiene. Each session consisted of 4 stations: 1) blood draw, 2) cardiorespiratory fitness test via maximal oxygen consumption (VO_{2max}) testing, 3) Dual Energy X-ray Absorptiometry (DEXA) to assess body composition, and 4) administration of surveys including the International Physical Activity Questionnaire (IPAQ)⁵ and overall stress measured via the Perceived Stress Scale survey⁶ (Figure 1). All subjects were asked to arrive at least 8 hours fasted (only water consumption permitted) and completed the blood draws first and VO_{2max} testing last.

Figure 1:

To measure cardiorespiratory fitness, all participants completed initial and follow-up direct VO_{2max} testing on an upright stationary bike.⁷ The use of VO_{2max} has been identified as the gold standard of measurement to examine cardiorespiratory fitness, function, and human performance. The test relies on the fact that maximal rates of oxygen consumption in skeletal muscle are usually limited by the heart's ability to deliver oxygen to working muscles.⁷ At each visit, participants completed an 8 to 12 minute maximal, incremental cardiopulmonary exercise test on a cycle ergometer (Corival, Lode, The Netherlands) following the American Heart Association and American College of Sports Medicine guidelines for exercise testing.^{8,9} Testing was conducted to measure VO_{2max} (TrueOne 2400, Parvomedics Inc., Sandy, UT) and maximal exercising heart rate (Quinton Q-Stress Cardiac Stress System, Mortara Instrument, Milwaukee, WI). Before each exercise test, height (Seca Medical, Germany) and weight (WB-110A Class III, Tanita, Japan) measurements were obtained. Seat height was adjusted to allow a 25° to 215° of knee extension during cycling. Participants were instructed to sit quietly on the bike for 10 minutes to ensure that increased sympathetic activity related to nervousness or anxiety did not alter blood pressure readings.¹⁰ During the resting period, 3 peripheral blood pressure values were recorded using an automated brachial blood pressure cuff (BP760, Omron Healthcare, Inc., Lake Forest, IL). The rate of perceived exertion (RPE) (Borg scale) was measured at rest and at the end of each 2-minute stage of the exercise test. Testing was concluded when the participant could no longer tolerate or maintain the cycling workload.

To examine body composition, a DEXA (GE Lunar iDXA scanner, Boston, Massachusetts) scan was performed. The DEXA scan has been established as a validated measure of bone mineral density as well as body composition and body fat content.^{11,12} After all

jewelry was removed, each participant was asked to lay flat on their back and remain still for the duration of the approximately 8-12 minute full-body scan. DEXA-certified investigators placed Velcro straps around participants' knees and ankles to maintain proper positioning and extremity alignment during the scan.

The subjects' blood samples were taken at the start of each data collection session for the purposes of analyzing key blood markers related to their overall health. These samples were tested to assess the subjects' lipid profiles, inflammatory markers, and blood glucose levels. Plasma samples were analyzed with commercially available ELISA test kits, following the manufacturer guidelines (for total cholesterol and plasma glucose, ab65390 and ab65333, respectively, Abcam, Boston, MA; for TNF-alpha, ELISA Max Deluxe Set, BioLegend, San diego, CA).

The International Physical Activity Questionnaire (IPAQ) is a self-report instrument used to measure physical activity levels. Research has demonstrated that the IPAQ data is reproducible and it has measurement properties at least on par with other existing self-report measures of physical activity.⁵ For the purposes of this study, the long form IPAQ was used for participants to report their physical activity over the past 7 days. This form has been found to have excellent test-retest reliability.¹³ The long form last 7 days self-administered format of the IPAQ has 5 parts: job-related physical activity, transportation physical activity, housework/house maintenance/caring for family, recreation/sport/leisure time physical activity, and time spent sitting. Research has shown that higher IPAQ scores correlate with lower mortality rates and reduced risk of cardiovascular disease; thus, the interpretation of these data was intended to demonstrate the subjects' general physical activity levels.¹³

The Perceived Stress Scale (PSS) was developed to psychologically assess the extent to which participants consider their lives to be stressful in the last month.⁶ Scoring may provide information about how unpredictable or unfamiliar certain life events may be. In light of the

COVID-19 pandemic, this validated, widely-used survey tool can underscore the stressful thoughts and feelings that young adults may be experiencing. Moreover, higher PSS scores have been associated with decreased ability to quit smoking, decreased blood sugar control among diabetics, increased vulnerability to depressive symptoms, and increased incidence of colds.⁶ The interpretation of this data was used to measure the general stress levels that physical therapy students experienced in the month prior to each round of data collection.

Data Analysis

Descriptive statistics including mean and SDs of the sample size were obtained. Paired t-tests were performed to analyze the differences in aerobic capacity, body fat percentage, BMI, MET-minutes/week, and stress level between periods of strict COVID-19 restrictions and ease of restrictions. Statistical significance was established at $p < 0.05$.

Results

Following the first round of testing, 2 participants dropped out of the study, leaving 16 participants, 8 females, and 8 males, for data analysis. Between the first and second rounds of data collection, participants' average VO_{2max} scores increased by 4.07 mL O₂/kg body weight/min, or 13.8% from baseline measurements in November 2020 ($p=0.013$). Although nonsignificant, the participants as a whole also saw a 1.5% increase in body fat percentage ($p=0.102$). Average BMI scores also increased by 0.76 kgm², or 3.1% from baseline measurements ($p=0.016$). Total MET (metabolic equivalent)-minutes/week increased in all activity levels from Round 1 to Round 2 testing appointments. The most drastic change was observed in moderate MET-minutes/week with a 141.3% increase in physical activity ($p=0.011$). Data from the Perceived Stress Scale revealed a 12.6% difference from baseline which was not statistically significant. Participants' total cholesterol levels also significantly decreased from baseline ($p=0.002$) while TNF-alpha and plasma glucose did not show any significant change. Results from primary outcome measures are depicted in Table 2.

Table 2: Primary and secondary outcome measures from all participants during Visit 1 data collection in November 2020 and Round 2 data collection in July 2021 (* indicates statistical significance with $\alpha=0.05$).

Outcome Measure	Visit 1		Visit 2		Mean % Difference	p-value
	Mean	SD	Mean	SD		
VO2 max (mL O2/kg body weight/min)	37.0	6.6	41.7	8.4	13.8	0.013*
Body fat %	29.7	6.6	31.2	6.7	1.5	0.102
BMI (kg/m²)	24.4	2.9	25.2	3.3	3.1	0.016*
Total Walking MET-minutes/week	295.7	370.8	353.7	481.4	19.5	0.605
Total Moderate MET-minutes/week	387.8	517.2	935.9	733.4	141.3	0.011*
Total Vigorous MET-minutes/week	437.5	429.7	542.5	779.6	24.0	0.667
Perceived Stress Scale (PSS) Scores	14.9	6.1	16.7	7.6	12.6	0.465
Total Cholesterol (mg/dL)	360.0	68.0	246.0	70.0	31.6	0.002*
TNF (pg/mL)	17.6	5.2	15.7	0.8	10.7	0.806
Plasma glucose (mmol/uL)	146.0	59.0	134.0	36.0	8.2	0.513

Conclusions

The significant increase in moderate MET minutes/week activity indicates that the COVID-19 quarantine restrictions hindered the participants' weekly physical activity. IPAQ scoring considers moderate levels of activity to be either vigorously intense activity for 20 minutes a day for at least 3 days a week, moderately intense activity for 30 minutes a day for at least 5 days a week, or a combination thereof with walking activity for a total of at least 600 MET-minutes/week.¹⁴ A brisk walk, light bicycling, pilates, and variable resistance training exercises are considered about 4 METs of activity which is equivalent to the IPAQ's moderate activity scoring standards.¹⁵

In addition, one of the most notable findings was a statistically significant increase in participants' BMI while body fat percentage remained statistically unchanged. These results can

likely be attributed to an increase in muscle mass rather than fat mass due to improved physical activity levels, more open access to gyms and increased opportunities for social interaction. By the time the second round of data collection was completed in June of 2021, the UTEP student physical therapist participants had already transitioned back to full-time face-to-face lectures and laboratory experiences which provided increased opportunities for moderate physical activity and interaction with their classmates. Also of note, the difference in PSS scores between visits was not statistically significant. The participants exhibited a moderate level of stress based on their scores and these levels remained relatively stable, indicating that the COVID-19 quarantine restrictions did not significantly increase participants' stress levels.⁶

Between rounds of testing, participants' total cholesterol levels decreased from baseline measurements while TNF-alpha and plasma glucose remained statistically the same. Like many of the other variables assessed, removal of COVID-19 restrictions likely played a role in the overall decrease in cholesterol levels due to increased physical activity level as shown through the IPAQ. It is worth highlighting that both mean total cholesterol values obtained from participants are well above what is considered to be a healthy level between 125 and 200 mg/dL for men and women over 20 years old.¹⁶ High cholesterol levels among our participants may be present, in part, due to moderate stress levels as seen on the PSS, diets high in saturated or trans fats, or other hereditary factors that we were unable to account for in the present study.¹⁶

Because of the study design, discrepancies may have occurred in testing methodology due to different researchers participating in data collection on different dates. Additionally, common limitations to maximal exercise testing include the participant's lack of motivation, general discomfort, leg fatigue, or presence of other symptomatology that prevents measurement of true maximal oxygen uptake during testing.⁹ It is possible that participants also experienced central fatigue, unwillingness to provide maximal effort, or other discomfort throughout VO_{2max} testing that may have impacted our results. However, all participants

received verbal encouragement and peer support from researchers throughout their maximal exercise testing experience with the goal of mitigating central fatigue and motivating participants to provide their best effort.

It is also possible that changes in our data between testing sessions may be due, in part, to seasonal changes in behavior from winter to summer. Buchowski et al. found that young and middle-aged women tend to participate in fewer sedentary behaviors in the summer compared to the winter season likely due to environmental conditions, such as hours of daylight or weather conditions.¹⁷ It is possible that participants in our study exhibited behavioral changes based on extraneous factors, including those related to diet and wellness, that we did not account for in this study. Based on these data it is not known to what extent this study's results are related to the participants' involvement in the UTEP DPT program.

In conclusion, the COVID-19 restrictions in El Paso, Texas can be negatively attributed to health outcomes such as aerobic capacity, minutes of moderate-level physical activity per week, and body mass index for graduate students. As the COVID-19 pandemic continues, it is important for community leaders, educators, and students alike to be aware of the impact that constraints on access to gyms, community facilities, and the workplace may have on the health of young adults. Future research should continue to examine additional health variables that may have been influenced by the pandemic as well as the impact on other populations in the United States to identify areas for improvement in the promotion of overall health and wellness.

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