

Original Research

Hassles during the First Year of Medical School: Can a Student Wellness Program Make a Difference?

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Abstract

Acute stress during medical school affects medical student well-being. The objective of the current study was to examine the influence of a holistic, school-sponsored student wellness program (SWP) on acute stress during the first year of medical school. First-year medical students attending two osteopathic medical schools participated, one school with a holistic student wellness program (SWP group) and one without an organized student wellness program (Control group). The SWP was founded on osteopathic philosophy and designed to



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help students balance educational goals with a holistic, healthy lifestyle. Participants completed the Medical Education Hassles Scale-R (MEHS-R), which measures acute stress, during orientation and approximately every four to six weeks throughout their first year. Administration times were classified into academic periods (examination, routine, vacation) and 13-week quarters (Q1–Q4). Hassles severity was calculated for each of the seven MEHS-R subscales (Academic and Time Pressures, Financial, Social, External Influences, Day-to-Day Functioning, Relationships with Immediate Family, Health). At orientation, the SWP group had significantly lower hassles severity than the Control group for all subscales except Financial ($p \leq 0.04$). For the examination academic period, the Academic and Time Pressures and Day-to-Day Functioning hassles severities were significantly lower for the SWP group than the Control group after accounting for differences at orientation ($p \leq 0.05$). For the vacation academic period, Financial hassles severity was significantly lower for the SWP group than the Control group ($p \leq 0.05$). There were no significant differences between the SWP and Control groups during the routine academic period ($p > 0.05$). For first-year medical students, Academic and Time Pressures had the highest hassles severity ($p < 0.001$). These results indicated that holistic, school-sponsored student wellness interventions during the first year of medical school can significantly decrease the acute stress inherent in medical school, particularly during high stress examination academic periods.

Keywords

Holistic student wellness program; medical school; hassles; acute stress; school-sponsored wellness program

1. Introduction

In 2019, the National Academies of Sciences, Engineering, and Medicine (NASEM) were commissioned to study student wellness in higher education [1]. Student wellness involves consideration of physical, emotional, psychological, and spiritual health. In the NASEM report, the authors noted that stress has potentially negative consequences for student wellness, such as increased incidence of mental illness, substance use, and emotional distress [1]. The NASEM recommendations suggested the need for wellness programs that are incorporated into the campus culture and available for all students during orientation and periodically throughout the year [1].

In contrast to many higher education disciplines, the medical school educational environment is highly dependent on the hierarchical apprenticeship model, so concerns about medical student mental health are a worldwide consideration [1, 2]. The stresses and pressures of medical school and their associated effects on medical student health and well-being are well documented globally [3-8]. As students enter medical school, they may already have acute and chronic stressors; 60% of students reported moderate to high stress in the previous two weeks and 68% in the previous 12 months [9]. In one study, entering medical students reported experiencing stress about finances, day-to-day functioning, and academic and time pressures, but their depression and anxiety levels resembled those of the general population [10]. Further, acute and chronic stress appear to be a common element for students throughout their training. In a 2012 survey, medical students in the

United States reported stress from school pressures, finances, relationships with family and with friends, housing, residency competitiveness, health, and transportation [11]. These sources of stress varied based on the students' year of training, and school pressures was the highest stressor across all four years of training [11]. When surveyed during the middle of their first term, 56% of medical students in England reported a stressful event, other than examinations, in the past month [5]. For medical students entering their clinical years, the percentages of moderate to high stress in the previous two weeks and previous 12 months increased to 63% and 92%, respectively [9]. In medical students, the prevalence of self-reported depression was 27%, but only 16% of students who had a positive depression screen sought treatment and over 10% experienced suicidal ideation during the previous year [12]. Globally, approximately one-third of students experience anxiety during medical school, substantially higher than the prevalence in the general population, which is estimated to be as low as 3% and no more than 25% [7]. Acute stress during medical school is prevalent and associated with decreased feelings of well-being, burnout, and suicidal ideation; lower levels of acute stress are associated with resilience to burnout and increased well-being [9, 13-30]. During medical school, most students experience one or more forms of distress, such as fatigue, stress, depressive symptoms, and poor quality of life [16]. High stress levels, and all the other forms of distress, have been associated with students seriously considering dropping out of medical school [16].

The Action Collaborative on Clinician Well-being and Resilience, launched by the National Academy of Medicine, included students in their definition of clinicians when they developed a conceptual model of factors affecting clinician well-being and resilience [31]. The nucleus of their conceptual model was centered on patient well-being and emphasized the connection between clinician well-being and patient well-being through the clinician–patient relationship [31]. Some of the factors affecting clinician well-being, and ultimately affecting patient well-being, included personal factors related to physical, mental, and spiritual well-being; financial stressors and economic vitality; relationships and social support; and work-life integration [31]. The stresses and pressures experienced during medical school extend beyond graduation and burnout symptoms are experienced by almost 50% of physicians [32]. In the NASEM report, the authors noted that wellness programs that focus on maintaining a holistic, healthy lifestyle during medical school can encourage students who are experiencing distress to seek help [1]. Although the effects of various wellness programs on stress and other forms of distress have been examined, there are no consistent guidelines, so wellness programs implemented and studied in medical schools globally vary widely in content, timing, and accessibility. Previous research indicates that the academic and time pressures inherent in medical school can be reduced through the use of wellness programs focused on self-care, regular exercise, stress management, and personal counseling [33-43]. Medical students who engaged in a multifactorial approach to self-care that included nutrition, physical activity, interpersonal relations, spiritual growth, stress management, and health responsibility reported decreased perception of stress on their psychological and physical quality of life [33]. Therefore, interventions targeted at stress could reduce burnout and improve well-being [44, 45]. Further, providing multiple interventions that target specific types of stress at certain times during medical school could improve student wellbeing, which may ultimately improve the well-being of practicing clinicians and patients [21, 31, 46-50]. However, research is lacking on the effects of holistic, longitudinal wellness programs on the various types of acute stress that medical students experience throughout their first year of medical school. Additionally, research is needed to

examine how medical students' experiences of the various types of acute stress change during their first year of medical school.

The primary objective of the current study was to examine the influence of a holistic, school-sponsored student wellness program (SWP) on different types of acute stress (i.e., academic and time pressures, financial, social, external influences, day-to-day functioning, relationships with immediate family, and health) during the first year of medical school. Specifically, we compared the acute stress, as measured by hassles severity, experienced by first-year medical students attending a medical school with an SWP with those attending a medical school without a formalized SWP. Secondary objectives were to examine whether acute stress differed between academic periods and between quarters during the first year of medical school and to determine the most prominent types of acute stress experienced by first-year medical students during different academic periods.

2. Materials and Methods

2.1 Setting

A longitudinal, multiple cohort study was conducted at two colleges of osteopathic medicine (COMs) to examine the effect of a medical school-sponsored SWP on the acute stress experienced by first-year medical students. One COM provided an organized student wellness program (SWP group), and the other COM provided no formalized student wellness program (Control group). Both medical schools had lecture-based curricula. The curriculum for the SWP group was organized based on disciplines, and the curriculum for the Control group was organized based on systems. Data from participants in the Control group who were taking part in an optional problem-based learning curriculum were excluded from our study analyses. Both COMs were located in rural midwestern towns of similar size. Although the town sizes were similar, the SWP group's COM was a private university with fewer than 400 graduate medical students; the Control group's COM was a larger public university with approximately 21,000 undergraduate and graduate students. Tuition costs for the SWP group were considerably higher than those for the Control group.

2.2 Participants

First-year medical students at the two COMs were recruited during their orientation programs to participate in the current study. The A.T. Still University-Kirksville Institutional Review Board approved the study protocol under expedited review. All participants provided informed consent before participation.

2.3 Intervention

Students in the SWP group voluntarily participated in a multifaceted SWP provided by the COM [51]. The SWP was designed to encourage and help students balance demanding educational goals with practicing a holistic, healthy lifestyle. The SWP was founded on the osteopathic philosophy of holistic medicine that encourages individuals to engage in preventive practices to promote health and reduce the need for intervention. The SWP theme was "You are your own first patient", which emphasized the influence of clinician well-being on patient well-being [31]. The program used seven dimensions of wellness: emotional, environmental, intellectual, physical, professional development, social, and spiritual [52]. Subcommittees for each wellness dimension, consisting of students, staff,

and faculty, coordinated activities throughout the academic year. Activities were designed to promote a healthy lifestyle while helping students achieve their academic goals. Examples of activities for each wellness dimension are provided in Table 1. No similar SWP was available for students in the Control group during the time of the study.

Table 1 Examples of activities available for students in the SWP group through the medical school-sponsored student wellness program.

Wellness Dimension	Activity Example
Emotional	Prevention programs on coping strategies, free counseling support services
Environmental	Campus-wide recycling program
Intellectual	Programs on study habits, student support services including tutoring
Physical	Daily athletic activities, intramural sports opportunities
Professional development	Programs with alumni, lectures on budgeting and getting out of debt
Social	Holiday dinner, dances
Spiritual	Comparative religion panels

2.4 Measures

2.4.1 Demographic Questionnaire

At the start of the study, participants completed a demographic questionnaire that included questions on gender, age, marital status, and ethnic background.

2.4.2 Medical Education Hassles Scale-Revised

Hassles experienced by the participants, which are indicators of acute stress, were assessed using the Medical Education Hassles Scale-R (MEHS-R) [53]. Participants indicated the severity of each of the 101 potential hassles of the MEHS-R experienced during the previous week on a 4-point scale (0 = none or not applicable, 1 = somewhat, 2 = quite a bit, and 3 = a great deal). The original Medical Education Hassles Scale, from which the MEHS-R was refined, had adequate test-retest reliability over a 1-week period [27].

The MEHS-R has seven subscales: Academic and Time Pressures, Financial, Social, External Influences, Day-to-Day Functioning, Relationships with Immediate Family, and Health [54]. The Academic and Time Pressures subscale measures the severity of hassles related to medical school coursework and related time pressures (e.g., heavy workload, cramming, not getting enough sleep, making mistakes, interruptions). The Financial subscale measures the severity of hassles related to general expenses and those specifically related to medical school (e.g., not enough money for various items [tuition and books for medical school, food, housing], concerns about owing money). The Social subscale measures the severity of hassles related to social interactions (e.g., being lonely, lack of understanding about school commitments from friends, problems getting along with fellow students). The External Influences subscale measures the severity of hassles related to items mostly out of the control of the medical student (e.g., pollution, crime, difficulty finding parking). The Day-to-Day Functioning subscale measures the severity of hassles related to activities of daily living (e.g., shopping for groceries, doing laundry, planning meals, washing dirty dishes). The Relationships with

Immediate Family subscale measures the severity of hassles related to relationships with a spouse or significant other and with children (e.g., not enough time to spend with spouse or lover/children, thinking about having children). The Health subscale measures the severity of hassles related to health concerns (e.g., concerns about weight, menstrual problems, smoking too much). The MEHS-R subscales were validated using exploratory and confirmatory factor analyses [54].

Hassles severity for each of the seven MEHS-R subscales was calculated by averaging the severity scores for the items included in that subscale (possible range = 0–3 points). The mean of the items was used for the subscales to facilitate comparisons between subscales.

2.5 Protocol

The demographic questionnaire was administered to participants during orientation. The MEHS-R was administered during student orientation before the beginning of classes each year and then approximately every four to six weeks throughout the first year for a total of 10 administrations. Researchers tracked the academic activities (examinations, routine classes, or no classes) of the week before the MEHS-R was administered and classified each administration after orientation as occurring during an examination, routine, or vacation academic period. Additionally, the academic year was divided into four 13-week quarters (Q1–Q4). The definitions of the academic periods and the designations of the 13-week quarters resulted in Q2 and Q4 having no routine academic period and Q1 having no vacation academic period.

2.6 Statistical Analysis

Statistical analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC, USA). For all primary analyses, p values ≤ 0.05 were considered statistically significant. Post hoc analyses were considered statistically significant when the pairwise p value was ≤ 0.01 .

Analysis of variance was used to compare the hassles severity between groups (SWP or Control) for each of the seven subscales during the orientation academic period. General linear mixed models with random intercepts were used to compare groups on hassles severity during the first year of medical school while covarying on participants' corresponding hassles severity during the orientation academic period and the quarter. The interaction of group and academic period was included in the model to examine whether the pattern of hassles severity for each academic period varied across groups. Participants were assumed to be independent, and the within-participant correlation structure was unrestricted. When the interaction between group and academic period was significant, the groups were compared within academic period. Effect sizes were estimated using Cohen's d with an associated 95% confidence interval (CI).

General linear mixed models with random intercepts were used to test for differences between the orientation and other academic periods and between quarters on the hassles severity for each of the seven subscales. The interaction of academic period and quarter was included in the model to examine whether the pattern of hassles severity for each academic period varied across quarters. Participants were assumed to be independent, and the within-participant correlation structure was unrestricted. Post hoc analyses were performed comparing the orientation hassles severity with all other academic period and quarter combinations. When the interaction between academic period and quarter was significant, the academic periods were compared within quarter, and the quarters were compared within academic period. General linear mixed models with random intercepts were

also used to determine the most prominent types of hassles by comparing the hassles severities between the seven subscales for each of the academic periods.

3. Results

3.1 Participants

Of the recruited first-year medical students from the two medical schools, 172 volunteered to participate in the study (SWP group, n = 125; Control group, n = 47). A majority of participants were male (112/172, 65%; SWP group, 88/125, 70%; Control group, 24/47, 51%), single (122/172, 71%; SWP group, 81/125, 65%; Control group, 41/47, 87%), and White (135/172, 78%; SWP group, 100/125, 80%; Control group, 35/47, 74%). The mean ± SD age of participants was 24.8 ± 3.2 years (SWP group, 24.9 ± 3.1 years; Control group, 24.6 ± 3.4 years) with a range of 21 to 42 years.

3.2 Influence of a Student Wellness Program (Between-Group Comparisons)

For all MEHS-R subscales except Financial, the SWP group had lower hassles severity than the Control group during the orientation academic period (Table 2). Because of these differences between the groups at the start of the academic year, the participants' hassles severity during the orientation academic period was included as a covariate in the comparisons between groups on hassles severity during the other three academic periods (examination, routine, and vacation).

Table 2 Comparison of hassles experienced during medical school orientation by first-year medical students for those attending a medical school with an organized student wellness program (SWP group) and those attending a medical school with no student wellness program (Control group).

Hassles Severity by Hassles Subscale ^a	SWP Group Mean (95% CI)	Control Group Mean (95% CI)	F	df	p
Academic and Time Pressures	0.60 (0.51–0.69)	0.83 (0.68–0.98)	7.20	1, 170	0.008
Financial	0.59 (0.51–0.67)	0.74 (0.61–0.88)	3.48	1, 170	0.06
Social	0.31 (0.26–0.37)	0.47 (0.38–0.56)	8.46	1, 169	0.004
External Influences	0.27 (0.22–0.33)	0.41 (0.33–0.50)	7.31	1, 170	0.008
Day-to-Day Functioning	0.39 (0.33–0.45)	0.54 (0.44–0.63)	6.28	1, 170	0.01
Relationships with Immediate Family	0.21 (0.16–0.26)	0.31 (0.23–0.40)	4.15	1, 170	0.04
Health	0.34 (0.27–0.41)	0.52 (0.40–0.63)	6.82	1, 170	0.01

^a The possible score range was 0–3 points for hassles severity of each subscale. CI = confidence interval.

Comparisons of hassles severity by MEHS-R subscale between the SWP and Control groups are presented in Table 3.

Table 3 Comparison of hassles experienced by first-year medical students for those attending a medical school with an organized student wellness program (SWP group) and those attending a medical school with no student wellness program (Control group).

Hassles Severity by Hassles Subscale ^a	Academic Period						Effects	
	Examination		Routine		Vacation		Academic Period by Group <i>F, df, p</i>	Group <i>F, df, p</i>
	SWP Group Mean (95% CI)	Control Group Mean (95% CI)	SWP Group Mean (95% CI)	Control Group Mean (95% CI)	SWP Group Mean (95% CI)	Control Group Mean (95% CI)		
Academic and Time Pressures	0.97 (0.87–1.06)	1.26 (1.13–1.39)	0.70 (0.58–0.82)	0.50 (0.33–0.68)	0.45 (0.35–0.55)	0.53 (0.39–0.67)	15.73 2, 850	NA
	SWP < Control		NS		NS		<0.001	
Financial	0.41 (0.34–0.48)	0.48 (0.38–0.57)	0.43 (0.34–0.51)	0.45 (0.32–0.57)	0.28 (0.21–0.36)	0.48 (0.38–0.59)	4.31 2, 850	NA
	NS		NS		SWP < Control		0.01	
Social	0.30 (0.25–0.35)	0.38 (0.31–0.45)	0.27 (0.21–0.33)	0.24 (0.15–0.33)	0.19 (0.14–0.25)	0.28 (0.21–0.36)	4.75 2, 843	NA
	NS		NS		NS		0.009	
External Influences	0.21 (0.16–0.25)	0.31 (0.24–0.38)	0.16 (0.11–0.22)	0.21 (0.12–0.29)	0.22 (0.17–0.26)	0.25 (0.18–0.32)	1.79 2, 850	2.32 1, 181
	NA		NA		NA		0.17	0.13
Day-to-Day Functioning	0.46 (0.40–0.52)	0.61 (0.52–0.70)	0.42 (0.34–0.49)	0.40 (0.29–0.51)	0.34 (0.28–0.41)	0.40 (0.31–0.50)	4.71 2, 852	NA
	SWP < Control		NS		NS		0.009	
Relationships with Immediate Family	0.21 (0.16–0.26)	0.28 (0.22–0.35)	0.18 (0.12–0.24)	0.23 (0.14–0.32)	0.14 (0.09–0.19)	0.20 (0.13–0.27)	0.07 2, 852	3.34 1, 192
	NA		NA		NA		0.94	0.07

	0.34	0.43	0.35	0.34	0.35	0.38	1.64	0.63
Health	(0.27–0.40)	(0.34–0.52)	(0.27–0.42)	(0.23–0.46)	(0.29–0.42)	(0.29–0.48)	2, 852	1, 183
	NA		NA		NA		0.20	0.43

^a The possible score range was 0–3 points for hassles severity of each subscale. CI = confidence interval, NA = not applicable, NS = not significant (between-group comparison).

3.2.1 Between-Group Comparison: Academic and Time Pressures Hassles Severity

For the Academic and Time Pressures subscale, there was a significant interaction of group and academic period ($F(2,850) = 15.73, p < 0.001$) (Table 3, Figure 1). During examination academic periods, the Academic and Time Pressures hassles severity for the SWP group was significantly lower than the Control group after accounting for differences at the orientation academic period ($d = 0.58, 95\% \text{ CI} = 0.24\text{--}0.92$). There was no significant difference between the groups for the routine and vacation academic periods.

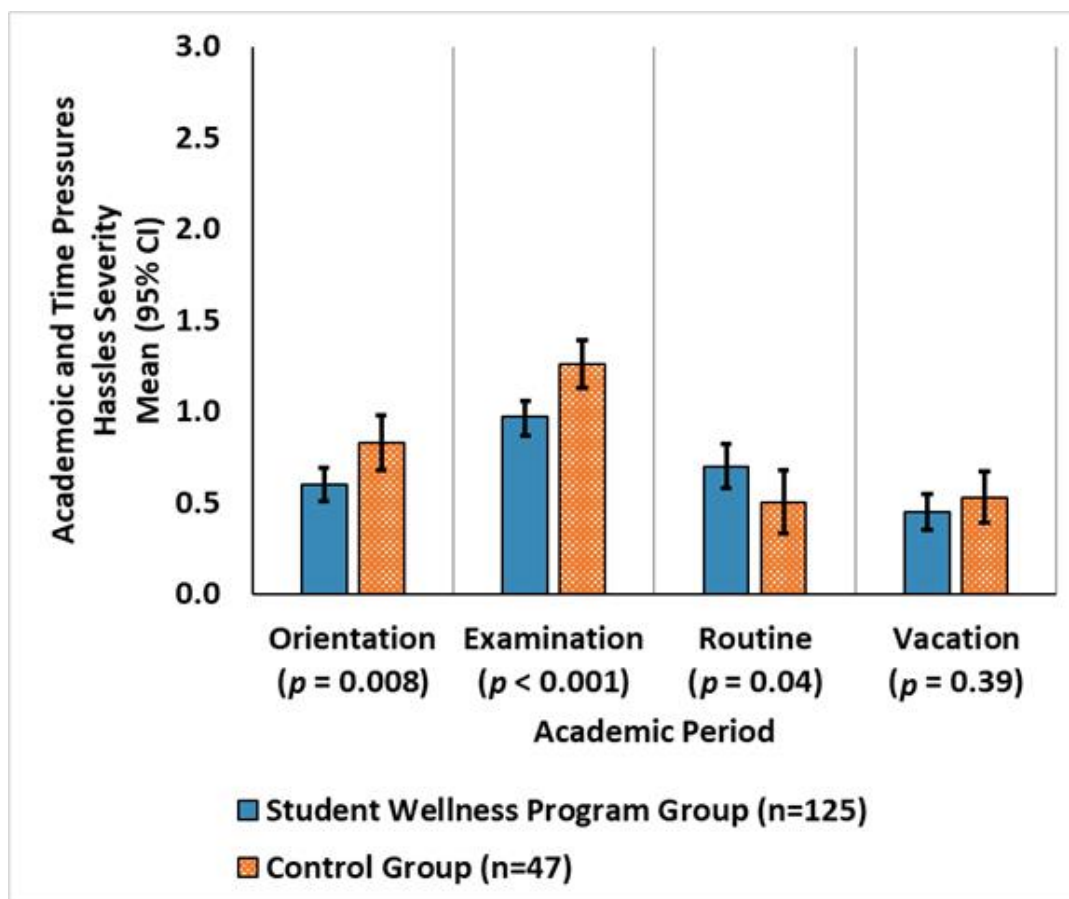


Figure 1 Academic and Time Pressures hassles severity by academic period comparing Student Wellness Program and Control groups. CI = confidence interval.

3.2.2 Between-Group Comparison: Financial Hassles Severity

For the Financial subscale, there was a significant interaction of group and academic period ($F(2,850) = 4.31, p = 0.01$) (Table 3, Figure 2). For the vacation academic period, the Financial hassles severity for the SWP group was significantly lower than the Control group after accounting for differences at the orientation academic period ($d = 0.50, 95\% \text{ CI} = 0.16\text{--}0.84$). There was no significant difference between the groups for the examination or routine academic periods.

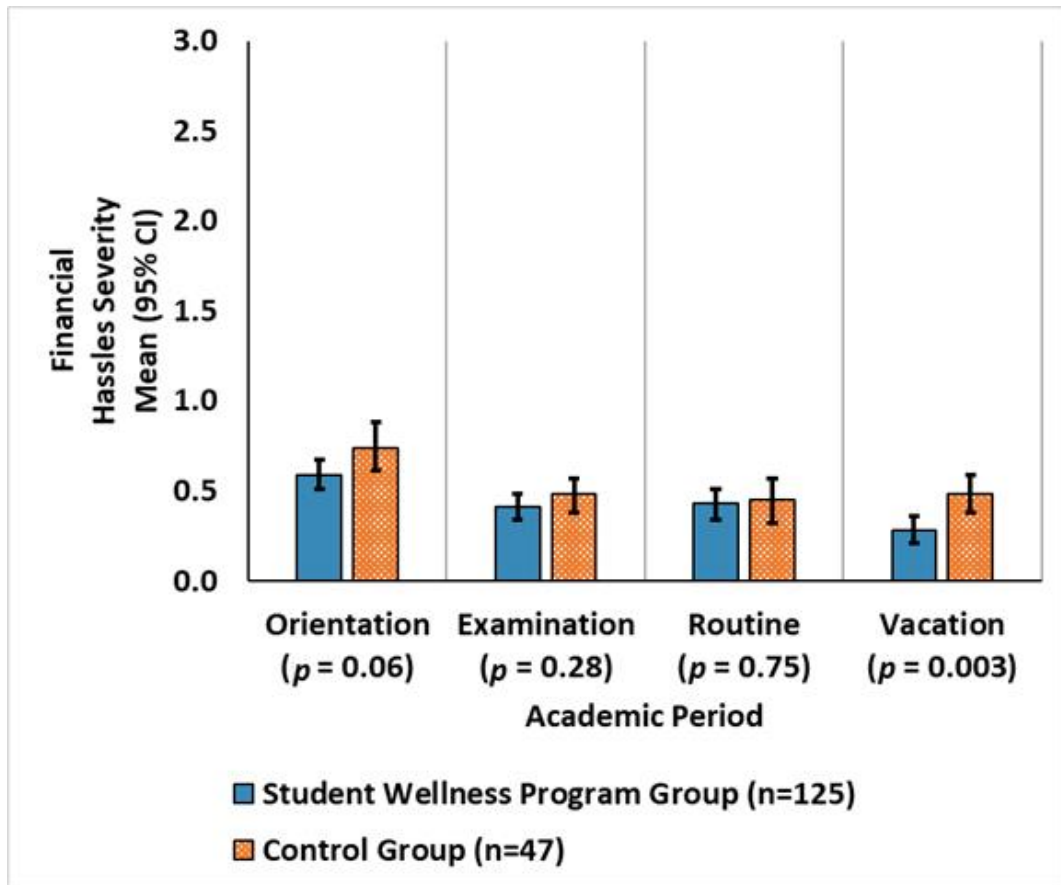


Figure 2 Financial hassles severity by academic period comparing Student Wellness Program and Control groups. CI = confidence interval.

3.2.3 Between-Group Comparison: Day-to-Day Functioning Hassles Severity

For the Day-to-Day Functioning subscale, there was a significant interaction of group and academic period ($F(2,852) = 4.71, p = 0.009$) (Table 3, Figure 3). During examination academic periods, the Day-to-Day Functioning hassles severity for the SWP group was significantly lower than the Control group after accounting for differences at the orientation academic period ($d = 0.46, 95\% \text{ CI} = 0.12\text{--}0.79$). There was no significant difference between the groups for the routine and vacation academic periods.

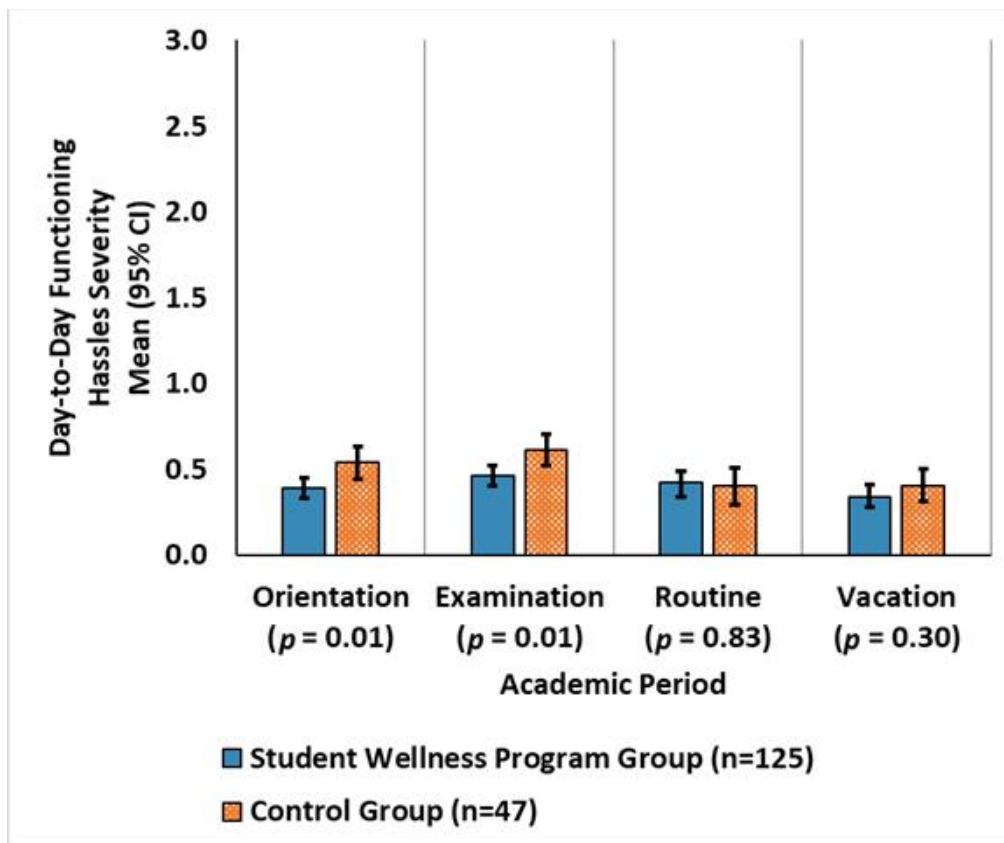


Figure 3 Day-to-Day Functioning hassles severity by academic period comparing Student Wellness Program and Control groups. CI = confidence interval.

3.2.4 Between-Group Comparison: Other MEHS-R Subscales

For the Social subscale, there was a significant interaction of group and academic period ($F(2,843) = 4.75, p = 0.009$), but there were no significant differences between the groups for any of the academic periods (Table 3). For the remaining three MEHS-R subscales (External Influences, Relationships with Immediate Family, and Health), there were no interactions of group and academic period and no significant differences between the groups.

3.3 Effect of Academic Period and Quarter

Comparisons of hassles severity, as measured by the MEHS-R, between academic periods and across quarters are presented in Table 4. For these comparisons, data from the SWP and Control groups were pooled.

Table 4 Comparison of hassles experienced by first-year medical students between academic periods and across quarters.

Hassles Severity by Hassles Subscale ^a	Quarter	Examination Mean (95% CI)	Routine Mean (95% CI)	Vacation Mean (95% CI)	Effects	Post hoc (Academic Periods) ^b
Academic and Time Pressures	Orientation	0.66 (0.57–0.75)				
	Q1	1.18 (1.10–1.26)	0.91 (0.82–1.00)	NA	Academic Period by Quarter: $F(3, 1590) = 4.41$ $p = \mathbf{0.004}$	E > R > O
	Q2	1.01 (0.92–1.10)	NA	0.55 (0.46–0.65)		E > (O, V)
	Q3	1.01 (0.92–1.11)	0.79 (0.69–0.89)	0.53 (0.39–0.67)		E > O, E > R > V
	Q4	0.88 (0.79–0.97)	NA	0.21 (0.12–0.30)		E > O > V
	Post hoc (Quarters) ^c	Q1 > (Q2, Q3) > Q4 > O		Q1 > (O, Q3)	(O, Q2, Q3) > Q4	
Financial	Orientation	0.63 (0.56–0.71)			Academic Period by Quarter: $F(3, 1587) = 0.86$ $p = 0.46$	^
	Q1	0.47 (0.40–0.54)	0.47 (0.40–0.54)	NA		Academic Period: $F(2, 1587) = 3.32$ $p = \mathbf{0.04}$
	Q2	0.43 (0.36–0.51)	NA	0.39 (0.31–0.46)		O > (E, R) > V

	Q3	0.37 (0.29–0.44)	0.35 (0.27–0.42)	0.35 (0.24–0.45)	Quarter: $F(4, 1584) = 25.98$ $p < \mathbf{0.001}$	
	Q4	0.39 (0.32–0.47)	NA	0.30 (0.23–0.38)		
	Post hoc (Quarters) ^c	< — — — O > Q1 > Q2 > (Q3, Q4) — — — >				v
	Orientation	0.35 (0.30–0.40)				
Social	Q1	0.35 (0.30–0.39)	0.32 (0.27–0.37)	NA		NS
	Q2	0.30 (0.25–0.35)	NA	0.24 (0.19–0.28)	Academic Period by Quarter: $F(3, 1584) = 2.80$ $p = \mathbf{0.04}$	(O, E) > V
	Q3	0.28 (0.24–0.33)	0.24 (0.18–0.29)	0.26 (0.19–0.33)		O > (E, R, V)
	Q4	0.28 (0.23–0.33)	NA	0.16 (0.11–0.21)		O > E > V
	Post hoc (Quarters) ^c	O > (Q3, Q4) Q1 > (Q2, Q3, Q4)	(O, Q1) > Q3	O > (Q2, Q3) > Q4		
	Orientation	0.31 (0.27–0.36)				
External Influences	Q1	0.27 (0.23–0.31)	0.24 (0.19–0.28)	NA	Academic Period by Quarter: $F(3, 1587) = 7.64$ $p < \mathbf{0.001}$	O > (E, R)
	Q2	0.21 (0.16–0.26)	NA	0.29 (0.24–0.33)		(O, V) > E

	Q3	0.22 (0.17–0.27)	0.18 (0.13–0.23)	0.14 (0.08–0.21)		O > (E, R, V)
	Q4	0.20 (0.15–0.25)	NA	0.17 (0.12–0.21)		O > (E, V)
	Post hoc (Quarters) ^c	(O, Q1) > (Q2, Q3, Q4)	O > Q1 > Q3	(O, Q2) > (Q3, Q4)		
Day-to-Day Functioning	Orientation	0.43 (0.37–0.49)				
	Q1	0.56 (0.51–0.62)	0.54 (0.48–0.60)	NA		(E, R) > O
	Q2	0.46 (0.40–0.52)	NA	0.44 (0.38–0.50)	Academic Period by Quarter: $F(3, 1589) = 9.46$ $p < \mathbf{0.001}$	NS
	Q3	0.47 (0.41–0.54)	0.41 (0.34–0.48)	0.33 (0.24–0.42)		E > V
	Q4	0.42 (0.36–0.49)	NA	0.21 (0.15–0.27)		(O, E) > V
	Post hoc (Quarters) ^c	Q1 > (O, Q2, Q3, Q4)	Q1 > (O, Q3)	O > Q4 Q2 > Q3 > Q4		
Relationships with Immediate Family	Orientation	0.24 (0.19–0.29)			Academic Period by Quarter: $F(3, 1595) = 1.03$ $p = 0.38$	^
	Q1	0.25 (0.21–0.28)	0.22 (0.17–0.26)	NA	Academic Period: $F(2, 1597) = 4.11$ $p = \mathbf{0.02}$	 (O, E, R) > V
	Q2	0.22 (0.18–0.27)	NA	0.17 (0.13–0.22)		

	Q3	0.19 (0.15–0.24)	0.21 (0.16–0.26)	0.17 (0.10–0.25)	Quarter: $F(4, 1590) = 1.78$ $p = 0.13$	 v
	Q4	0.20 (0.16–0.25)	NA	0.13 (0.09–0.18)		
	Post hoc (Quarters) ^c < — — — NA — — — >					
	Orientation	0.39 (0.33–0.46)				^
	Q1	0.39 (0.33–0.45)	0.39 (0.33–0.45)	NA	Academic Period by Quarter: $F(3, 1589) = 0.75$ $p = 0.52$	
	Q2	0.37 (0.31–0.44)	NA	0.36 (0.30–0.43)	Academic Period: $F(2, 1590) = 0.78$ $p = 0.46$	NA
	Q3	0.36 (0.30–0.43)	0.36 (0.29–0.43)	0.35 (0.26–0.45)	Quarter: $F(4, 1587) = 0.84$ $p = 0.50$	 v
	Q4	0.38 (0.31–0.44)	NA	0.32 (0.25–0.38)		
	Post hoc (Quarters) ^c < — — — NA — — — >					

Health

^a The possible score range was 0–3 points for hassles severity of each subscale. ^b Post hoc comparisons between academic periods. Comparisons were made within each quarter when the academic period by quarter interaction was significant. ^c Post hoc comparisons between quarters. Comparisons were made within each academic period when the academic period by quarter interaction was significant. CI = confidence interval, E = examination, NA = not applicable, NS = not significant, O = orientation, Q1 = quarter 1, Q2 = quarter 2, Q3 = quarter 3, Q4 = quarter 4, R = routine, V = vacation.

3.3.1 Academic Period and Quarter Comparison: Academic and Time Pressures Hassles Severity

There was a significant interaction of academic period and quarter for the Academic and Time Pressures subscale ($F(3, 1590) = 4.41, p = 0.004$) (Table 4, Figure 4). Academic and Time Pressures hassles severity during the orientation academic period was lower than during all examination academic periods and the Q1 routine academic period, higher than the Q4 vacation academic period, and not different from the Q2 vacation academic period and the Q3 routine and vacation academic periods.

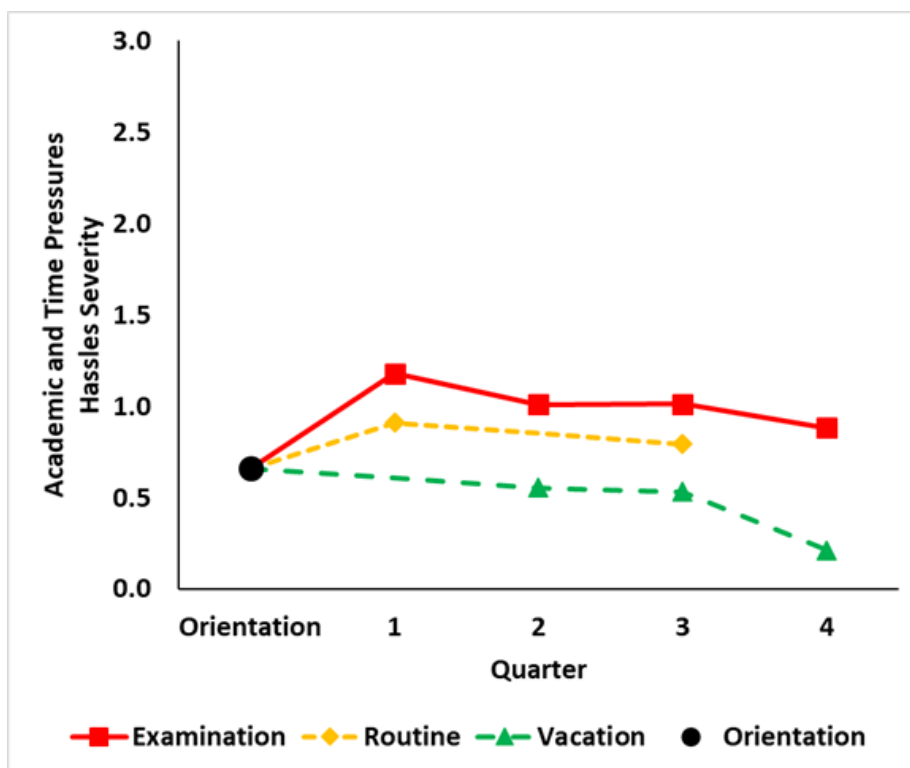


Figure 4 Academic and Time Pressures hassles severity by academic period and quarter during the first year of medical school.

During examination academic periods, Academic and Time Pressures hassles severity were highest for Q1 and lowest for Q4. During routine academic periods, Q1 had significantly higher Academic and Time Pressures hassles severity than Q3. During vacation academic periods, Q2 and Q3 had higher Academic and Time Pressures hassles severity than Q4.

During each of the four quarters, Academic and Time Pressures hassles severity during examination academic periods was significantly higher than the other academic periods. Additionally during Q3, Academic and Time Pressures hassles severity during the routine academic period was significantly higher than the vacation academic period.

3.3.2 Academic Period and Quarter Comparison: Financial Hassles Severity

There was no interaction of academic periods and quarters for the Financial subscale ($F(3,1587) = 0.86, p = 0.46$), but there was a significant difference between academic periods ($F(2,1587) = 3.32, p = 0.04$) and between quarters ($F(4,1584) = 25.98, p < 0.001$) (Table 4, Figure 5). Financial hassles

severity during the orientation academic period was higher than all other academic periods. Comparing between quarters, Financial hassles severity was highest during Q1 and lowest during Q3 and Q4. Comparing between academic periods, Financial hassles severity was significantly higher during examination and routine academic periods than vacation academic periods.

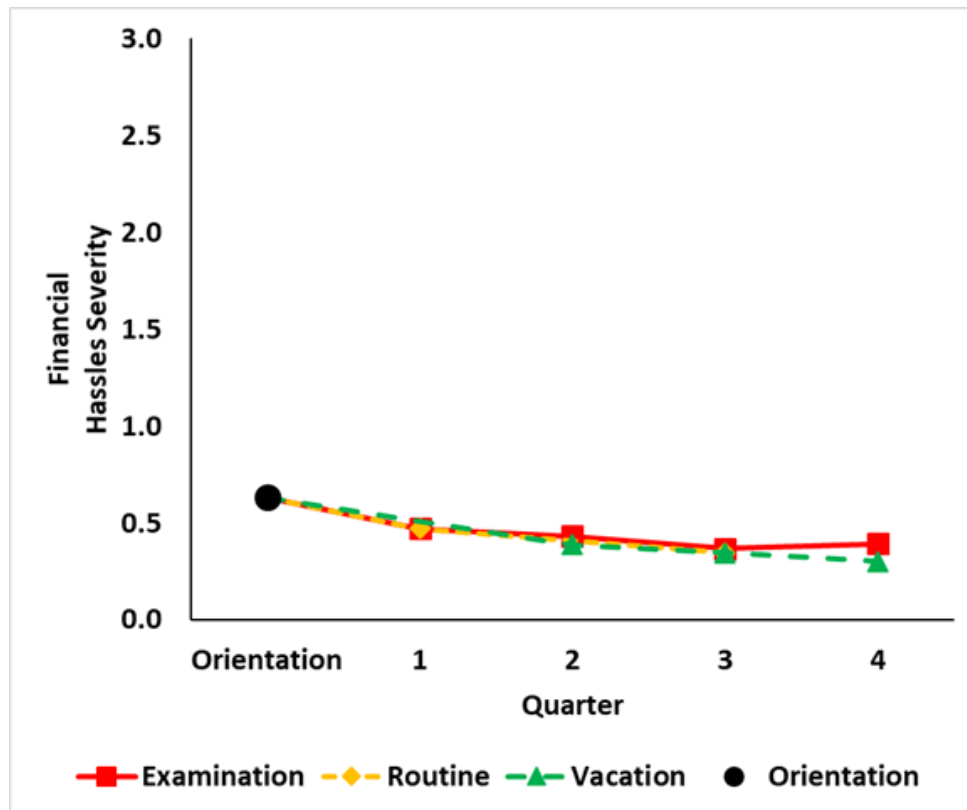


Figure 5 Financial hassles severity by academic period and quarter during the first year of medical school.

3.3.3 Academic Period and Quarter Comparison: Social Hassles Severity

There was a significant interaction of academic periods and quarters for the Social subscale ($F(3,1584) = 2.80, p = 0.04$) (Table 4). Social hassles severity during the orientation period was higher than the Q3 and Q4 examination, Q3 routine, and all vacation academic periods.

During examination academic periods, Social hassles severity was higher for Q1 than the other quarters. During routine academic periods, Q1 had significantly higher Social hassles severity than Q3. During vacation academic periods, Q2 and Q3 had higher Social hassles severity than Q4.

During Q2 and Q4, Social hassles severity during examination academic periods was significantly higher than vacation academic periods. During Q1 and Q3, Social hassles severity was not significantly different between the academic periods.

3.3.4 Academic Period and Quarter Comparison: External Influences Hassles Severity

There was a significant interaction of academic periods and quarters for the External Influences subscale ($F(3,1587) = 7.64, p < 0.001$) (Table 4). External Influences hassles severity during the

orientation academic period was higher than all other academic periods and quarters except for the Q2 vacation academic period.

During examination academic periods, External Influences hassles severity was higher for Q1 than the other quarters. During routine academic periods, Q1 had significantly higher External Influences hassles severity than Q3. During vacation academic periods, Q2 had higher External Influences hassles severity than Q3 and Q4.

During Q2, the vacation academic period External Influences hassles severity was significantly higher than the examination academic period. There were no differences between academic periods for any of the other quarters.

3.3.5 Academic Period and Quarter Comparison: Day-to-Day Functioning Hassles Severity

There was a significant interaction of academic periods and quarters for the Day-to-Day Functioning subscale ($F(3,1589) = 9.46, p < 0.001$) (Table 4, Figure 6). Day-to-Day Functioning hassles severity during the orientation academic period was lower than the Q1 examination and routine academic periods and higher than the Q4 vacation academic period.

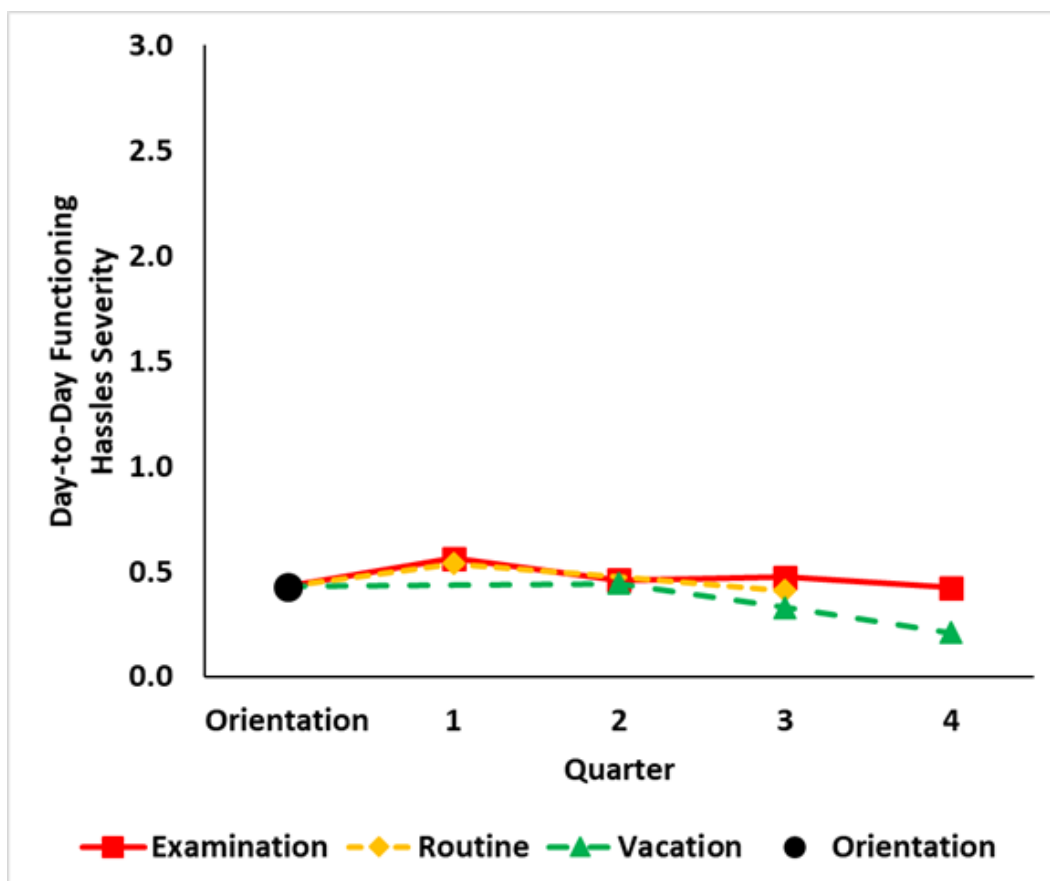


Figure 6 Day-to-Day Functioning hassles severity by academic period and quarter during the first year of medical school.

During examination and routine academic periods, Day-to-Day Functioning hassles severity was higher for Q1 than the other quarters. During vacation academic periods, Q2 had the highest Day-to-Day Functioning hassles severity, and Q4 had the lowest.

During Q3 and Q4, Day-to-Day Functioning hassles severity was significantly higher during examination academic periods than vacation academic periods. There were no differences between academic periods for Q1 and Q2.

3.3.6 Academic Period and Quarter Comparison: Relationships with Immediate Family Hassles Severity

There was no significant interaction of academic period and quarter for the Relationships with Immediate Family subscale ($F(3,1595) = 1.03, p = 0.38$) (Table 4). There was a significant difference between academic periods ($F(2,1597) = 4.11, p = 0.02$) but not between quarters ($F(4,1590) = 1.78, p = 0.13$). Relationships with Immediate Family hassles severity during the orientation academic period was higher than vacation academic periods.

Comparing between academic periods, Relationships with Immediate Family hassles severity was significantly higher during examination and routine academic periods than vacation academic periods.

3.3.7 Academic Period and Quarter Comparison: Health Hassles Severity

There was no significant interaction of academic period and quarter for the Health subscale ($F(3,1589) = 0.75, p = 0.52$) (Table 4). There were also no significant differences between academic periods ($F(2,1590) = 0.78, p = 0.46$) or quarters ($F(4,1587) = 0.84, p = 0.50$).

3.4 Comparison of Hassles Subscales on Severity

For all academic periods, there was a significant difference between the seven subscales on hassles severity (Figure 7). For the orientation academic period ($F(6,1031) = 52.77, p < 0.001$), the Academic and Time Pressures and Financial subscales had the highest hassles severity, followed by Day-to-Day Functioning and Health. Social, External Influences, and Relationships with Immediate Family had lower hassles severity. For the other three academic periods (examination: $F(6,5810) = 615.44, p < 0.001$; routine: $F(6,2220) = 177.52, p < 0.001$; vacation: $F(6,2534) = 45.00, p < 0.001$), the Academic and Time Pressures subscale had the highest hassles severity. The Day-to-Day Functioning, Financial, and Health subscales had hassles severity in the middle; the exact order depended on the academic period. The Social, External Influences, and Relationships with Immediate Family subscales had the lowest hassles severity, and the exact order, again, depended on the academic period.

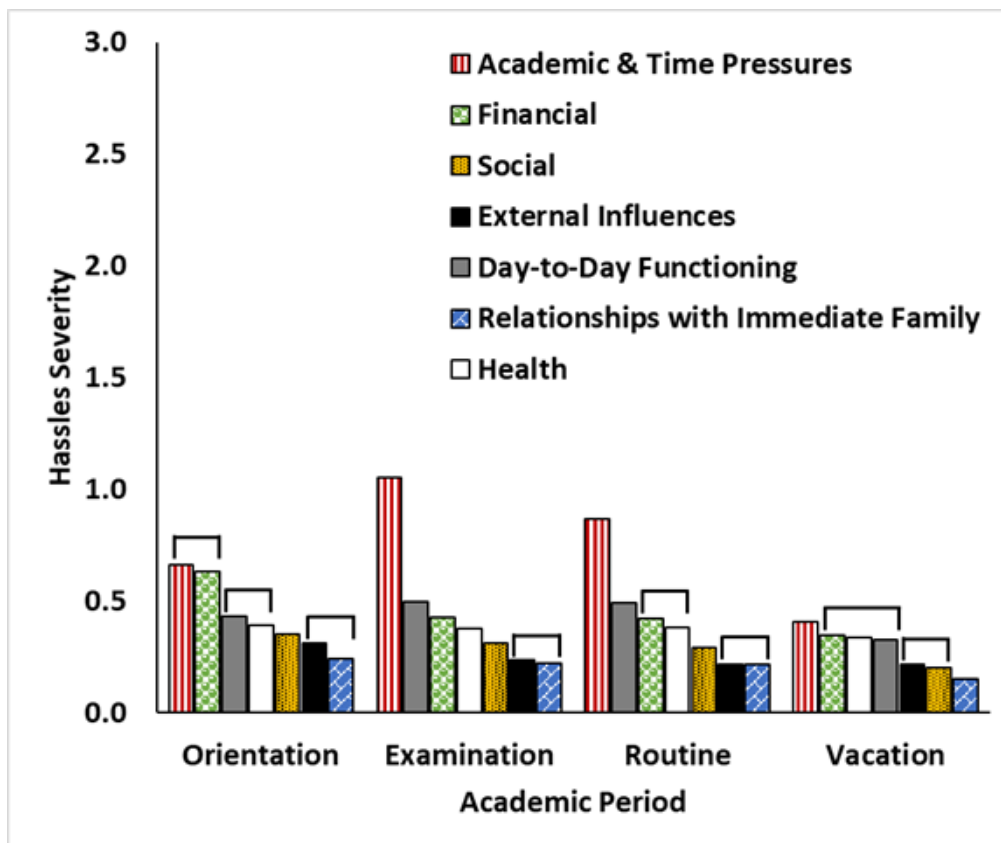


Figure 7 Prevalence of types of hassles during the first year of medical school. Subscales joined by square brackets were not significantly different from each other.

4. Discussion

4.1 Effect of a Holistic, Medical School-Sponsored Student Wellness Program on Acute Stress

The results of the current study indicated that some aspects of the acute stress experienced by students during their first year of medical school (i.e., Academic and Time Pressures, Day-to-Day Functioning, and Financial), as measured by the MEHS-R, can be lowered through holistic wellness programming. A well-designed and comprehensive SWP can have a positive effect on acute stress and assist medical students in maintaining a healthy academic and life balance. After accounting for differences at orientation, the medical students in the SWP group who participated in an organized SWP reported less acute stress from Academic and Time Pressures and Day-to-Day Functioning during examination academic periods than those in the Control group, and effect sizes were estimated to be medium. Similar results during examination academic periods have been reported in previous studies [35, 55, 56]. In a study investigating the effects of an elective stress management course, first-year medical students who participated in the course did not experience increased cortisol levels during an examination period when compared with students who did not participate in the elective course [56]. In a hypnosis study involving medical and dental students, students assigned to a hypnotic-relaxation intervention group and those assigned to a control group both had increased stress levels three days before an examination [55]. However, students in the intervention group appeared to be protected from the stress-related immunological dysregulation observed in the control group [55]. Another study examined including an SWP designed to promote

student well-being as part of the first-year medical school core curriculum [35]. The SWP focused on education, stress management, spirituality, exercise, nutrition, connectedness, and environment (ESSENCE lifestyle model) [35]. Participants in the SWP reported decreased psychological distress after completing the program even though the evaluation was conducted during the week preceding end of term examinations [35]. Our results support these findings that wellness programming can protect against acute stress experienced by medical students during examination academic periods; however, data on effect sizes for these previous studies were not available for direct comparison of our holistic wellness programming to these other wellness programs.

In the current study, those in the SWP group also reported less acute stress from Financial hassles during vacation academic periods with a medium effect size, but there was no difference between the groups on any aspect of acute stress during routine academic periods. Social hassles and hassles related to Relationships with Immediate Family were not significantly different between the SWP and Control groups during the first year of medical school. In contrast, medical students in India who participated in stress management skill training experienced decreased interpersonal-related stress with a medium effect size [39]. Although the SWP in the current study offered a variety of social opportunities for the medical students, this aspect of the program may have been similar to the Control group environment, or students from both medical schools were equally satisfied with their social opportunities. Because the severity of External Influences and Health hassles was low for both groups, the SWP would not be expected to have a significant influence on these types of acute stress.

Multiple studies have examined the influence of a variety of mindfulness, stress management, and relaxation interventions on stress levels of medical students, reporting mostly positive results, particularly immediately after completion of the intervention [42, 57-65]. However, results from two studies of mindfulness-based stress management programs indicated that the positive effects of the programs were not maintained after six months [59, 63]. In a randomized controlled trial at a medical school in Grenada, the authors reported no significant difference on perceived stress between students who completed their assigned 12-week structured wellness intervention to those who left the study; the estimated effect size was in the medium range ($d = 0.41$) [42]. In contrast, the students participating in one of the structured wellness interventions had no increase in their perceived stress over the 12-week intervention period when compared with the control group, which did have an increase ($d = 0.63$) [42]. These results suggest that a 12-week wellness intervention had positive effects on perceived stress, particularly when participation in the wellness intervention was maintained over the entire 12 weeks. Notably, the holistic wellness program of the current study was maintained throughout the entire first year of medical school, and the reduction of acute stress during examination academic periods was also maintained when compared with the Control group. These results highlight the importance of sustained student wellness programming for reducing acute stress, as recommended by the NASEM [1].

Other studies investigating the effects of exercise or physical activity on stress levels, either as a sole intervention or in combination with a mindfulness or relaxation intervention, have also shown mostly positive results [42, 43, 60]. In a nonrandomized study of first-year and second-year US medical students, students were assigned to three groups: a group fitness intervention, an individual or partner exercise group, or a control group of those who did not regularly exercise [43]. Participants in the group fitness intervention reported decreased perceived stress at the end of the intervention, but perceived stress for the other two groups was not significantly changed [43]. In

the randomized controlled trial at a medical school in Grenada, students were randomized to one of three 12-week structured wellness interventions (yoga, mindfulness, or walking) or a control group [42]. All three of the wellness interventions showed medium (yoga, $d = 0.51$) to large (mindfulness, $d = 0.74$; walking, $d = 0.83$) effect sizes immediately after the intervention (effect sizes were estimated using data included in the published paper) [42]. The structured nature of these wellness interventions may have increased participation, which in turn may have resulted in larger effects than those seen in the current study. The holistic wellness program in the current study encouraged the first-year medical students to participate in physical activities, including group fitness classes and intramural sports. Although the current study did not document participation in group fitness interventions, the encouragement the students received may have motivated their participation and contributed to the observed reduction of acute stress during examination academic periods.

During orientation, the SWP group reported significantly lower hassles severity than the Control group for all types of hassles except one. These differences between the groups at orientation necessitated the use of the orientation hassles severity as a covariate when comparing the SWP and Control groups. One possible explanation for these baseline differences is that the SWP began during orientation and was incorporated throughout orientation for the SWP group. Because wellness messaging about self-care is essential for success in medical school, the SWP provided students in the SWP group with information about support services for success before classes began. Additionally, there were inherent differences between the two medical schools regarding the student composition and campus environment that may have resulted in differences in acute stress levels during orientation. For example, the participants in the SWP group attended a private medical school, and participants in the Control group attended a public medical school. Similarly, in a study of students attending eight medical schools in Bangladesh, students attending public schools reported higher levels of stress than those attending private schools [20]. Future research involving additional medical schools, potentially using cluster randomization to assign schools to the SWP or Control groups, would potentially mitigate these differences at orientation.

4.2 Acute Stress Changes over the First Year and Differences between Academic Periods

In addition to examining the effect of a holistic SWP, the current study identified periods of high acute stress that occur in the medical education environment. As expected, most types of acute stress were highest during examination academic periods and lowest during vacation academic periods. However, acute stress from External Influences was higher during the Q2 vacation academic period than the same quarter examination academic period. This finding likely occurred because the students in the SWP group had an examination immediately after their vacation during that quarter. The results of the current study are similar to those of a previous study where approximately half of medical students in Serbia reported experiencing high stress related to examinations [66]. In contrast, in a study of changes in health habits during the first semester of medical school, students reported being more stressed during the middle of the term than during their final examinations, which corresponded with an increase in depression scores during the middle of the term [46]. After assessment during the middle of the term, over half of the students were randomized to receive a self-awareness intervention, a self-care intervention, or both; and these interventions may account for the decreased stress reported during final examinations [46].

These results [46] further support the findings from the current study that suggested interventions focused on student wellness can mitigate the effect of examinations on medical student acute stress levels.

Results of the current study also indicated that medical students started their training with acute stress related to finances, socialization, and external influences. Acute stress about academics increased in intensity from orientation to Q1 and then decreased as the quarters progressed. Similarly, concerns about finances, socialization, and external influences tended to decrease throughout the first year of medical school. These decreases in acute stress reported by the medical students in the current study contradicted findings from previous studies that reported acute stress increased during the first year of medical school [13, 53, 67-69]. Our result may be explained by adaptation over time or because almost three of four of the study participants were taking part in the SWP.

4.3 Highest and Lowest Types of Acute Stress

In addition to comparing acute stress levels between academic periods and between quarters, the current study examined which types of acute stress were most severe. The most persistent and severe stress experienced throughout the first year of medical school was, unsurprisingly, caused by Academic and Time Pressures, and the least severe were caused by Social, External Influences, and Relationships with Immediate Family. Acute stress from Financial hassles was initially as high as that from Academic and Time Pressures, but Financial hassles lessened throughout the first year to a level equal to or below acute stress from Day-to-Day Functioning and Health. Previous studies have reported that the primary source of medical student stress was equivalent to the hassles included in the MEHS-R Academic and Time Pressures subscale [14, 15, 70-73]. In a study of first-year and fourth-year medical students, participants described a recent stressful situation, and their responses were then categorized as either external or internal stressors [73]. Of the first-year medical students, 54% described internal stressors, and 23% of stressors were related to relationships with immediate family, 13.5% to social, 13.5% to health, and 4% to finances [73]. Similarly, in a survey of medical students in Florida, first-year medical students rated external influences (e.g., time spent commuting), social factors (e.g., romantic relationship management), relationships with immediate family (e.g., family demands), financial difficulties, and health factors (e.g., psychological/psychiatric conditions and other medical conditions) as contributing less strongly to their stress than academic factors [70]. These results were consistent with our finding that academic stress had the highest prevalence; however, financial stress in those previous studies [70, 73] had a lower prevalence than in our study. Holistic SWP that focus on the highest sources of stress (Academic and Time Pressures, Day-to-Day Functioning, Financial, and Health) may have an increased impact on student well-being.

4.4 Recommendations for Holistic, Medical School-Sponsored Student Wellness Programs

Overall, our results suggested several methods of lowering the stresses and pressures associated with medical school. First, because a coordinated and comprehensive SWP may reduce the acute stresses of medical school, it should be included as part of the curriculum, promoting a culture of well-being as recommended by the NASEM [1]. In one study, researchers surveyed medical students in Florida about their views on how to support their well-being during medical school [45].

Respondents' suggestions covered a variety of topics and included many of the components of the SWP experienced by our SWP group, such as socializing and peer support, nutrition, exercise, work-life balance, financial guidance, time management skills, and career guidance [45]. Ideally, a comprehensive SWP like the one experienced by our SWP group would be incorporated throughout the medical school experience and would holistically support students through academic services, counseling, financial advising, social engagement, and physical exercise. Second, because orientation is an important point of induction into medical school, it should be structured to present a message of wellness and self-care and to outline the support services available for creating a climate of caring [1]. Finally, students should be reminded to reach out for support, particularly during examination academic periods, and administrators should strive to destigmatize the process of asking for assistance. As recommended by the NASEM, regular assessments of students' well-being and awareness of the support available can help guide medical schools to adjust their SWP to address unique challenges experienced by their students [1].

4.5 Limitations and Future Research

Several limitations should be considered for the current study. Our study relied on self-reported perceptions of hassles. Therefore, this type of data may be influenced by bias related to social desirability. Further, individuals may have been less likely to report their personal hassles and provide more neutral responses on the MEHS-R. Additionally, since the study was conducted at two different medical schools, it is possible that the culture and climate of each school is represented by the responses of the participants. Previous research suggests that students attending public medical schools report higher levels of stress than those attending private medical schools [20], which is consistent with our reported differences at orientation. However, by including the orientation stress levels as covariates when comparing the two schools, the impact of this limitation was reduced although probably not eliminated.

To address the limitations outlined above and further advance the understanding of the impact of holistic medical school-sponsored wellness programs, there are many potential directions for continued research in this currently relevant and important topic area. Research is needed to examine the impact of holistic wellness programs beyond stress to the broader area of student well-being that includes mental, emotional, and physical health; substance use; burnout; and academic performance. Broadening the diversity of the participants is also critical for achieving a better understanding of acute stress during medical school and associated management strategies like wellness programs. Studies that include students attending urban medical schools, schools with more diverse ethnic and socioeconomic student populations, and students receiving different curricular and evaluation formats will allow for better generalization of the impact of acute stress and holistic wellness programs on medical students. Also, we see a need to determine whether holistic SWP specifically targeted to medical students are more successful in reducing stress and improving well-being than more generalized university-wide programs. Following medical students through their postgraduate training and into practice would help characterize unique stressors present at various stages of training, the lingering influences of stress experiences in medical school, and the long-term impact of holistic wellness programs on clinician and patient well-being. In keeping with the conceptual model of factors affecting clinician well-being and resilience proposed by the Action Collaborative on Clinician Well-being and Resilience, it would be interesting to

compare medical school programs in the United States with those in other regions, such as Scandinavia, with different training environments, health care systems, and other external factors [31]. Additionally, the current dataset provides a pre-COVID assessment of acute stress during medical school, which presents an opportunity to study the effects of the COVID pandemic on medical student stress and the effectiveness of holistic SWP by obtaining data from current students entering medical school. Studies comparing different models of holistic wellness programs, such as structured vs self-driven programs or programs targeted at specific types of acute stress before peak periods, could also improve the effectiveness of holistic wellness programs for reducing stress during medical school, thus eventually impacting clinician and patient well-being.

5. Conclusions

Medical school is a rigorous and demanding environment for students. However, there are options to mitigate associated stresses of this environment. Although academic stresses and daily pressures will likely always be a part of medical school, holistic medical school-supported student wellness programming can provide medical students with the skills they need to adapt and adjust to the stresses inherent in medical school and beyond in medical practice, improving not only their own well-being but also the well-being of their patients.

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Author Contributions

CKS and BFD designed the study; JCJ conducted the statistical analyses; JCJ reviewed the literature; all authors designed, wrote, critically reviewed, and edited the manuscript.

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Competing Interests

The authors have declared that no competing interests exist.

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