



ORIGINAL ARTICLE

Stress-induced immune-related diseases and health outcomes of pharmacy students: A pilot study

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Abstract Stress in health sciences students has been studied extensively. Nevertheless, only few studies have been conducted on pharmacy students and nothing was done to compare stress effects on the immune responses of Pharmacy and Doctor of Pharmacy (PharmD) students. The aim of this pilot study was (1) to measure the self-reported perceived stresses, immune-related diseases and health outcomes of pharmacy and PharmD students, (2) to investigate the relationship between perceived stresses, health outcomes and immune-related diseases and (3) to compare stress induced changes in the health and immune system of pharmacy and PharmD students. The study represents a cross sectional survey using an interviewer administered questionnaire about stress and students' health states during the fall semester of 2009/2010. At commencement of this study, 222 of pharmacy and PharmD participant students (113 and 109 respectively) from the third and uppermost levels of study were picked up randomly. They were found to perceive stress related to program intensity, lack of exercise and social activities, bad nutritional routines and accommodation. Effects of increased study loads on students' health and immune-related diseases were more pronounced on PharmD students, while showing significant changes on Pharmacy students. In general, more than 50% of students of each program got ill several times, mainly during the midterm period, had cold/flu, were under medical care and had problems in skin and/or hair. Also, PharmD students reported relatively higher levels of perceived stress and lower emotional and satisfaction quality of life compared to Pharmacy students. Results may help to increase the awareness of students to get prepared to what they might face, and may enable them to reduce the program's negative effects.

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1. Introduction

Stress may be defined as psychophysiological process usually experienced as a negative emotional state that generates a host of chemical and hormonal reactions in the body. The health effects of stress involve mainly autonomic, cardiovascular and immune systems where temporary stress can cause elevated blood pressure, headaches, stomachaches, sleeping problems, and chest pains (Farias et al., 2011; Ho et al., 2010; Sood et al., 2012). Many studies have shown that exposure to physical

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or psychological stress can affect disease outcomes in immune-related disorders such as viral and bacterial infections, contact dermatitis and allergy (Kemeny and Schedlowski, 2007). This is due to its capability in modifying and altering various features of the immune response such as making people vulnerable to increasing their susceptibility to infections, increasing their risk for upper respiratory tract infections (UTI) and triggering inflammatory responses leading to more colds and sickness in times of stress (Heffner, 2011; Ho et al., 2010; Höglund et al., 2006; Khanfer et al., 2010; Kiecolt-Glaser, 2010; Mathur and Pedersen, 2008; Pedersen et al., 2010; Segal et al., 2006; Segerstrom and Miller, 2004; Uchakin et al., 2001; Woods et al., 2009). They can also increase and decrease the defense mechanism depending on different factors, one of which is the duration of the stressful conditions (Cohen et al., 1998; Dragoş and Tănăsescu, 2010). Stress can be acute and short, or chronic and persistent. Studies on acute psychological stresses showed leukocytosis, increased natural killer (NK) cell cytotoxicity and reduced proliferative response to mitogens (Segal et al., 2006). On the other hand, chronic psychological stressors may lead to adverse health effects such as changes in the cardiovascular function and the development of coronary artery disease (CAD) (Ho et al., 2010; Marazziti et al., 2007). However, not all types of stress are harmful or even negative. The presence of certain genetic factors and stressful events in person's life can develop depression which is characterized as a disorder of both immune suppression and immune activation. Evidences show that depression can both activate and suppress the immune system function (Blume et al., 2011; Kiecolt-Glaser and Glaser, 2002). On the other hand, the body's ability to respond to environmental threats or stressors varies from one person to another.

University students were found to exert some forms of stress which have been used in experimental researches and most commonly seen in the student population (Bonnie et al., 2008; Dodd et al., 2010; Glaser et al., 1999; Preuss et al., 2010). Students react to university in a variety of ways. For some, university can be stressful if they were away from their homes and families. Living in the university student accommodation, in private accommodation or with relatives is another source of stress. The presence of excessive physical and/or emotional stress in the university student life can leave the resources of the immune system depleted, which may affect the immune system ability to cope with such changes leading to different immune-mediated diseases such as cold, flu, sore throat, hair and skin disorders (Alexis et al., 2004; Gloger et al., 1997; Khanfer et al., 2010; Zhang et al., 2010). Studies have shown that in chronic stress, white blood cell count was below normal level and subjects became vulnerable to cold. So, once a person catches cold or flu, stress can exacerbate symptoms (Chen and Miller, 2007; Qureshi et al., 2002).

1.1. Faculty of pharmacy study system at the University of Jordan

The University of Jordan is a multi ethnic public university with multidiscipline. The Faculty of Pharmacy at the University of Jordan is one of its scientific faculties and has two undergraduate programs; B.Sc. in Pharmacy and B.Sc. in Doctor of Pharmacy (PharmD). Acceptance grade rate for PharmD program is higher than that for Pharmacy program. Pharmacy program is a 5 years study of 162 credit hours while

PharmD program is a 6 years study of 216 credit hours. Students of both programs have mostly common subjects during the first two years of study. Thereafter, each program has its own specific specialty topics and a few subjects in common. The academic system of study is based on credit hours. Credit hours are the number of study hours per week. They include complementary general topics (faculty and university requirements) and specialty topics (specific to each program of specialization). Credit hours are referred to as either total (all topics) or specialty topics. Normally, total credit hours are in the range of 15–18 per week while specialty topics credit hours are in the range of 12–16. Higher and lower loads will be referred to as overloads and underloads respectively. Students may be allowed to exceed 18 credit hours to a limited extent. The academic year at the University of Jordan comprises mainly both fall and spring semesters, each is of 16 weeks.

The intensive PharmD program compared to the Pharmacy program requires hard work and huge commitment for PharmD students which may produce more stress on their lives when compared to pharmacy students. Stress in health sciences students has been studied extensively, but little work has been completed regarding pharmacy students and nothing was done to compare the academic stress effects on the immune responses of Pharmacy and PharmD students. Such a study can help in improving the students' responsiveness towards their academic stress.

The purpose of this pilot study was to measure the self-reported perception of stress and the immune-related diseases, and to investigate the relationship between the perceived stress and the immune system response within a sample of Pharmacy and PharmD students. The study objectives were to: (1) examine perceived stress of the participants (sample); (2) examine the impact of perceived stress on the participants' emotional, social and satisfaction quality of life; (3) examine the health and immune-mediated diseases of the participants; (4) investigate the relationship between perceived stress by the participants and health and immune-mediated diseases; (5) compare stress and immune-mediated diseases of each program; Pharmacy program to PharmD program. This study could thus be of great academic, psychological and medical interest to improve the programs curricula and students' behavior and attitude towards the different stresses they face in their study. Also, it may be of interest to increase the awareness of students in each program to get prepared to what they might go through, and may enable them to reduce its negative effects. Moreover, it may be advantageous to other universities with almost the same system of teaching both programs.

2. Materials and methods

This study was carried out using a cross-sectional design, where an interviewer administered questionnaire was applied to a number of Pharmacy and PharmD students from mid (third year) and uppermost (fifth year then) levels of study at the Faculty of Pharmacy, University of Jordan, Amman, Jordan. The survey was designed to reveal information about stress as perceived by participants in the previous fall semester of 2009/2010. The number of students viewed to participate in this study was 300 students (150 from each program) representing about 40% of the total number of students in both mentioned levels and programs. It was arranged for participants to answer the survey questionnaire on a date within

Table 1 Sociodemographic characteristics of Pharmacy and PharmD students participating in a survey to assess perceived stress, health outcomes and immune-related diseases during the fall semesters of 2009/2010.

Personal concerns	Study program			
	Pharmacy (<i>n</i> = 113)		PharmD (<i>n</i> = 109)	
	No.	%	No.	%
Sex				
Male	38	33.6	16	14.7
Female	75	66.4	93	85.3
Married				
Male	0	0	0	0
Female	0	0	3	2.8
Study level				
Third year	56	51.9	52	48.1
Fifth year	57	50	57	50
Employment				
YES, but not supporting family	4	3.5	4	3.7
YES and supporting family	0	0	3	2.8
Accommodation				
With family	96	85	92	84.4
With relatives	4	3.5	3	2.8
Alone in private houses	10	8.8	4	3.7
Student accommodation	3	2.7	10	9.2

the first three weeks of the spring semester (during February) of the academic year 2009/2010, i.e. before getting stressed with the spring exams which might have an influence on their answers thereafter. Participants were assigned after getting permission from the professors teaching the third and the fifth year's classes of both programs to allow for my research assistants to hand over the survey forms to the allocated number of students during class periods, and to administer and collect the questionnaire forms from the respondents on the spot after completion. A verbal informed consent to participate in this study was first obtained from the responding students after briefing, discussing and answering questions regarding this survey by myself and my research assistants as was applicable. The respondents were 246 (130 of Pharmacy and 116 of PharmD students). But, thereafter, the number ended with 222 participants (113 of Pharmacy and 109 of PharmD students) who complied fully with the requirements of this study. To protect their anonymity, designated numbers for the participants were placed on the questionnaire forms. Participants were not promised of any reward, but were shown much appreciation and were thanked for their participation.

The questionnaire was developed by reviewing available surveys in the literature which used to measure students' academic stress such as Gadzella (1991) student-life stress inventory (SLSI), Insel and Roth (1985) Students Stress Scale and other potential sources of stress that were identified by the researcher (Burge, 2009; Womble, 2003). In assessing the health outcomes and the self-reported immune-related responses, the questions were created based on the Medical outcome study: Study-form (MOS SF-36) that was developed by Ware et al. (1993) and other sources indicating the health and immune related outcomes. Comparability with those surveys and the validity of the instrument were important factors in determining which questions to be included in this survey. The content validity of the instrument was ascertained by grounding the

questionnaire on literature review. Test for clarity was performed to evaluate the questionnaire and demonstrate the content validity by an expert committee of one clinical pharmacist, two clinical immunologists, one statistician and a clinical psychologist, ensuring its applicability to the students' community at the University of Jordan. To facilitate data collection, the questionnaire was translated into Arabic (mother language of participants) and handed over to respondents. Additionally, a preliminary test that was not included in the analysis of the final data was applied on a representative sample (around 5% of the target sample) (*n* = 20) to address any ambiguity in the questions and to determine whether the data would provide reliable information.

The purpose of this study is to detect if there is any correlation between experienced stresses that students perceive and their immune responses, taking into consideration that students may not be under the same amount of stress every single semester. Based on this assumption, the questionnaire was designed of four major parts in addition to a part about general personal information including age, sex, height, weight and marital status. Body mass index (BMI) was calculated from self-reported height and weight. The first part was about family concerns, accommodation and employment if applicable. The second part was about study concerns, current cumulative grade point average (CGPA) and satisfaction tendencies. The third part was about the daily hassles that can contribute to a student's health such as exercising, nutritional routines, smoking, having social activities and also the amount of sleeping. To determine the impact of university stress on student life, participants were asked to indicate the frequency of changes in their physical and emotional states and their attitudes during the fall semester of 2009/2010. Students described their immune system responses and health outcomes in the last part of the survey by indicating the changes in their health (such as having cold/flu, tonsillitis, hair problems, skin problems, getting

Table 2 Study related comparison between Pharmacy and PharmD students participating in a survey to assess perceived stress, health outcomes and immune-related diseases during the fall semesters of 2009/2010.

Study concerns	Program				<i>p</i> Value	X^2	<i>df</i>
	Pharmacy (<i>n</i> = 113)		PharmD (<i>n</i> = 109)				
	No.	%	No.	%			
<i>Total credit hours loads</i>							
< 15 credit hours	63	55.7	1	0.9	0.00	83.5	2
15–18 credit hours	48	42.5	95	87.2			
> 18 credit hours	2	1.77	13	11.9			
<i>Specialty topics credit hours loads</i>							
< 12 credit hours	38	33.6	2	1.83	0.00	43.5	2
12–16 credit hours	64	56.6	75	68.8			
> 16 credit hours	11	9.7	32	29.4			
<i>CGPA</i>							
< 2.00	8	7.1	0	0	0.01	13.3	4
2–2.49	30	26.5	21	19.3			
2.5–2.99	36	31.8	32	29.4			
3–3.64	31	27.4	41	37.6			
3.65–4.00	8	7.1	15	13.8			

Pearson's chi-square test was used to determine significance between pharmacy and PharmD students ($p < 0.05$).

medical care and hospitalization) and the frequency of their occurrence during that fall semester of 2009/2010. Health and immune-related data were all self-reported by the participants. Based on consultations with experts at the University of Jordan, the nature of the survey requested no Institutional Review Board approval bearing in mind that no questions of private nature or drug abuse were included.

Responses were coded and statistical analyses were calculated using SPSS, version 17 (SPSS, Inc., Chicago, IL). Pearson's chi-square was used to test for significant differences between Pharmacy and PharmD students' responses. Results were considered significant when p value was less than 0.05 and highly significant when p value was less than 0.01. In a few cases, some participants failed to answer some questions, resulting in missing data which were not estimated or used in analysis. Descriptive measures presented include percentages and corresponding degrees of freedom (df) and chi-square (X^2).

3. Results

3.1. Subjects

A total of 300 questionnaire forms were distributed randomly among the targeted students of whom only 222 fully responded to the requirements of the survey (response rate = 74%), comprising 113 Pharmacy students (75 (66.4%) females and 38 (33.6%) males) and 109 PharmD students (93 (85.3%) females and 16 (14.7%) males). None of the Pharmacy students was married while three of the PharmD female students were married. All participants were in the range of 20–22 years of age and their mean BMI was $22.03 \pm 0.23 \text{ kg/m}^2$ which was not found to have an effect on their health or induce stress. The majorities of the participant students (107 (94.7%) of Pharmacy and 98 (89.9%) of PharmD) reported that they were not anemic. Also, 86 (76.1%) of the Pharmacy and 82 (75.2%) of the PharmD were not allergic to chemicals, food or drugs.

3.2. The sociodemographic characteristics of the participants

The sociodemographic characteristics of Pharmacy and PharmD participant students are shown in Table 1. Most of those students in both programs were living with their families and/or relatives, but 13 (11.5%) and 14 (12.9%) of Pharmacy and PharmD students respectively were living in either private or student accommodations. Only 3 (23.1%) of those pharmacy students compared to 10 (71.4%) of those PharmD students were living in student accommodation. Most of the participants were not employed and the majority of those who were employed were mainly not supporting their families. That did not show significant effects on their health or induce stress ($p = 0.618$).

3.3. Study related characteristics

In this study, a marked difference in credit hours loads and GPA between Pharmacy and PharmD students was noticed ($p < 0.05$; chi-squared test). Table 2 shows a comparison between PharmD and Pharmacy participant students to determine whether the PharmD students were more crowded with credit hours loads and if such a case affected their GPA. The majority (95 (87.2%)) of the PharmD students were having normal total credit hours loads (15–18), whereas 63 (55.7%) of the Pharmacy students were having less than 15 total credit hours loads in that semester. On the other hand, when asked about their specialty topics credit hours loads, 75 (68.8%) of the PharmD students indicated having normal specialty topics credit hours loads (12–16), while another 32 (29.4%) of the PharmD students indicated having more than 16 credit hours loads. In the meantime, 64 (56.6%) of the Pharmacy students had normal specialty topics credit hours loads, while 38 (33.6%) had less than 12 specialty topics credit hours loads. Although PharmD students had more total and specialty topics credit hours loads, the majority of them showed significant higher GPA grades. In this concern, 41 (37.6%) of the PharmD students had grades in the range of 3–3.64 and none had less

than 2 grades during that fall semester, whereas 36 (31.8%) of the Pharmacy students had grades in the range of 2–2.99 and another 8 (7.1%) had less than 2 grades. To determine whether there were any external factors stressing students' life during that semester, 64 (58.7%) of the PharmD students indicated that they had lots of stresses not related to their study as compared to the rest 45 (41.3%) of the PharmD students who did not have any external stresses during that semester. The majority of the PharmD students had normal credit hours in both total and specialty topics. Meanwhile, 61 (53.9%) of the Pharmacy students had lots of stresses not related to their study and the rest 52 (46.1%) of the Pharmacy students did not have as such. The majority of the Pharmacy students were underloaded with both total and specialty topics.

3.4. The impact of perceived stress on the participants' psychological states

The impact of perceived stress on emotional and satisfaction quality of life among Pharmacy and PharmD student participants during the academic fall semester 2009/2010 is shown in Table 3. To determine the participants psychological states and feelings and if they had periods of depression and been upset during that fall semester, they were asked to indicate how many times they felt depressed, happy/laughing or upset/cry-

ing. Also, they were asked about how they viewed that semester and how they would consider it compared to the other semesters. Half of the Pharmacy and more than half of the PharmD participant students (57 (50.4%) and 68 (62.4%) respectively) felt depressed and unhappy most of the time. To investigate the effect of credit hours loads in this response, 29 (50.9%) of those Pharmacy depressed students had normal total credit hours loads, while 27(47.5%) of those Pharmacy depressed students had less than 15 credit hours loads ($p = 0.00$). On the other hand, 57 (83.8%) of those PharmD students had normal total credit hours loads, while only one (1.4%) of those depressed students had less than 15 credit hours loads ($p = 0.00$). PharmD students showed mixed feelings whereby 35 (32.1%) and 34 (31.2%) all felt depressed/unhappy most of the time while upset/crying and happy/laughing respectively from one to five times during that semester. Also, 28 (25.7%) and 22 (20.2%) of the PharmD students all felt depressed/unhappy most of the time while upset/crying and happy/laughing respectively more than five times during that semester ($p = 0.00$ and $p = 0.01$ respectively). Concerning their views about that semester, 28 (25.7%), 27 (24.8%) and 10 (9.2%) of the PharmD students found it normal, bad and the worst ever respectively as compared to other semesters ($p = 0.02$). On the other hand, 32 (28.3%) of the Pharmacy students had sometimes felt depressed/unhappy and found that semester to be normal

Table 3 Comparison between Pharmacy and PharmD students' psychological responses to the different university stresses during the fall semester of 2009/2010.

Psychological responses	Feeling depressed and unhappy during the fall semester of 2009/2010									
	Most of the time		Sometimes		Never		Pearson's test			
	No.	%	No.	%	No.	%	<i>p</i>	<i>df</i>	χ^2	
<i>Pharmacy (n = 113)</i>										
Participants' views										
The best	7	6.2	12	10.6	1	0.9	0.07	9	15.7	
Normal	23	20.4	32	28.3	3	2.6				
Bad	16	14.2	5	4.4	0	0				
The worst ever	11	9.7	3	2.6	0	0				
Number of times being upset/crying										
None	8	7.1	10	8.8	1	0.9	0.38	6	6.45	
One to five times	27	23.9	32	28.3	2	1.8				
More than five times	22	19.5	10	8.8	1	0.9				
Number of times being happy/laughing										
None	7	6.2	3	2.7	0	0	0.47	6	5.7	
One to five times	21	18.6	15	13.3	1	0.9				
More than five times	29	25.6	34	30.1	3	2.7				
<i>PharmD (n = 109)</i>										
Participants' views										
The best	3	2.8	9	8.3	0	0	0.02	9	19.7	
Normal	28	25.7	16	14.7	3	2.8				
Bad	27	24.8	9	8.3	0	0				
The worst ever	10	9.2	4	3.7	0	0				
Number of times being upset/crying										
None	5	4.6	7	6.4	1	0.9	0.00	6	38.8	
One to five times	35	32.1	27	24.8	2	1.8				
More than five times	28	25.7	4	3.7	0	0				
Number of times being happy/laughing										
None	12	11.1	2	1.8	0	0	0.01	6	17.3	
One to five times	34	31.2	11	10.1	1	0.9				
More than five times	22	20.2	24	22	2	1.8				

Pearson's chi-square test was used to determine significance between pharmacy and PharmD students ($p < 0.05$).

($p = 0.07$). Pharmacy students' responses did not show significant results for being upset/crying or happy/laughing ($p = 0.38$ or $p = 0.47$ respectively). But, when compared with the PharmD students' responses, 27 (23.9%) of the pharmacy students had been upset/crying from one to five times while being depressed/unhappy sometimes, whereas 35 (32.1%) of the PharmD students had also felt upset/cried from one to five times while being depressed/unhappy most of the time during that semester ($p = 0.014$). Meanwhile, 22 (19.5%) and 28 (25.7%) of the Pharmacy and PharmD students respectively had been upset/crying more than five times and depressed/unhappy most of the time during that semester ($p = 0.02$).

3.5. Factors affecting health

There are a number of factors that can contribute to a student's health as indicated in Table 4. Exercising, nutritional routines, smoking, social activities and the effect of sleeping hours all can contribute to how a student's health can be. Regarding this, 89 (78.8%) of the Pharmacy and 99 (90.8%) of the PharmD students did not smoke cigarettes ($p = 0.005$) and 45 (39.8%) of the Pharmacy and 31 (28.4%) of the PharmD students practiced exercises on a regular basis ($p = 0.103$). Also, only 25 (22.9%) of the PharmD students compared to 39 (34.5%) of the Pharmacy students had social-life activities ($p = 0.233$). Nutrition is also a problem for university students where only 46 (40.7%) and 44 (40.4%) of the Pharmacy and PharmD students respectively used to have three regular healthy meals per day during that semester ($p = 0.997$). On the other hand, the majority (88 (77.8%) of the Pharmacy and 84 (77.1%) of the PharmD) students used to sleep between five and eight hours daily ($p = 0.047$).

3.6. Health-related outcomes

To determine the health disorders during that semester, significant self-reported issues by the participants related to credit

hours loads are shown in Fig. 1. The majority of the students (83 (73.5%) of pharmacy and 92 (84.4%) of PharmD) indicated that they got ill during the fall semester 2009/2010 from one to three times ($p = 0.00$). Only 26 (23%) of the Pharmacy and 16 (14.7%) of the PharmD students stated that they did not get ill, while the rest got ill more than three times during that semester ($p = 0.00$). Also, 72 (63.7%) of the Pharmacy and 72 (66.1%) of the PharmD students indicated getting ill mainly during the midterm period of the fall semester 2009/2010 ($p = 0.00$). On the other hand, 65 (57.5%) of the Pharmacy and 53 (48.6%) of the PharmD students did not seek medical care ($p = 0.00$) and only 1(0.9%) of the Pharmacy and 7 (6.4%) of the PharmD students were hospitalized during that semester. The majority of the participants stated that their health during the last 6 months did not differ than before, while 43 (38.1%) of the Pharmacy and 43 (39.4%) of the PharmD felt a difference ($p = 0.00$). Stressed people might experience periods of quick short breath, and if they were asthmatic, stress might exacerbate asthma. In this concern, 27 (23.9%) of the Pharmacy and 40 (36.7%) of the PharmD students had periods of short breath during the fall semester of 2009/2010 while the rest did not ($p = 0.00$).

3.7. Immune-related diseases

Considering the immune-related diseases in responses to credit hours loads (Fig. 2), the majority of the participants (82 (72.6%) of the Pharmacy and 91 (83.5%) of the PharmD) stated that they caught cold/flu from one to three times ($p = 0.00$) and when asked whether they usually catch flu/cold easily during relaxation periods like holidays, 80 (70.8%) of the Pharmacy and 69 (63.3%) of the PharmD students answered NO ($p = 0.00$). In contradiction, 85 (75.2%) of the Pharmacy and 88 (80.7%) of the PharmD students did not have any bacterial infection (like tonsillitis) ($p = 0.00$). On the other hand, the effect of accommodation on students' health showed an increased susceptibility to bacterial infections and mainly

Table 4 Daily life factors that might affect Pharmacy and PharmD students' health participating in a survey to assess perceived stress, health outcomes and immune-related diseases during the fall semesters of 2009/2010.

Factors affecting health	Study program			
	Pharmacy ($n = 113$)		PharmD ($n = 109$)	
	No.	%	No.	%
Regular exercise				
Yes	45	39.8	31	28.4
No	68	60.2	78	71.6
Cigarette smoking				
Yes	24	21.2	10	9.2
No	89	78.8	99	90.8
Social activity				
Yes	39	34.5	25	22.9
No	74	65.5	84	77.1
Having three regular healthy meals/day				
Yes	46	40.7	44	40.4
No	67	59.3	65	59.6
Sleeping hours/day				
Less than 5 h	2	1.8	9	8.3
From 5 to 8 h	88	77.8	84	77.1
More than 8 h	23	20.4	16	14.7

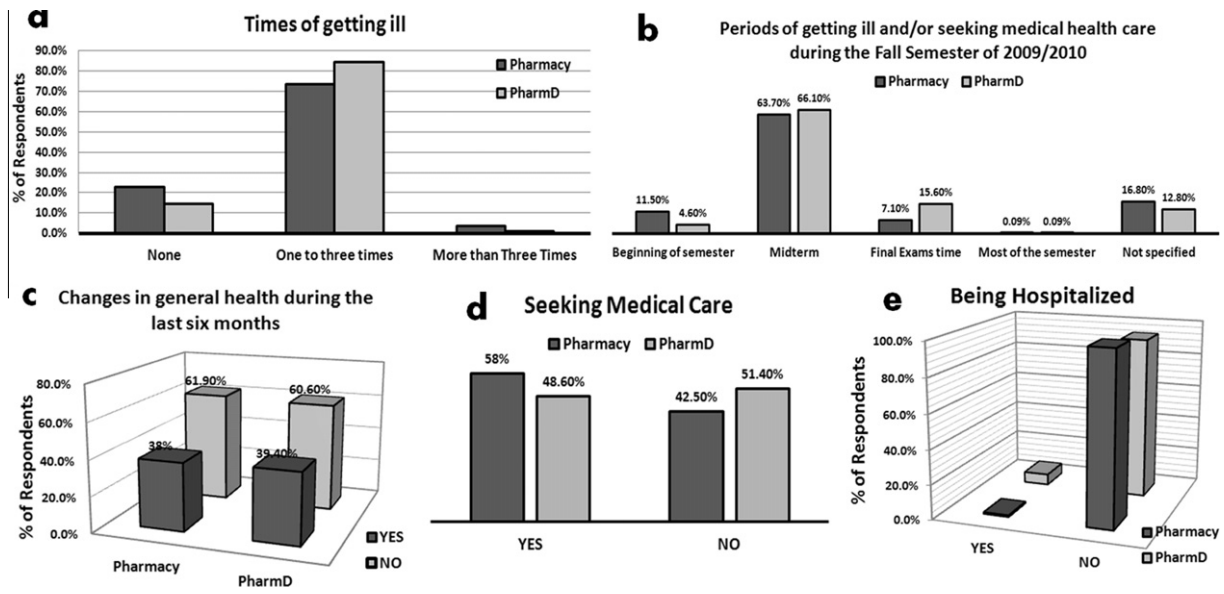


Figure 1 Health outcomes among Pharmacy and pharmD students participating in the survey.

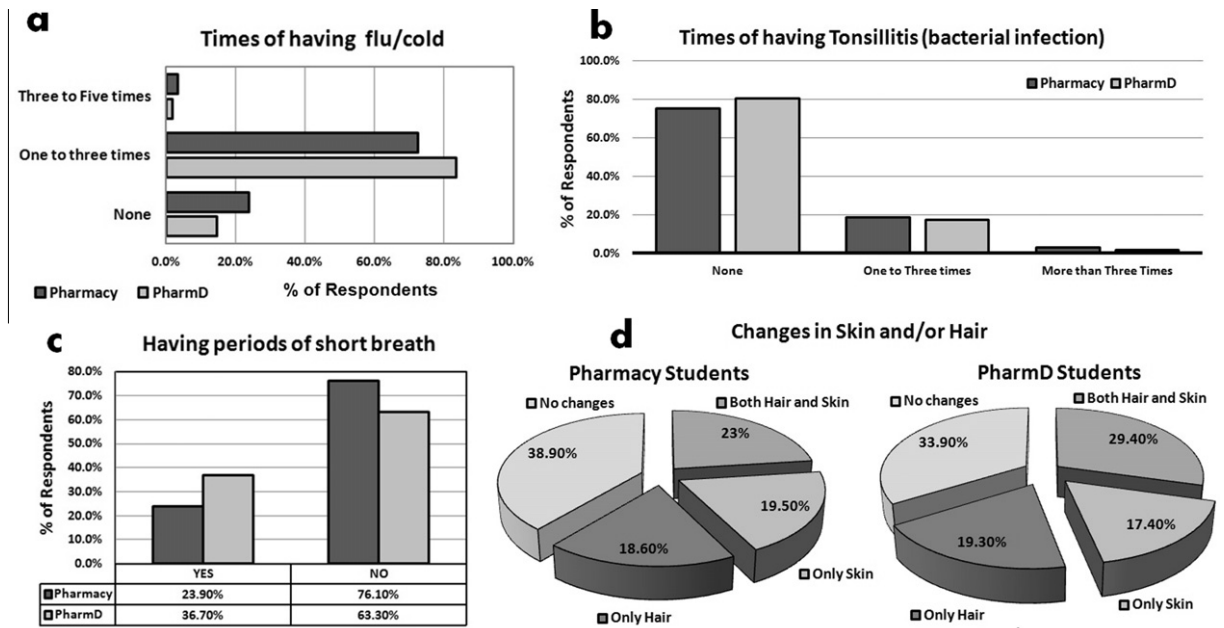


Figure 2 Immune-related disease among Pharmacy and PharmD students participating in the survey.

tonsillitis. The effect was significant mostly on PharmD students. In this context, 10 (9.2%) of the PharmD students were accommodated in the university student accommodation whereby six (60%) of them had tonsillitis from one to three times compared to only one out of three pharmacy students in the same type of accommodation who had tonsillitis ($p = 0.03$). Skin problems are signs of a weakened immune system. In this connection, 26 (23%) of the Pharmacy and 32 (29.4%) of the PharmD students had noticed both skin and hair problems ($p = 0.00$). Only 44 (38.9%) of the Pharmacy and 37 (33.9%) of the PharmD students did not notice any hair/skin problems ($p = 0.00$). The rest were divided into almost two equal groups; one had noticed hair problems only

and the other skin problems only ($p = 0.001$ and $p = 0.002$ respectively). This was consistent with recent studies showing that psychological stress adversely affects the immune system and exacerbates various skin and hair diseases such as psoriasis, alopecia areata and atopic dermatitis (Reich et al., 2010; Lyte et al., 1990).

4. Discussion

Students enrolled in Pharmacy or PharmD programs and participated in this study were found to perceive different kinds of stress such as program curriculum intensity, lack of exercise and social activities, bad nutritional routines and, for some

of them, student accommodation and sleep deprivation. These stresses can all pose students' own threat to affect their health as well as their academic performance. Several studies reported and evaluated stresses in Pharmacy and PharmD students, but almost all of them investigated their effects on students' mental health (Canales and Kranz, 2008; Hirsch et al., 2009; Marshall et al., 2008). Hirsch and colleagues (2009) observed an increased stress with reduced health-related quality of life across PharmD curriculum. Students' responses to the different stressors are variable; some might increase their immune defense mechanism during stressful times such as exams and hence increase their resistance to infections, while others might increase susceptibility to infections and be more prone to catching cold or flu (Biondi and Zannino, 1997; Cohen et al., 1998; Pedersen et al., 2010; Segerstrom and Miller, 2004).

From the findings of this study, it was evident that PharmD students were more stressed and more crowded with total and specialty topics credit hours loads. Still, they had higher grades than Pharmacy students of the same levels who were relaxed with less credit hour loads. In determining the stress factors affecting students' lives, credit hours loads were shown to have a strong impact. But, not all stresses were study related. Students were also under other stress factors affecting the social aspects of their lives and activities. Comparatively, PharmD students had less time for social activities and exercise. Also, almost 60% of the Pharmacy and PharmD students used to have three healthy meals each day. Moreover, the majority of the students from both programs had an average of 5–8 sleeping hours per day. Nevertheless, lack of exercise, imbalanced diet, sleeping disturbances, low social activities and intensity of the program can cause stress on student's life and affect his or her immune system. Studies have shown that exercises positively influence the immune function. Also, eating a healthy, balanced diet is an important part of maintaining good health (Kiecolt-Glaser, 2010; Mathur and Pedersen, 2008; Walsh et al., 2011; Woods et al., 2009). Other studies indicated that animals with low social activities were at higher risk for infection (Dowd et al., 2008; Dowd and Aiello, 2009). Also, sleeping disturbance and short sleep duration adversely affect human physical health and lack of sleep often has a negative impact on the quality of life, social activities and health (Boyum et al., 1996; Irwin et al., 2006; van Leeuwen et al., 2009).

On the other hand, half of the Pharmacy students felt depressed most of the time, while more than half of them considered it normal or the best semester. Meanwhile, more than half of the PharmD students felt depressed most of the time, while less than half of them found it normal or the best semester and the rest considered it bad and even the worst ever. In addition, PharmD students showed periods of mixed feelings during that fall semester, whereby sometimes they felt happy and laughing and at other times upset and crying, indicating that PharmD students might have had more reduced mental health-related quality of life compared to Pharmacy students. This was consistent with previous studies indicating relatively high levels of perceived stress among PharmD students with reduced mental health-related quality of life due to the intensity of their program (Canales and Kranz, 2008; Hirsch et al., 2009; Marshall et al., 2008).

The effect of stress on students' immune system and hence health was stated in the participants answers. Getting ill sev-

eral times, catching flu/cold and bacterial infections many times, having problems in skin and/or hair and experiencing periods of short breath were obvious among both Pharmacy and PharmD students with a more distinct effect on PharmD students. The kind of accommodation also showed a significant effect on PharmD students, mainly associated with increasing their susceptibility to bacterial infection and tonsillitis. Living in the university student accommodation during that semester was another major stressor for some of those students. University stresses related to the accommodation are considered chronic. This result is consistent with previous researches showing the effect of chronic stress in increasing the susceptibility of the upper respiratory tract to infections (Cohen et al., 1998; Pedersen et al., 2010). On the other hand, students felt ill and sought medical care mostly during the midterm period, which may indicate that university has another major impact on their health.

In conclusion, the negative relation between academic stress and immune-related health outcomes was proved. The high stress on the Faculty of Pharmacy students deserves attention, while their mental health condition seems to worth even more attention. PharmD students reported relatively higher levels of perceived stress and lower emotional and satisfaction quality of life compared to Pharmacy students. Higher levels of stress were negatively correlated with the students' immune-related diseases and psychological states. I believe this to be the first study that identifies and compares Pharmacy and PharmD students' immune responses to the different stresses they experience during their university study. Results from this pilot study may be of interest to other academicians and psychologists to improve the Pharmacy and PharmD programs curricula and students' behavior and attitude towards the different stresses they face in their study. Also, it may be of interest to increase the awareness of students in each program to get prepared to what they might go through, and may enable them to reduce its negative effects.

5. Limitations and future directions

Despite the richness of the questionnaire content, this study has certain limitations. The collected data in this pilot study was utilized as responses to each question and was not computed as scores. Another limitation lies in the observation that most of the pharmacy students who participated in this survey were females; however, this represents almost the actual distribution of genders at the Faculty of Pharmacy, University of Jordan. Furthermore, this study includes conducting only a one time measurement and inclusion of only 2 years levels of students at one university located in Amman, the Capital of Jordan. Therefore, a larger-scale study is needed on Faculty of Pharmacy students from all levels and from more than one university in Jordan and for a long term effect to define further the scope of the impact of university stress on the health and immune-related diseases among Pharmacy and PharmD students. Also, a further study is needed to identify other contributing factors to the high stress and immune-related diseases affecting Pharmacy and PharmD students, and to investigate the actual effectiveness of strategies to improve stress levels and immune-mediated diseases as students' progress through their programs.

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References

- Alexis, A.F., Dudda-Subramanya, R., Sinha, A.A., 2004. Alopecia areata: autoimmune basis of hair loss. *Eur. J. Dermatol.* 14 (6), 364–370.
- Biondi, M., Zannino, L.G., 1997. Psychological stress, neuroimmunomodulation, and susceptibility to infectious diseases in animals and man: a review. *Psychother. Psychosom.* 66 (1), 3–26.
- Blume, J., Douglas, S.D., Evans, D.L., 2011. Immune suppression and immune activation in depression. *Brain Behav. Immun.* 25 (2), 221–229.
- Bonnie, A., McGregor, Michael, H., Antoni, Rachel Ceballos, Bonnie, B., Blomberg., 2008. Very low CD19+ B-lymphocyte percentage is associated with high levels of academic stress among healthy graduate students. *Stress Health* 24 (5), 413–418.
- Boyum, A., Wiik, P., Gustavsson, E., Veiby, O.P., Reseland, J., Haugen, A.H., Opstad, P.K., 1996. The effect of strenuous exercise, calorie deficiency and sleep deprivation on white blood cells, plasma immunoglobulins and cytokines. *Scand. J. Immunol.* 43 (2), 228–235.
- Burge, J., 2009. Coping frequency, coping effectiveness, and personality factors in university students. Unpublished Honours thesis, University of Canberra, Australia.
- Canales, P.L., Kranz, P., 2008. Perceived stress by students in a pharmacy curriculum. *Education* 129 (1), 139–146.
- Chen, E., Miller, G.E., 2007. Stress and inflammation in exacerbations of asthma. *Brain Behav. Immun.* 21 (8), 993–999.
- Cohen, S., Frank, E., Doyle, W.J., Skoner, D.P., Rabin, B.S., Gwaltney Jr., J.M., 1998. Types of stressors that increase susceptibility to the common cold in healthy adults. *Health Psychol.* 17 (3), 214–223.
- Dodd, L.J., Al-Nakeeb, Y., Nevill, A., Forshaw, M.J., 2010. Lifestyle risk factors of students: a cluster analytical approach. *Prev. Med.* 51 (1), 73–77.
- Dowd, J.B., Aiello, A.E., 2009. Socioeconomic differentials in immune response. *Epidemiology* 20 (6), 902–908.
- Dowd, J.B., Haan, M.N., Blythe, L., Moore, K., Aiello, A.E., 2008. Socioeconomic gradients in immune response to latent infection. *Am. J. Epidemiol.* 167 (1), 112–120.
- Dragoş, D., Tănăsescu, M.D., 2010. The effect of stress on the defense systems. *J. Med. Life* 3 (1), 10–18.
- Farias, S.M., Teixeira, O.L., Moreira, W., Oliveira, M.A., Pereira, M.O., 2011. Characterization of the physical symptoms of stress in the emergency health care team. *Rev. Esc. Enferm. USP* 45 (3), 722–729.
- Gadzella, B.M., 1991. Student-life stress inventory: identification of and reaction of stressors. *Psychol. Reports* 74, 395–402.
- Glaser, R., Friedman, S.B., Smyth, J., Ader, R., Bijur, P., Brunell, P., Cohen, N., Krilov, L.R., Lifrak, S.T., Stone, A., Toffler, P., 1999. The differential impact of training stress and final examination stress on herpes virus latency at the United States Military Academy at West Point. *Brain, Behav., Immunity* 13, 240–251.
- Gloger, S., Puente, J., Arias, P., Fischman, P., Caldumbide, I., González, R., Quiroz, J., Echavari, O., Ramírez, C., 1997. Immune response reduced by intense intellectual stress: changes in lymphocyte proliferation in medical students. *Rev. Med. Chil.* 125 (6), 665–670.
- Heffner, K.L., 2011. Neuroendocrine effects of stress on immunity in the elderly: implications for inflammatory disease. *Immunol. Allergy Clin. North Am.* 31 (1), 95–108.
- Hirsch, J.D., Do, A.H., Hollenbach, K.A., Manoguerra, A.S., Adler, D.S., 2009. Students' health-related quality of life across the preclinical pharmacy curriculum. *Am. J. Pharm. Edu.* 73 (8), 147.
- Ho, R.C., Neo, L.F., Chua, A.N., Cheak, A.A., Mak, A., 2010. Research on psychoneuroimmunology: does stress influence immunity and cause coronary artery disease? *Ann. Acad. Med. Singapore* 39 (3), 191–196.
- Höglund, C.O., Axén, J., Kemi, C., Jernelöv, S., Grunewald, J., Müller-Suur, C., Smith, Y., Grönneberg, R., Eklund, A., Stiernä, P., Lekander, M., 2006. Changes in immune regulation in response to examination stress in atopic and healthy individuals. *Clin. Exp. Allergy* 36 (8), 982–992.
- Insel, P.M., Roth, W.T., 1985. *Core Concepts in Health*, fourth ed. Mayfield, Palo Alto, CA.
- Irwin, M.R., Wang, M., Campomayor, C.O., Collado-Hidalgo, A., Cole, S., 2006. Sleep deprivation and activation of morning levels of cellular and genomic markers of inflammation. *Arch. Intern. Med.* 166 (16), 1756–1762.
- Kemeny, M.E., Schedlowski, M., 2007. Understanding the interaction between psychosocial stress and immune-related diseases: a step-wise progression. *Brain Behav. Immun.* 21 (8), 1009–1018.
- Khanfer, R., Phillips, A.C., Carroll, D., Lord, J.M., 2010. Altered human neutrophil function in response to acute psychological stress. *Psychosom. Med.* 72 (7), 636–640.
- Kiecolt-Glaser, J.K., 2010. Stress, food, and inflammation: psychoneuroimmunology and nutrition at the cutting edge. *Psychosom. Med.* 72 (4), 365–369.
- Kiecolt-Glaser, J.K., Glaser, R., 2002. Depression and immune function: central pathways to morbidity and mortality. *J. Psychosom. Res.* 53 (4), 873–876.
- Lyte, M., Nelson, S.G., Thompson, M.L., 1990. Innate and adaptive immune responses in a social conflict paradigm. *Clin. Immunol. Immunopathol.* 57 (1), 137–147.
- Marazziti, D., Ambroggi, F., Abelli, M., Di Nasso, E., Catena, M., Massimetti, G., Carlini, M., Dell'Osso, L., 2007. Lymphocyte subsets, cardiovascular measures and anxiety state before and after a professional examination. *Stress* 10 (1), 93–99.
- Marshall, L.L., Allison, A., Nykamp, D., Lanke, S., 2008. Perceived stress and quality of life among doctor of pharmacy students. *Am. J. Pharm. Edu.* 72 (6), 137.
- Mathur, N., Pedersen, B.K., 2008. Exercise as a mean to control low-grade systemic inflammation. *Mediators Inflamm.* 2008, 109502.
- Pedersen, A., Zachariae, R., Bovbjerg, D.H., 2010. Influence of psychological stress on upper respiratory infection – a meta-analysis of prospective studies. *Psychosom. Med.* 72 (8), 823–832.
- Preuss, D., Schoofs, D., Schlotz, W., Wolf, O.T., 2010. The stressed student: influence of written examinations and oral presentations on salivary cortisol concentrations in university students. *Stress* 13 (3), 221–229.
- Qureshi, F., Alam, J., Khan, M.A., Sheraz, G., 2002. Effect of examination stress on blood cell parameters of students in a Pakistani medical college. *J. Ayub. Med. Coll. Abbottabad* 14 (1), 20–22.
- Reich, A., Wójcik-Maciejewicz, A., Slominski, A.T., 2010. Stress and the skin. *G Ital Dermatol. Venereol.* 145 (2), 213–219.
- Segal, A.B., Bruno, S., Forte, W.C., 2006. Immune function in acute stress. *Allergol. Immunopathol. (Madr)* 34 (4), 136–140.

- Segerstrom, S.C., Miller, G.E., 2004. Psychological stress and the human immune system: a meta-analytic study of 30 years of inquiry. *Psychol. Bull.* 130 (4), 601–630.
- Sood, P., Priyadarshini, S., Aich, P., 2012. Psychological stressors as interventions: good out of the evil. *Front. Biosci. (School Ed.)* 4, 43–60.
- Uchakin, P.N., Tobin, B., Cabbage, M., Marshall Jr., G., Sams, C., 2001. Immune responsiveness following academic stress in first-year medical students. *J. Interferon Cytokine Res.* 21 (9), 687–694.
- van Leeuwen, W.M., Lehto, M., Karisola, P., Lindholm, H., Luukkonen, R., Sallinen, M., Härmä, M., Porkka-Heiskanen, T., Alenius, H., 2009. Sleep restriction increases the risk of developing cardiovascular diseases by augmenting proinflammatory responses through IL-17 and CRP. *PLoS One* 4 (2), e4589.
- Walsh, N.P., Gleeson, M., Shephard, R.J., Gleeson, M., Woods, J.A., Bishop, N.C., Fleshner, M., Green, C., Pedersen, B.K., Hoffman-Goetz, L., Rogers, C.J., Northoff, H., Abbasi, A., Simon, P., 2011. Position statement. Part one: Immune function and exercise. *Exerc. Immunol. Rev.* 17, 6–63.
- Ware, J.E., Snow, K.K., Kosinski, M., Gandek, B., 1993. SF-36 Health Survey Manual and Interpretation Guide. Health Institute, New England Medical Center, Boston, MA.
- Womble, L.P., 2003. Impact of Stress Factors on College Students Academic Performance. University of North Carolina.
- Woods, J.A., Vieira, V.J., Keylock, K.T., 2009. Exercise, inflammation, and innate immunity. *Immunol. Allergy Clin. North Am.* 29 (2), 381–393.
- Zhang, J., Li, L., Lu, Q., Xiao, R., Wen, H., Yan, K., Li, Y., Zhou, Y., Su, Y., Zhang, G., Li, W., Zhou, J., 2010. Acute stress enhances contact dermatitis by promoting nuclear factor-kappaB DNA-binding activity and interleukin-18 expression in mice. *J. Dermatol.* 37 (6), 512–521.