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Exploring awareness of health conditions associated with metabolic syndrome amongst pharmacy students

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ABSTRACT

Background: Despite the increasing global recognition of metabolic syndrome (MeS) as an underlying cause of cardiovascular risks, limited research has been conducted regarding the awareness of this emerging problem among pharmacy students. This study aims to determine pharmacy students' levels of knowledge and awareness concerning MeS and its associated cardiovascular risks.

Methods: A web-based survey was administered to 332 pharmacy college students from eight universities in Jordan during March 2017 and March 2018. The survey included questions related to seven conditions associated with MeS: diabetes, adiposity, hypertension (HTN), high serum cholesterol (hyperlipidemia), arteriosclerosis, stroke, and myocardial infarction (MI). Knowledge scores per question were categorized as follows: "good knowledge" if 81-100% of students answered correctly, "fair knowledge" if 51-80% answered correctly, and "poor knowledge" if 50% or fewer answered correctly. A poisson regression model was used to regress total knowledge scores on study parameters.

Results: Overall, the results indicated that pharmacy students were most familiar with knowledge about stroke, with an average percentage of correct answers of 65.8%. Conversely, students were least familiar with MI, as only 35.1% of the questions related to this condition were answered correctly. A significant gap in knowledge regarding HTN and MI was evident, as a good level of knowledge was lacking for all questions related to these two conditions. Gender (being a female), a student's cumulative grade point average (GPA), and the year in college (one to five years) were positively associated with higher knowledge levels.

Conclusions: The outcomes of this study suggest that awareness of MeS among pharmacy students is lacking in several important aspects. This study may have implications that can be effectively harnessed in pharmacy education modalities within the academic sphere.

Introduction

Undoubtedly, the contemporary literature revealed a high prevalence of Metabolic Syndrome (MeS) associated factors among young adults (1, 2). The early identification of MeS can induce pertinent intervention, hence, alleviating the burden of developing cardiovascular diseases later in life (3). This cannot be achieved unless the young perceive adequate knowledge and awareness to counter MeS significant risks (4). Former studies in the current literature targeting the early adulthood population highlighted the need to increase the awareness of MeS in order to promote healthy attitudes as they currently hold an unsatisfying level of knowledge about associated factors and conditions related to MeS (5, 6).

Despite the surge of studies investigating MeS, few were directed to verify a comprehensive understanding of the causing risks among medical students (7-9). It is worthwhile to direct medical college students' perception towards this epidemic health challenge and equip undergraduates with imperative knowledge to decrease MeS in the community. It is empirical to understand the MeS concept and its different composing components while discussing it with the general public (10-12). With their unique settings and open access to the public, ill or not, aware and qualified community pharmacists are out -front to make a positive contribution to the MeS field (13). To our knowledge, the awareness level of pharmacy students (referred to as students in the manuscript) concerning MeS associated factors has not been appraised elsewhere.

This prospective study aimed to investigate the MeS awareness in the perspective of pharmacy college students concerning health-related risk factors and complications. In addition, this study aimed to examine the factors associated with better knowledge amongst the students.

Methods

Study design

A cross-sectional, survey-based design research was conducted during 2017/2108, from March 2017 to March 2018. To obtain a representative sample, researchers approached students with a bachelor of pharmacy degrees from several accredited Jordanian universities, including public and private universities. Following the class instructor's approval, students in classes were informed about the study aims and protocol and provided a written informed consent form. Participants have assured anonymity of data collected and complete personal information privacy.

Eligible students were consented and were provided a paper print of the survey hyperlink to pursue the self-administered web survey via their smartphones. Students were encouraged to work individually and take as much time as they needed to answer the questions. The outcome responses were then gathered for data entry and further analysis. It should be noted that students were not offered any remuneration for participation.

Participants

The researchers targeted a convenience sample of college-aged students pursuing a pharmacy degree in a Jordanian university institution. Eligible students enrolled in the study met the following inclusion criteria: registered as a full-time student during the study duration, aged 18 years and over, and have a good command of the English language (based on student's reporting).

The Survey

The survey was adopted from a previously published research by Becker and colleagues (14). It was designed via Google-Forms and administered in English since it is the official science language in Jordan. To minimize under/over responses, the questions were activated to preclude duplication and guaranteed that the answer was required before moving to another.

The survey comprised contextual questions centered on two main categories: socio-demographic background and sequence of questions to evaluate students' knowledge in the domain of MeS.

Regarding the first section, surveyed students were asked to provide open-ended and closed-ended responses to general information about gender, nationality, age, current residence place, height (meter) and weight (kilogram) for BMI estimation, alongside information about familial clinical history of chronic diseases. Academic related topics regarding students' university, current GPA (Grade Point Average) and the year level in college were also included, in addition to inquiry about lifestyle adaptations leading to MeS incidence, mainly physical activities performed weekly and smoking habits of cigarette, tobacco and hookah (oriental smoking instrument consisting of water container with long tube through which tobacco vapor is inhaled).

The second section was tailored to assess students' knowledge through 90 questions exploring seven health conditions related to MeS, with an overlook on the suggested treatments. The questions were assigned as follows: 16 questions assigned to diabetes, nine questions to adiposity, 12 questions to hypertension (HTN), six questions to elevated serum cholesterol (Hyperlipidemia), 17 questions to arteriosclerosis, 12 questions about stroke, and 18 questions to myocardial infarction (MI). In this section, questions were styled as closed-ended so that participants' knowledge about the subject could be concluded, as they responded with "True," "False," or "I Don't Know."

The survey was piloted with 15 random students for clarity of content, easy hyperlink access and design verification. Adjustments were performed as needed.

Measuring tools

The key target of this study was to evaluate the present knowledge level of main health conditions deeply relevant to risks and complications arising from MeS. This was measured by grading the responses of "True," "False," and "I Don't know" allied to each statement; one point was given to the "Correct Answer," and a zero to the "Wrong" or "I Don't Know" response. The maximum total score assessed for MeS knowledge was 90 points. More than that, participants' level of knowledge was interpreted in further depth. It was decided that, if ≤ 50% of the participants answered a question correctly, the knowledge level was ranked as "poor", "fair" level rank was given for question answered by 51-80% of the students correctly, and for a range between 81-100% of the students answering a question correctly, the estimated knowledge was given a "good" level rank. It is noteworthy that the socio-demographic and clinical data responses were not graded.

Data Analysis

Obtained outcomes were directly downloaded from the Google-Forms platform into the computer database. Responses and frequencies were processed on a Microsoft office Excel readable sheet; thereby it was readable for analysis, then analyzed using IBM statistical package for social sciences (IBM SPSS Statistics, version 23.0, Chicago, Illinois). Data were analyzed based on gender as the impact of gender difference on academic performance was well-documented in the extant research for several disciplines (15-21).

Descriptive analysis was performed for socio-demographic and clinical characteristics besides students' responses to the 90 following questions. Continuous variables were expressed as mean ± standard deviation (SD) while proportions were expressed as proportions (percentages) and 95% confidence intervals. For all testing analyses, a probability p-value was estimated to determine statistical significance. Reported data for p-values were 2-sided and a value of p less than 0.050 was accepted as significant.

Poisson regression model was used to test for associations between study parameters including gender, GPA, nationality, BMI, university, place of residence, smoking habit, year in college and family history of chronic diseases with the total score of students' level of MeS knowledge. In this model, the dependent variable was the total score of the MeS knowledge survey. The remaining listed parameters were used as independent variables with the association between the dependent and independent variables based on the corresponding p-value. Normality of distribution was tested by Kolmogorov-Smirnov, while Levene's test was used to test for homogeneity of variance.

Results

Study Flow

Among 415 students approached at the pharmacy-oriented lectures within the involved eight different universities in the capital Amman and other governorates, only 39 students were deemed ineligible, yielding 376 eligible students invited to participate in the study. Of the 376 students, about 13 students refused to sign the informed consent and 31 students failed to complete the survey. Eventually, 332 surveyed students were included in the final analysis with a response rate estimated to be 80.0% Figure 1.

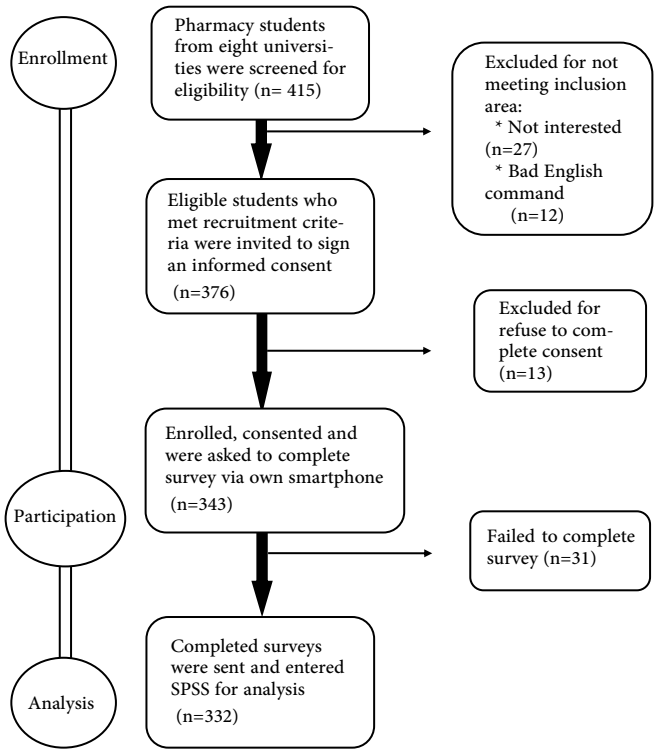


Figure 1. Study flow diagram showing numbers and retention of pharmacy college students through enrollment during the study period.

Socio-Demographic and Clinical Characteristics

The socio-demographic and clinical background analysis was performed comparing students' gender Table 1. The overall estimated BMI was 23.400 ± 3.98 kg/m^2, 34.7% of students were overweight students (BMI ≥ 25). Most surveyed students (83.4%, n=277) were in their third, fourth and last year of academic study with significant higher proportion of females (n=207, 62.3% females vs. n=70, 21.1% males; p=0.001). Of the 332 students, the highest proportion of surveyed students reported they earned a "good" average grade in pharmacy 37.2% (n=123) with a significant difference between the compared groups.

Table 1. Socio-demographics and clinical characteristics for pharmacy students, (n=332).

Variables	Females	Males	Total	p-value
Number of Students, n (%)	237 (71.4)[b]	95 (28.6)[b]	332 (100)	—
Year in College[c], n (%)				0.001 [a]
5[th] - year undergraduate	108 (32.5)	43 (13.0)	151 (45.5)	
4[th] - year undergraduate	41 (12.3)	12 (3.6)	53 (15.9)	
3[rd] - year undergraduate	58 (17.5)	15 (4.5)	73 (22.0)	
1[st] and 2[nd] - year undergraduate	30 (9.1)	25 (7.5)	55 (16.6)	
University, n (%)				0.005 [a]
Applied Science Private University (ASU)	154 (46.4)	46 (13.6)	200 (60.2)	
Others[c]	83 (25.0)	49 (14.8)	132 (39.8)	

Grade Point Average (GPA), n (%)				0.015 [1]
Excellent	66 (19.9)	13 (3.9)	79 (23.8)	
Very Good	61 (18.4)	21 (6.3)	82 (24.8)	
Good	79 (23.9)	44 (13.3)	123 (37.2)	
Fair	30 (9.1)	17 (5.1)	47 (14.2)	
Nationality, n (%)				< 0.001 [1]
Jordanian	107 (32.2)	18 (5.4)	125 (37.7)	
Iraqi	66 (19.9)	53 (16.0)	119 (35.8)	
Syrian	35 (10.5)	12 (3.6)	47 (14.2)	
Others [3]	29 (8.7)	12 (3.6)	41 (12.3)	
Place of Residence, n (%)				0.090 [1]
West Amman	153 (46.1)	49 (14.8)	202 (60.9)	
East Amman	63 (19.0)	35 (10.5)	98 (29.5)	
Other Governorates [4]	21 (6.3)	11 (3.3)	32 (9.6)	
Smoking Habits, n (%)				< 0.001 [1]
Smokers	25 (7.5)	40 (12.1)	65 (19.6)	
Non-Smokers	184 (55.5)	41 (12.3)	225 (67.9)	
Irregular Smokers	28 (8.4)	14 (4.2)	36 (12.6)	
Physical Activity [5], n (%)				0.068 [1]
Active	109 (32.8)	67 (20.2)	176 (53.0)	
Inactive	115 (34.7)	41 (12.3)	156 (47.0)	
Family History of Chronic Diseases*, n (%)				0.173 [1]
Hypertension	100 (30.1)	35 (10.5)	135 (40.6)	
Diabetes	76 (22.9)	36 (10.8)	112 (33.7)	
Cholesterol	44 (13.2)	11 (3.3)	56 (16.5)	
Heart Diseases	23 (6.9)	14 (4.2)	37 (11.1)	
Others [6]	48 (14.5)	31 (9.3)	79 (23.8)	
Age (years) Mean±SD	22.13 ± 1.61	22.36 ± 1.65	22.25 ± 2.63	0.010 [2]
Self-reported Weight (kg) Mean±SD	60.09 ± 8.61	77.66 ± 14.81	65.08 ± 13.33	< 0.001 [2]
Self-reported Height (cm) Mean±SD	162.89 ± 5.84	175.29 ± 7.88	166.42 ± 8.56	< 0.001 [2]
BMI (kg/m²) Mean±SD	22.64 ± 3.18	25.34 ± 5.04	23.400 ± 3.98	< 0.001 [2]

(n) number of students, **(SD)** Standard Deviation.
[1] Indicated numbers represent percentages from the grand total of the sample.
[2] Proportions of denoted variables differ significantly between gender subcategories (p-value < 0.050 between males and females).
[3] Others: include students from other Jordan universities like; Al-Zaytoona University of Jordan, Al-Isra University, Amman Arab University, Jordan University, Petra University, Philadelphia University, Zarqa Private university.
[4] Others: : include other nationalities listed by students; American, Bangladeshi, Kuwaiti, Libyan, Moroccan, Palestinian, Yemeni.
[5] Others: include other governorates than the capital included by students: Al-Zarqa, Irbid, Jerash, Kerak, Madaba.
[6] Respondents were considered physically active if they do moderate intensity activity at least 150 min weekly.
* Total % is more than 100% because of respondents with more than one family history of chronic disease.
[7] Others: include other family history of chronic diseases listed by respondents; Asthma, Cancer, Thyroid.
[8] Analysis using Chi-square test.
[9] Analysis using Independent sample t-test, (CI 95%).

Knowledge of Pharmacy Students Regarding MeS Health Related Conditions

Overall Knowledge

Table 2 summarized the average scores and correct answer proportions for each subject examined in the survey. On average, students showed higher knowledge level in stroke condition compared to other MeS health related topics, as they answered 65.8% of the questions correctly, with an average score of 7.89 out of total 12 points. Though, for question assigned for MI condition, not more than 35.1% were answered correctly by the students with average score of 6.32 from a total of 18 points. Indeed, more deep insight of students' knowledge assessment is presented in the following paragraphs.

Table 2. Summary of average scores and percentage of correct answers for each survey topic, (n=332).

Condition	Maximum Score	Average Score	SD*	Average percentage of correct answers
Diabetes	16	10.08	3.13	63.00
Adiposity	9	5.65	2.11	62.78
Hypertension	12	7.22	2.69	60.17
Cholesterol	6	2.86	1.27	47.67
Arteriosclerosis	17	8.30	3.68	48.82
Myocardial infarction	18	6.32	2.75	35.11
Stroke	12	7.89	3.57	65.75

***** Standard Deviation
n: number of students

Good Knowledge of Health Conditions associated with MeS

As Table 3 depicts, good knowledge was attributed to questions answered correctly by more than 80% of the students. In this scope, students were aware about types of diabetes (n=309, 93.1%) and impact of hereditary factors on developing diabetes (n=269, 81.0%). Moreover, 81.0% (n=269) of students recognized the complementary role of low-cholesterol diet in hyperlipidemia treatment and almost all surveyed students had clear knowledge of the definition of stroke (n=230, 96.3%). Nevertheless, no good-level knowledge was reflected for the HTN and MI conditions.

When comparing genders, female students showed a significantly higher score for good-knowledge in the aforementioned subjects. About diabetes, frequent symptom of urination and eye disorders' complication were reported significantly more correctly by female students (n=216, 65.1% females vs. n=77, 23.2% males; p=0.01) and (n=220, 66.3% females vs. n=70, 21.1% males; p <0.001) respectively. Considering adiposity, more females (62.7%) than males (22.0%, p=0.013) recognized that adipose individuals are at risk for suffering MI and comparable proportions realized the adiposity impact on developing arteriosclerosis (61.1% females and 20.2% males; p=0.001). In addition to the several types of stroke correctly noted by 61.7% females and 20.8% males (p=0.003) and arteriosclerosis high risk of suffering a stroke by 60.8% females and 21.7% males (p=0.041).

Table 3. Pharmacy students responses to the survey comparing gender differences [Good knowledge level][1], (n=332).

Conditions	Question	Correct Answer	Females	Males	Total	p-vale[2]
Diabetes	There are several different types of diabetes	True	224 (67.5)	85 (25.6)	309 (93.1)	0.102
	Hereditary factors play a major role in the development of diabetes.	True	197 (59.3)	72 (21.7)	269 (81.0)	0.124
	Eye disorders can be consequences of diabetes	True	220[3] (66.3)	70[3] (21.1)	290 (87.3)	< 0.001
	Frequent urination is a frequent symptom of diabetes.	True	216[3] (65.1)	77[3] (23.2)	293 (88.3)	0.010
Adiposity	Adipose individuals have an elevated risk of suffering heart infarction.	True	208[3] (62.7)	73[3] (22.0)	281 (84.6)	0.013
	Adipose individuals are more likely to suffer from arteriosclerosis.	True	203[3] (61.1)	67[3] (20.2)	270 (81.3)	0.001
High Blood Cholesterol	A low cholesterol diet can supplement therapy for high blood cholesterol.	True	198 (59.6)	71 (21.4)	269 (81.0)	0.064
Arteriosclerosis	Arteriosclerosis increases the risk of suffering a stroke	True	202[3] (60.8)	72[3] (21.7)	274 (82.5)	0.041
Stroke	A stroke affects the brain	True	166 (50.0)	64 (19.3)	230 (96.3)	0.633
	There are different types of strokes	True	205[3] (61.7)	69[3] (20.8)	274 (82.5)	0.003

[1] Percentage of students answered each question correctly between (81-100%), n: number of students
[2] Analysis using Chi-square test
[3] p-value < 0.050

When comparing genders, female students showed a significantly higher score for good-knowledge in the aforementioned subjects. About diabetes, frequent symptom of urination and eye disorders' complication were reported significantly more correctly by female students (n=216, 65.1% females vs. n=77, 23.2% males; p=0.01) and (n=220, 66.3% females vs. n=70, 21.1% males; p <0.001) respectively. Considering adiposity, more females (62.7%) than males (22.0%, p=0.013) recognized that adipose individuals are at risk for suffering MI and comparable proportions realized the adiposity impact on developing arteriosclerosis (61.1% females and 20.2% males; p=0.001). In addition to the several types of stroke correctly noted by 61.7% females and 20.8% males (p=0.003) and arteriosclerosis high risk of suffering a stroke by 60.8% females and 21.7% males (p=0.041).

Fair Knowledge of the Health Conditions Relevant to MeS

Table 4 displays questions answered correctly by 51-80% of the students. Regarding diabetes category, a significant better fair-knowledge was indicated by female students for: gestational diabetes (n=185, 55.7%; p=0.042) and arteriosclerosis as a consequence for diabetes (n=155, 46.7%; p=0.03). Yet, a non-gender significance was identified when students characterized diabetes with "too much sugar" entering the cells (n=130, 39.2%).

Table 4. Pharmacy students responses to the survey comparing gender differences [Fair knowledge level], (n=332).

Conditions	Question	Correct Answer	Females	Males	Total	p-vale*
Diabetes	Hereditary factors play only a minor role in the development of diabetes.	False	143, (43.1)	42, (12.7)	185 (55.7)	0.008
	Pregnant women have a reduced risk of acquiring diabetes.	False	172, (51.8)	54, (16.3)	226 (68.1)	0.005
	For some diabetics it is not advisable to take insulin.	True	157 (47.3)	60 (18.1)	217 (65.4)	0.593
	With diabetes, sugar cannot enter the cells sufficiently.	True	159 (47.9)	62 (18.7)	221 (66.6)	0.750
	With Diabetes, too much sugar enters the cells.	False	149 (44.9)	53 (16.0)	202 (60.8)	0.232
	Pregnant women have an increased risk of acquiring diabetes.	True	185, (55.7)	64, (19.3)	249 (75.0)	0.042
	Arteriosclerosis is one of the sequels of diabetes	True	155, (46.7)	50, (15.1)	205 (61.7)	0.030
	With Diabetes, sugar cannot diffuse in the blood.	False	156 (47.0)	52 (15.7)	208 (62.7)	0.059
Adiposity	Adiposity is not only caused by nutrition, other factors contribute as well.	True	196, (59.0)	67, (20.2)	263 (79.2)	0.013
	An excessively fatty, high-caloric diet is the only factor that determines adiposity.	False	168, (50.6)	50, (15.1)	218 (65.7)	0.002
	Cessation of breathing while sleeping is a possible consequence of adiposity.	True	170, (51.2)	56, (16.9)	226 (68.1)	0.024
	Adipose individuals have the same risk than non-adipose individuals of suffering a stroke.	False	164, (49.4)	52, (15.7)	216 (65.1)	0.012
	Adiposity can be treated surgically	True	177, (53.3)	60, (18.1)	237 (71.4)	0.036
Hypertension	Hypertension is associated with heredity	True	196, (59.0)	69, (20.8)	265 (79.8)	0.039
	Pregnant woman are less likely to suffer from hypertension.	False	158, (47.6)	51, (15.4)	209 (63.0)	0.027
	After medication has lowered hypertension, the medication can usually be discontinued.	False	167 (50.3)	61 (18.4)	228 (68.7)	0.267
	Pregnant women are as likely to suffer from hypertension as non-pregnant women.	False	139 (41.9)	45 (13.6)	184 (55.4)	0.062
	Individuals with hypertension are less likely to suffer from arteriosclerosis.	False	137 (41.3)	46 (13.9)	183 (55.1)	0.120
	Hypertension can cause dizziness	True	169 (50.9)	62 (18.7)	231 (69.6)	0.279
	Hypertension can be caused by disorders of the thyroid gland.	True	143 (43.1)	56 (16.9)	199 (59.9)	0.815
	Hypertension can cause renal damage.	True	171 (51.5)	63 (19.0)	234 (70.5)	0.292
	Hypertension can lead to eye disorders.	True	145 (43.7)	59 (17.8)	204 (61.4)	0.876
	Hypertension can be caused by cerebral tumors.	True	134 (40.4)	43 (13.0)	177 (53.3)	0.063
High Blood Cholesterol	High blood cholesterol can be treated with medication	True	160 (48.2)	60 (18.1)	220 (66.3)	0.448
	High blood cholesterol promotes arteriosclerosis	True	188, (56.6)	61, (18.4)	249 (75.0)	0.004
Arteriosclerosis	Leg pains are a symptom of arteriosclerosis	True	128 (38.6)	41 (12.3)	169 (50.9)	0.074
	With arteriosclerosis, arteries become less elastic.	True	134 (40.4)	57 (17.2)	191 (57.5)	0.564
	Arteriosclerosis can cause renal damage	True	128 (38.6)	43 (13.0)	171 (51.5)	0.150
	With arteriosclerosis, blood platelets accumulate on the arterial walls.	True	172, (51.8)	56, (16.9)	228 (68.7)	0.016
	With arteriosclerosis, fat accumulates on the arterial walls.	True	185, (55.7)	55, (16.6)	240 (72.3)	< 0.001
	Individuals with high blood pressure are more likely to suffer from arteriosclerosis.	True	143 (43.1)	52 (15.7)	195 (58.7)	0.349
	With arteriosclerosis, arteries become brittle.	True	140 (42.2)	53 (16.0)	193 (58.1)	0.584
Stroke	Permanent speech defects are possible consequences of a stroke.	True	182 (54.8)	65 (19.6)	247 (74.4)	0.114
	A stroke is often followed by memory dysfunction.	True	174, (52.4)	53, (16.0)	227 (68.4)	0.002
	A stroke is caused by artery obstruction.	True	138 (41.6)	48 (14.5)	186 (56.0)	0.201

	A stroke is preceded frequently by speech problems.	True	165٭ (49.7)	51٭ (15.4)	216 (65.1)	0.006
	Diabetics are more likely to suffer a stroke.	True	136٭ (41.0)	43٭ (13.0)	179 (53.9)	0.045
Heart Infarction	When suffering a heart infarction, pain may radiate into the arms.	True	151 (45.5)	53 (16.0)	204 (61.4)	0.180
	The oxygen supply to the heart is not affected by a heart infarction.	False	133 (40.1)	43 (13.0)	176 (53.0)	0.073
	Hereditary factors play a role in the risk of suffering a heart infarction.	True	154 (46.4)	57 (17.2)	211 (63.6)	0.394
	After a heart infarction, anticoagulants are administered.	True	150 (45.2)	54 (16.3)	204 (61.4)	0.275
	A heart infarction is often preceded by shortness of breath.	True	193٭ (58.1)	57٭ (17.2)	250 (75.3)	< 0.001
	A heart infarction is caused by arterial obstruction.	True	149 (44.9)	51 (15.4)	200 (60.2)	0.122
	After a heart infarction has occurred, parts of the cardiac muscle tissue can die.	True	167٭ (50.3)	54٭ (16.3)	221 (66.6)	0.017
	With a heart infarction, cardiac muscle tissue dies	True	142 (42.8)	56 (16.9)	198 (59.6)	0.871
	Diabetes is a predisposing factor for a heart infarction.	True	127 (38.8)	45 (13.6)	172 (51.8)	0.305

٭ Percentage of students answered each question correctly between (51–80%), n: number of students
- Analysis using Pearson's Chi-square test
٭p-value < 0.050

For adiposity, more female students provided correct responses concerning impact on; sleep apnea (n=170, 51.2% females and n=56, 16.9% males; p=0.024) and stroke (n=164, 49.4% females and n=52, 15.7% males; p=0.012). They recognized diet effect as a contributory - not solo- factor for adiposity (n=196, 59.0% females and n=67, 20.2% males; p=0.013), with considerable proportions implying that adiposity can be treated surgically (n=177, 53.3% females and n=60, 18.1% males; p=0.036).

More, female students had more knowledge about relating HTN to heredity (n=196, 59.0% females and n=69, 20.8% males; p=0.039) and pregnancy (n=158, 47.6% females and n=51, 15.4% males; p=0.027). Nonetheless, both compared groups disclaimed the relation between arteriosclerosis (n=149, 44.9%), cerebral tumors (n=155, 46.7%) and thyroid disorders (n=133, 40.1%) to HTN. Several students believed that HTN can cause renal damage (n=234, 70.5%), dizziness (n=231, 69.6%), eye disorders (n=204, 61.4%) and that medications can be discontinued when blood pressure is lowered (n=104, 31.3%).

Fair knowledge was realized when students recognized medicine as a therapy (n=220, 66.3%) for hyperlipidemia. Within arteriosclerosis category, female students revealed significant better knowledge associating hyperlipidemia to the cause (n=188, 56.6% females and n=61, 18.4% males; p=0.004), blood platelets accumulation (n=172, 51.8% females and n=56, 16.9% males; p=0.016) and fat accumulation (n=185, 55.7% females and n=55, 16.6% males; p<0.001) on arteries with the arteriosclerosis condition. Yet, lower proportions of students were able to relate renal damage (n=171, 51.5%) and leg pain symptom (n=169, 50.9%) to arteriosclerosis with no statistical significant difference between the genders.

Regarding stroke, both female and male students correctly referred stoke to artery obstruction 186 (56.0%), and 247 (74.4%) students reported possible speech defects complications. However, significant females' proportions correctly identified diabetes as a possible cause (n=136, 41.0% females; p=0.045), speech problems as a prior symptom (n=165, 49.7% females; p=0.006), and memory dysfunction being a common consequence of stroke (n=174, 52.4% females; p=0.002) compared to 43 (13.0%), 51 (15.4%) and 53 (16.0%) males respectively.

In MI context, significantly more female students were able to stipulate that: MI is signified with shortness of breath (n=193, 58.1% females and n=57, 17.2% males; p <0.001), oxygen supply to the heart being affected (n=133, 40.1% females and n=43, 13.0% males; p=0.073) and heart tissues dying (n=167, 50.3% females and n=54, 16.3% males; p=0.017). Besides, 204 (61.4%) and 204 (61.6%) of the students, females and males, respectively agreed that suffering MI pain may radiate into the arms and anticoagulants were suitable treatment.

Poor Knowledge of the Health Conditions Relevant to MeS

Poor knowledge was allied with questions answered correctly by half the students or less as interpreted within Table 5. Of the 332 students responding to diabetes questions, only 107 (32.2%) believed that diabetics may eat sweets not especially-made for diabetics. Lesser proportions (n=77, 23.2%) recognized false beliefs regarding alertness as a common symptom for diabetes, and 49.1% (n=163) did not relate poor appetite to the symptoms. Moreover, more than half of the students had false beliefs about the treatment, as only (n=125, 37.7%) correctly stated insulin injections not being a must therapy in certain cases.

Table 5. Pharmacy students responses to the survey comparing gender differences [Poor knowledge level], (n=332).

Conditions	Question	Correct Answer	Females	Males	Total	p-vale-
Diabetes	An increased alertness is a frequent symptom of diabetes	False	57 (17.2)	20 (6.0)	77 (23.2)	0.559
	Diabetics may only eat special sweets for diabetics.	False	78 (23.5)	29 (8.7)	107 (32.2)	0.674
	Poor appetite is a frequent symptom of diabetes.	False	123 (37.0)	40 (12.0)	163 (49.1)	0.107
	Diabetes patients must have insulin shots.	False	90 (27.1)	35 (10.5)	125 (37.7)	0.847
Adiposity	The terms' overweight' and 'adiposity' are synonyms.	False	100 (30.1)	37 (11.1)	137 (41.3)	0.587
	Liposuction is a state-of-the-art treatment in adiposity therapy.	False	19 (5.7)	10 (3.0)	29 (8.7)	0.464
Hypertension	For the most part, a concrete single reason of why a patient suffers from hypertension can be determined	False	101 (30.4)	31 (9.3)	132 (39.8)	0.093
	People with hypertension are as likely to suffer from arteriosclerosis as those with normal hypertension	False	117٭ (35.2)	35٭ (10.5)	152 (45.8)	0.038
High Blood Cholesterol	High blood cholesterol does not cause acute ailments	True	38 (11.4)	22 (6.6)	60 (18.1)	0.127
	High blood cholesterol is not associated with hereditary factors.	False	90 (27.1)	31 (9.3)	121 (36.4)	0.361
	Fatigue is a frequent symptom of high blood cholesterol.	False	18 (5.4)	13 (3.9)	31 (9.3)	0.085

Arteriosclerosis	With arteriosclerosis, arteries become softer.	False	127, (38.3)	35, (10.5)	162 (48.8)	0.006
	Arteriosclerosis can be cured completely	False	82 (24.7)	25 (7.5)	107 (32.2)	0.144
	With arteriosclerosis, arteries contract.	False	35 (10.5)	12 (3.6)	47 (14.2)	0.614
	As a result of arteriosclerosis, blood pressure is likely to decline	False	106 (31.9)	36 (10.8)	142 (42.8)	0.256
	As a result of arteriosclerosis, blood pressure is likely to increase.	True	48 (14.5)	25 (7.5)	73 (22.0)	0.228
	High blood pressure and arteriosclerosis are not linked with each other.	False	116 (34.9)	38 (11.4)	154 (46.4)	0.140
	In arteriosclerosis, a sustainer can be inserted into the artery in order to stabilize it.	True	118 (35.5)	40 (12.0)	158 (47.6)	0.205
	The risk of suffering from arteriosclerosis is not hereditary	False	88 (26.5)	30 (9.0)	118 (35.5)	0.339
	Medication can remove completely sediments from the arteries.	False	100 (30.1)	33 (9.9)	133 (40.1)	0.210
Stroke	If a patient survives a stroke, there are usually no permanent consequences.	False	94 (28.3)	36 (10.8)	130 (39.2)	0.766
	The nutrient supply to the brain is not affected by a stroke	False	116 (34.9)	43 (13.0)	159 (47.9)	0.544
	A stroke is characterized by a sudden dysfunction of the heart	False	62 (18.7)	29 (8.7)	91 (27.4)	0.420
	A stroke is caused when overexcited cells produce too much electricity.	False	60 (18.1)	33 (9.9)	93 (28.0)	0.084
	A stroke is preceded frequently by chest pains	False	43 (13.0)	24 (7.2)	67 (20.2)	0.144
Heart Infarction	Smoking is a minor risk factor with respect to a heart infarction.	False	88 (26.5)	25 (7.5)	113 (34.0)	0.060
	A heart infarction is caused by cerebral dysregulation of the heart.	False	35 (10.5)	16 (4.8)	51 (15.4)	0.636
	Damage caused by a heart infarction is not usually permanent	False	76 (22.9)	29 (8.7)	105 (31.6)	0.785
	A heart infarction must be treated surgically.	False	72 (21.7)	20 (6.0)	92 (27.7)	0.086
	A heart infarction is typically followed by some degree of paralysis	False	46 (13.9)	20 (6.0)	66 (19.9)	0.735
	When suffering a heart infarction, pain may radiate into the stomach.	True	105 (31.6)	34 (10.2)	139 (41.9)	0.155
	A heart infarction is caused by malfunction of one or more heart valves.	False	20, (6.0)	19, (5.7)	39 (11.7)	0.003
	A heart infarction is usually preceded by loss of sensation and numbness.	False	27 (8.1)	18 (5.4)	45 (13.6)	0.069
	A heart infarction can manifest itself through nausea and vomiting.	True	95 (28.6)	37 (11.1)	132 (39.8)	0.848

· Percentage of students answered each question correctly between (≤ 50%), n: number of students
- Analysis using Pearson's Chi-square test
, p-value < 0.050

Adiposity terminology and treatment had its share in this area. Almost all students (n=303, 91.3 %) reported liposuction being the most up-to-date treatment for adiposity and only 41.3% (n=137) of students stipulated that 'overweight' and 'adiposity' terms are un-alike. As for hypertension condition, 39.8% of students could correctly predict multiple causes of hypertension, and only 35.2% of females and 10.5% of males believed hypertensive individuals were at higher risk for developing arteriosclerosis, with a significant higher females proportions for the latter response (p = 0.038).

Almost all but 9.3% of the students believed that fatigue is a frequent symptom for hyperlipidemia, and 36.4% could relate hyperlipidemia to hereditary, while 81.9% mistakenly affirmed that hyperlipidemia causes acute diseases.

On the other hand, notable proportions of students falsely think that with arteriosclerosis condition, arteries contract (85.8%), become softer (51.2%), sediments completely removed with medication (59.9%), and blood pressure increase as a result (22.0%).

Poor information was concluded by students for some of stroke symptoms and causes. Students falsely assumed that stroke is caused by excessive cell electricity (72%), characterized by a heart dysfunction (72.6%); and 79.8% believed it is often preceded by chest pains.

Further, considerable false information was reported by pharmacy students regarding MI condition. Only 113 (34.0%) believed smoking is a risk factor, 105 (31.6%) described MI damage as permanent, and 139 (41.9%) symptomized pain radiation to stomach. All but 13.6% of students did not relate numbness sensation or cerebral dysregulation of the heart (15.4%), or heart valve malfunction (11.7%) or paralysis (19.9%) to MI. While 39.8% associated nausea and vomiting symptoms to MI, and only 27.7% believed surgery is not the only treatment for MI.

Total Knowledge Score in Relation to Study Variables

Findings described in Table 6 show Poisson Regression model regressing the total knowledge score on gender, GPA, nationality, BMI, university, year in college, residence place, smoking habits, physical activity and family history of chronic disease. It was found that gender, GPA and year in college were significantly associated with the knowledge score of students.

Table 6. Poisson regression model for the total knowledge score*, (n=332).

	Total Score	
Variable	**OR****	**p-value**
Gender (Female)	1.092	0.009
GPA:		
Excellent	1.042	< 0.001
Very good	1.037	< 0.001
Good	1.030	< 0.001
Nationality (Jordanian)	0.990	0.604
BMI (Less than 25)	0.953	0.128
University(ASU)	1.055	0.058
Year in college:		
5th year	1.158	< 0.001
4th year	1.108	< 0.001
3rd year	1.006	0.128
2nd year	1.001	0.117
Residence place (Amman)	1.029	0.200
Smoking habits (Non-smokers)	0.992	0.680
Physical activity (Inactive students)	0.996	0.559
Family history of chronic diseases	1.104	0.129

* Omnibus test showed the overall model is statistically significant (p < 0.001)
** OR: odd ratio.
GPA: Grade Point Average for students
ASU: Applied Science Private University

Female students mean score was found to be 50.12 ± 13.19 Figure 2 with a percentage of 9.2% significantly more than male students (43.84 ± 16.15; p = 0.009). Moreover, students with higher academic GPA scored more than students with lower GPA (p < 0.001). Compared to 'fair' GPA students, 'excellent' grade students scored 4.2%

more, 'very good' graders scored 3.7% more and 'good' GPA students scored 3.0% more than 'fair' students Figure 3.

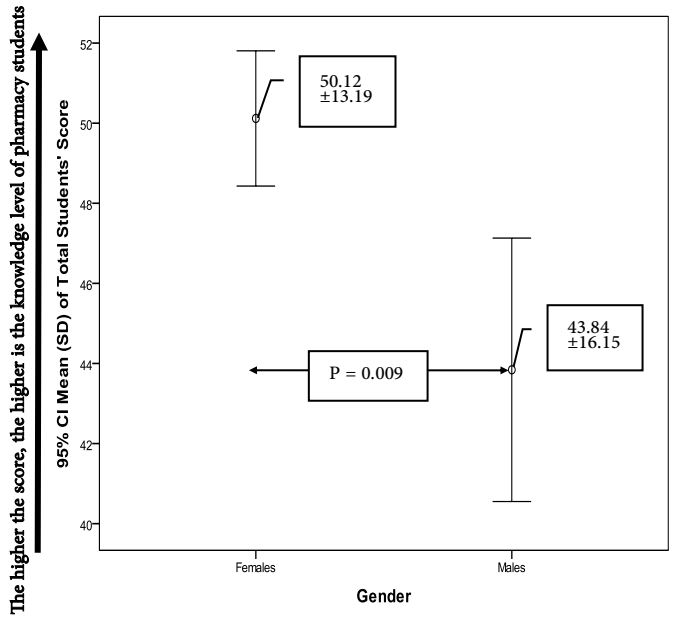


Figure 2. Students' (n= 322) knowledge based on total score means regarding gender P-values estimated by independent sample t-test.

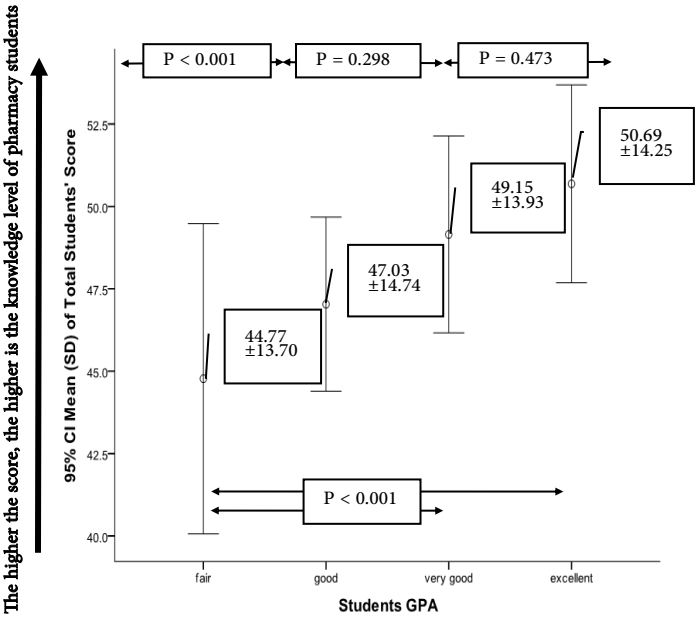


Figure 3. Students' knowledge based on total score means regarding students' Grade Point Average (GPA), P-values estimated by independent sample t-test, (n=332).

Also, results indicated that students in their fourth and final fifth year scored significantly more than first year college students ($p< 0.001$). Fifth (final) year pharmacy students scored 15.8% more, and fourth year students scored 10.8% more than freshmen students. Figure 4, summarizes mean scores of fifth, fourth and lesser year levels of the students with the corresponding p-value.

Discussion

Over the previous decade, there has been a heightened interest in MeS investigating diverse aspects of definition criteria controversy, prevalence, etiology, clinical utility, and constellation of health risks associated with the syndrome. Yet, limited research has revealed the knowledge level of medical students regarding the multi-factorial MeS health conditions. As a contribution to this field, an innovative approach was adopted by this cross-sectional survey-based multi-center study, targeting students across all years of pharmacy education, to determine whether the pharmacists to-be acquire the requisite knowledge to control this prevalent challenge among selves and community.

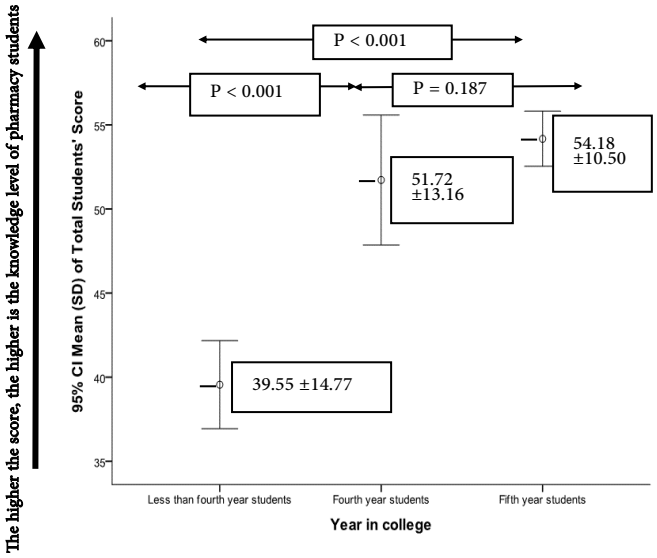


Figure 4. Students' knowledge based on total score means regarding year in college. P-values estimated by independent sample t-test, (n=332).

The socio-demographic and clinical profiles of the surveyed students showed that over a third of the students had an overweight tendency, i.e. BMI > 25. These findings are consistent with the national obesity prevalence rates reported for the general population in Jordan (22). However, female students had less values (normal BMI) compared to male students. Despite the fact that MeS is a multi-co-existing risk factor condition, central obesity is one of its critical components and literature confirmed a strong linear correlation between waist circumference and BMI values (23). This may indicate a primary need to promote healthy lifestyles within selves before others.

In comparative terms, female students were noted for their higher knowledge score and profound awareness of almost all inquired conditions. Diabetes symptoms, adiposity medical risks, MI and arteriosclerosis health complications. Several studies have explored the impact of gender on the educational performance (24-28). Although the reasons for difference in academic performance within college-aged genders are complex; our findings could be substantiated by the fact that female medical students place more emphasis on curricular-related learning outcomes more than males who have inclinations towards extracurricular activities (29, 30). This preference of females' score resembles Yahia and colleagues' outcomes within students participating in analogous study at Central Michigan University, US.

Other findings were perceived for the significant association between knowledge score and both students' year in college and the GPA. Fourth and fifth (final) year students indicated significantly higher knowledge about MeS related conditions than students in the 1st, 2nd and 3rd year levels. Such findings were anticipated, since students in the former year-levels covered more relevant subjects on medical disciplines within college courses. Typically, the adopted pharmacy curriculum in most Jordan universities discusses MeS related conditions in depth through clinical and pharmacy practice courses, in addition to other selective therapeutic courses projected to students starting from their fourth year (31-33).

One reason for the confined knowledge conveyed by first years' students, who were not involved yet in pharmacy clinical courses, is the impact of media. Ever-present role of media in forming community knowledge and public health perception is undeniable (34). Websites and social media have the potentials to broaden individuals' awareness through effective interactive tools more than traditional information resources (35). There is a need for productive utilization of different social media tools to engage medical education regarding MeS components, and direct young-aged users towards positive managing skills of the syndrome. As for higher GPA achieving students, they would be expected to outperform academically-struggling students, as they transcend study skills and concentration limitations, in addition to their higher ability in selecting main idea from the provided information (36).

It is evident that the current study revealed inadequate knowledge among pharmacy students about medical conditions related to MeS. For instance, in the diabetes context, there has been some misunderstanding of symptoms, etiology and treatment of the disease. More than a third of the students thought the disease is characterized by "too much" sugar in the cells.

Furthermore, common misconceptions were reported by more than half of the students, symptomizing "increased alertness" and "poor appetite" as recurrent indications for diabetes. Beyond that, students falsely believe that diabetic patients "must" be treated with insulin shots and only eat sweets especially-adapted for diabetics. These findings interpret limited awareness of the main components related to diabetes in the minds of pharmacy undergraduates. Being the third leading cause of death (37), comprehensive educational and community-based programs regarding diabetes are overarching needs to control MeS. Though, it is only fair to note students' knowledge in recognizing hereditary effect, types of diabetes, arteriosclerosis and stroke as sequels, along with frequent urination symptom and eye complications of the disease.

On the subject of adiposity, students realized the diet and physical activity impact, possible interventions, besides the proneness to suffer from sleep disorders, arteriosclerosis, MI, and even stroke. This knowledge is imperative as the central obesity has been repeatedly associated to MeS (38-40). However, with our surveyed students sharing the same misconception with Yahia et al. researched students, plurality of the students falsely believe that liposuction is the up-to-date surgical intervention for adiposity, as yet did not differentiate between "overweight" condition and the morbid overweight status "adiposity". These terms are generally confusing and our results showed that pharmacy students were misled too. Further, education is needed to inform students how to identify "overweight" persons with an increased weight above normal profiles and recognize the "adiposity" different stages associated with high risk disease, related to BMI values above 30 (41). Updating students with the latest treatment methods for adiposity is also vital for their knowledge and identifying liposuction as the "state-of-the art" treatment choice for adiposity may deviate students' perception from the importance of adopting healthy lifestyles as a primary intervention for this risk factor, if found. Such results may hinder the vital health promotion role of the upcoming pharmacists as they believe quick surgical incisions are the key solution rather than intensive sustainable healthy life choices.

With a prime causative factor for MeS development as HTN, the absence of students' good-level of knowledge regarding the subject is crucial. Yet, students were familiar with pregnancy induced HTN and the hereditary effect, but many could not relate HTN incidence to thyroid gland disorders or cerebral tumors, nor perceive HTN as a multi-cause condition. Regarding symptoms and complications, there was a fair agreement that HTN can cause renal damage, eye disorders and can manifest itself through dizziness. Still, the relation between arteriosclerosis to HTN was not clear. In the same manner, students mistakenly stipulated that anti-hypertensive drug therapy can be discontinued when blood pressure is lowered. A medical condition like HTN, so called the "silent killer", comprehend awareness of possible causes, and treatment is principal since individuals may acquire HTN without indicating remarkable symptoms which contribute to, if not controlled, a whole group of diseases.

Hyperlipidemia is second of two conditions where students were un-acquainted with the inquired topics besides MI condition. Even though the majority of students realized the relation with arteriosclerosis besides the collateral medication-dietary role in decreasing blood cholesterol profiles, symptoms and causes reflected a weakness gap. Predominant false belief was reported amongst students as they indicated "fatigue" a frequent symptom, and that hyperlipidemia leads to acute ailments. In year 2014, Yahia et al. briefed comparable findings about the aforementioned topics. Also, our results revealed that more than half the students were unaware of the rising risk of family history on hyperlipidemia incidence; one shared finding with equivalent proportions of surveyed laypersons in a parallel study conducted in Germany by Becker and colleagues (2008). Though the previous studies were at different time intervals, the commensurable findings indicate that these topics are still quite problematic as for pharmacy students.

As for arteriosclerosis outputs, over half the students shared similar knowledge of comparable proportions in Becker et al. (2008) study regarding lack of awareness about relating arteriosclerosis to hereditary factor. The stroke risk and nature of arteriosclerosis was correctly identified by the students. However, these promising results were tainted by the common misbelieve implied by the great majority of the students, stipulating that arteries "contract" with arteriosclerosis; another shared false belief with surveyed students by Yahia and colleagues. Moreover, the relation between arteriosclerosis with both HTN and hyperlipidemia was unclear in the students' minds. Topics related to the treatment of this condition should be highlighted in pharmacy undergraduate courses, as more than half the students were unaware of artery sustainers' use and suppose that medication could reverse arteriosclerosis completely. Improper knowledge of the matter may place pharmacy students in a situation to advise future patients about possibilities to stop medication when arteriosclerosis signs are controlled.

In the sphere of stroke topics, responses were encouraging. Students performed well regarding identification, etiology, causes and consequences. Most students implied that stroke is caused by artery obstruction, preceded by speech problems and often followed by memory dysfunction with possible permanent speech defects. However, like Becker et al. findings, more than two thirds the students related stroke to "electricity" produced by overexcited cells. More, the study results outlined a mixed unclear understanding of MI condition and stroke in certain aspects. Corresponding proportions believe that stroke is attributed to sudden heart dysfunction, and even a higher total falsely believe that stroke manifest itself through chest pains. The latter misunderstanding of stroke condition is reported also by two previous studies; Yahia et al. (2014) and Becker et al. (2008).

Students' responses to MI questions indicated "fair" and "poor" knowledge levels rather than "good" level. Relatively, students were informed about MI causes, anticoagulants for medication and recognized the radiating pain to the arms preceded by shortness of breath symptoms. Though, only few recognized the radiating pain to the stomach and the manifestation of nausea and vomiting along with MI. Provoking incorrect beliefs was indicated by students exceeding a two-thirds majority considering smoking only a minor risk for developing MI and stipulating that caused damage is temporary. More false beliefs were shared with students participated in Yahia et al. (2014) study referring MI cause to cerebral dysregulation of the heart and malfunction of heart valves, and a majority misbelieve that MI is often preceded by numbness, loss of sensation and followed by paralysis. Despite the students' perceived knowledge in respect to anticoagulants administration following MI condition, many flawed at mandatory need for surgical interventions to overcome this condition.

On average, students depicted well-rounded background in stroke topics, yet were least informed in MI conditions. The latter condition emerges a knowledge gap compared to other indicated conditions considering that students answered about two thirds the inquired questions incorrectly. There is a need for improvement in the MI area, in view of the fact that students' knowledge could be described as profound, since no good-level was interpreted as mentioned previously.

Notwithstanding that proximity of pharmacy students' responses with health/non- health students' feedbacks among Yahia et al. and Becker et al. studies, the estimated awareness level for pharmacy students regarding conditions related to MeS raises concern. Preparing undergraduate pharmacy students in the medical field to confront health challenges like MeS invites us to make further screening of educational strategies adopted by pharmacy colleges. It is rapidly emerging a question of how and when, rather than if, undergraduate pharmacy educational program needs continuous rehabilitation to adapt the changing medical practice demands.

Colleges of pharmacy performed an acknowledged improvement in the adopted curricula over the years. Curriculum experts and decision-makers have made significant revision to the content emerged in updating courses content to integrate pharmaceutical care-oriented topics (42). Yet, there is a strong case for a broader curricular-based revision addressing clinical tasks and focused interventions about MeS education modules aiming pharmacy students in their early years to gain optimal education required. Changing in teaching modalities and implication of novel methods may be effective for learning outcomes and improving students' perception towards MeS related components to better prepare patient-centered pharmacists.

Data collection was the most critical stage in conducting this research, as is the case with health and social research (43). Some challenges were encountered during data collection, from the approached universities targeting pharmacy students. Although the researchers were knowledgeable about university institutes' data collection requirements, the methods and challenges, the researchers faced real-time problematic situations. One issue was greatly encountered by some of the public universities unwillingness on the part of decision makers (i.e. deans and head of departments) to cooperate with survey research when invited. For instance, two universities informed the researcher they had internal regulations outlaw researchers to approach students in lectures due to time constraints to follow the course curricula. Besides experienced difficulties while obtaining permission to interview both public and private

universities' decision makers. Several instances were encountered when decision makers failed to keep their initial interview appointment with the researchers, after all arrangements were made earlier; thus, a second, and in some occasions a third round of appointments were arranged. Accordingly, recruited sample for the study was chiefly of pharmacy students enrolled in private universities. To compensate for the public university population, were decision makers were less likely to participate.

Rather than providing an exhaustive list of strength and weakness of the adopted course curriculum between public or private universities, this study offers an in-depth analysis within a set of universities to evaluate changes required to develop the upcoming role of pharmacy undergraduates in managing MeS within their community.

Although this study would benefit reshaping the pharmacy curriculum, one limitation can be disclosed as the research data were collected primarily from private universities. Yet, both Public and Private Jordan universities' academic accreditation commissions are provided under the supervision of Ministry of Higher Education & Scientific Research (44). This is even more supported by the obvious findings demonstrating that knowledge level score of pharmacy students was irrelevant to the registered university.

Conclusion

Our results provide novel insight of pharmacy students' awareness, in a context of strengths and weakness, regarding health conditions related to MeS. Since much of the students' current-existing knowledge is related to the academic curricula and clinical teaching modules, pharmacy education modalities should be re-evaluated to accentuate and cope with duties expected from future pharmacists as they are well-situated to make an important contribution to MeS prevention. Finally, in order to facilitate MeS awareness creation, further development is needed regarding academic field. It is recommended to develop breadth of MeS knowledge in pharmacy curricula by greater inclusion of MeS concept and related conditions, and support the influx of more academics in trans-disciplinary research to reverse MeS in the community.

Abbreviations

MeS: metabolic syndrome, GPA: Grade Point Average, BMI: Body Mass Index, HTN: Hypertension, MI: Myocardial Infarction.

Ethics approval and consent

Ethics approval was obtained from the Institutional Review Board (IRB) at the Applied Science Private University (grant number 2018-PHA-3).

Data availability

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Competing interest

The authors declare that no financial or other potential competing interest exist.

References

1. Al Dhaheri AS, Mohamad MN, Jarrar AH, Ohuma EO, Ismail LC, Al Meqbaali FT, et al. A Cross-Sectional Study of the Prevalence of Metabolic Syndrome among Young Female Emirati Adults. PloS one. 2016;11(7):e0159378.
2. Ferguson TS, Tulloch-Reid MK, Younger NO, Knight-Madden JM, Samms-Vaughan M, Ashley D, et al. Prevalence of the metabolic syndrome and its components in relation to socioeconomic status among Jamaican young adults: a cross-sectional study. BMC Public Health. 2010;10(1):307.
3. Nolan PB, Carrick-Ranson G, Stinear JW, Reading SA, Dalleck LC. Prevalence of metabolic syndrome and metabolic syndrome components in young adults: A pooled analysis. Preventive medicine reports. 2017;7:211-5.
4. Dalleck LC, Kjelland EM. The prevalence of metabolic syndrome and metabolic syndrome risk factors in college-aged students. American Journal of Health Promotion. 2012;27(1):37-42.
5. Paul A, Molly J. Effectiveness of a guided risk management strategy on the knowledge and attitude regarding the prevention of metabolic syndrome among adolescents. International Journal Of Community Medicine And Public Health. 2017;3(6):1564-7.
6. Yahia N, Brown C, Rapley M, Chung M. Assessment of college students' awareness and knowledge about conditions relevant to metabolic syndrome. Diabetology & metabolic syndrome. 2014;6 (1):111.
7. Reiner Ž, Sonicki Z, Tedeschi-Reiner EJCmj. The perception and knowledge of cardiovascular risk factors among medical students. 2012;53(3):278-84.
8. F de Freitas Jr RW, M de Araújo MF, P Marinho NB, A de Vasconcelos HC, S Lima AC, R Pereira DC, et al. Prevalence of the metabolic syndrome and its individual components in Brazilian college students. 2013;22(9-10):1291-8.
9. Morrell JS, Lofgren IE, Burke JD, Reilly RAJJoACH. Metabolic syndrome, obesity, and related risk factors among college men and women. 2012;60(1):82-9.
10. Bassi N, Karagodin I, Wang S, Vassallo P, Priyanath A, Massaro E, et al. Lifestyle modification for metabolic syndrome: a systematic review. 2014;127(12):1242. e1-. e10.
11. Eckel RH, Kahn R, Robertson RM, Rizza RAJC. Preventing cardiovascular disease and diabetes: a call to action from the American Diabetes Association and the American Heart Association. 2006;113(25):2943-6.
12. Grundy SMJTJoCE, Metabolism. Metabolic syndrome: a multiplex cardiovascular risk factor. 2007;92(2):399-404.
13. Eades CE, Ferguson JS, O'Carroll RE. Public health in community pharmacy: a systematic review of pharmacist and consumer views. BMC public health. 2011;11(1):582.
14. Becker B-M, Bromme R, Jucks R. College students' knowledge of concepts related to the metabolic syndrome. Psychology, Health and Medicine. 2008;13(3):367-79.
15. Kukulu K, Korukcu O, Ozdemir Y, Bezci A, Calik CJJop, nursing mh. Self-confidence, gender and academic achievement of undergraduate nursing students. 2013;20(4):330-5.
16. Ebenuwa-Okoh EJJoP. Influence of age, financial status, and gender on academic performance among undergraduates. 2010;1 (2):99-103.
17. Prajapati B, Dunne M, Bartlett H, Cubbidge RJO, Optics P. The influence of learning styles, enrolment status and gender on academic performance of optometry undergraduates. 2011;31(1):69-78.
18. Sonnert G, Fox MFJTJoHE. Women, men, and academic performance in science and engineering: The gender difference in undergraduate grade point averages. 2012;83(1):73-101.
19. DiPrete TA, Buchmann CJD. Gender-specific trends in the value of education and the emerging gender gap in college completion. 2006;43(1):1-24.
20. Carbonaro W, Ellison BJ, Covay EJSSR. Gender inequalities in the college pipeline. 2011;40(1):120-35.
21. DiPrete TA, Buchmann CJUAitFDotNC. Gender disparities in educational attainment in the new century: Trends, causes and consequences. 2013.
22. IndexMundi. Jordan demographics profile 2018 2018 [Available from: https://www.indexmundi.com/jordan/demographics_profile.html.
23. Gierach M, Gierach J, Ewertowska M, Arndt A, Junik R. Correlation between body mass index and waist circumference in patients with metabolic syndrome. ISRN endocrinology. 2014;2014.
24. Haist SA, Wilson JF, Elam CL, Blue AV, Fosson SE. The effect of gender and age on medical school performance: an important interaction. Advances in health sciences Education. 2000;5(3):197-205.
25. Grunspan DZ, Eddy SL, Brownell SE, Wiggins BL, Crowe AJ, Goodreau SM. Males under-estimate academic performance of their female peers in undergraduate biology classrooms. PloS one. 2016;11(2):e0148405.
26. Buchmann C, DiPrete TA. The growing female advantage in college completion: The role of family background and academic achievement. American sociological review. 2006;71(4):515-41.

27. Quadlin NJASR. The mark of a woman's record: Gender and academic performance in hiring. 2018;83(2):331-60.
28. Ruffing S, Wach F, Spinath FM, Brünken R, Karbach JJFip. Learning strategies and general cognitive ability as predictors of gender-specific academic achievement. 2015;6:1238.
29. Almasry M, Kayali Z, Alsaad R, Alhayaza G, Ahmad MS, Obeidat A, et al. Perceptions of preclinical medical students towards extracurricular activities. International journal of medical education. 2017;8:285.
30. Lumley S, Ward P, Roberts L, Mann JP. Self-reported extracurricular activity, academic success, and quality of life in UK medical students. International journal of medical education. 2٠١٥;٦:١١١.
31. Philadelphia University. Course Description for of Pharmacy 2011/2012 2012 [Available from: http://www.philadelphia.edu.jo/course-description-2011-pharmacy.
32. University of Petra. Pharmacology and biomedical sciences, course description 2013 [Available from: https://www.uop.edu.jo/En/Academics/PharmacyMedicalSciences/PharmacologyandBiomedicalSciences/Pages/CourseDescription.aspx.
33. Applied Science Private University (ASU). Clinical pharmacy & therapeutics, courses 2017 [Available from: http://www.asu.edu.jo/en/Pharmacy/cpt/Pages/courses.aspx.
34. Korda H, Itani Z. Harnessing social media for health promotion and behavior change. Health promotion practice. 2013;14(1):15-23.
35. Lyson HC, Le GM, Zhang J, Rivadeneira N, Lyles C, Radcliffe K, et al. Social Media as a Tool to Promote Health Awareness: Results from an Online Cervical Cancer Prevention Study. Journal of Cancer Education. 2018:1-4.
36. Proctor BE, Prevatt FF, Adams KS, Reaser A, Petscher Y. Study skills profiles of normal-achieving and academically-struggling college students. Journal of College Student Development. 2006;47(1):37-51.
37. Institute for Health Metrics and Evaluation (IHME). Country profiles, Jordan 2016 [Available from: http://www.healthdata.org/jordan.
38. Al Rashdan I, Al Nesef Y. Prevalence of overweight, obesity, and metabolic syndrome among adult Kuwaitis: results from community-based national survey. Angiology. 2010;61(1):42-8.
39. Medscape. Metabolic syndrome, pathophysiology. 2017 [Available from: https://emedicine.medscape.com/article/165124-overview#a4.
40. Obeidat AA, Ahmad MN, Haddad FH, Azzeh FS. Evaluation of several anthropometric indices of obesity as predictors of metabolic syndrome in Jordanian adults. Nutricion hospitalaria. 2015;32(٢).
41. Centers for Disease Control and Prevention. Defining adult overweight and obesity 2018 [Available from: https://www.cdc.gov/obesity/adult/defining.html.
42. Alefan Q, Alsmadi MtM. Pharmacy education in Jordan: updates. International Journal of Pharmacy Practice. 2017;25(6):418-20.
43. Rimando M, Brace AM, Namageyo-Funa A, Parr TL, Sealy D-A, Davis TL, et al. Data collection challenges and recommendations for early career researchers. The Qualitative Report. 2015;20 (12):2025-36.
44. Jordan. Ministry of Higher Education & Scientific Research 2017 [Available from: http://www.mohe.gov.jo/en/pages BriefMohe2.aspx.