Student and supervisor perceptions of undergraduate research in college of Medicine and Health Sciences, Sultan Qaboos University, Oman

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Abstract

Undergraduate research (UGR) is a valuable experience, that can potentially enhance the quality of graduates, and raise the awareness of the importance of research and its impact on career development. These outcomes, however, depend on the environment under which students conduct research. We undertook a self-administered survey, to elucidate the experiences of both students and supervisors, in the College of Medicine and Health Sciences (COMHS), Sultan Qaboos University, Oman. The study examined supervisors (n = 90) and students' (n = 314) perceptions to UGR and factors that hinder the research experience. The supervisors' and students' satisfaction towards UGR was good (mean = 72.4 ± 13.0) and moderate (mean = 57.8 ± 14.2), respectively. The students reported a good satisfaction towards the relevance of research (Mean = 71.34 ± 20.0) research learning skills acquired (63.43 ± 18.9), research supervisor (68.47 ± 23.5), with female students been more positive towards UGR than males. The students' grade in UGR module was the only independent factor influencing the overall satisfaction. The supervisors were highly satisfied with the relevance of UGR (mean = 84.4% ±20.7), the module structure (mean = 73.3 ± 14.6), workload (mean = 73.3 ± 14.6) and the students' performance (71.8%±18). However, supervisors were less positive towards the students' acquired skills (mean = 69.0% ±12.8) and logistics for UGR (mean = 67.8%±16.3). In summary, supervisors and students in COMHS, Oman, regard UGR as valuable and recognize its relevance. Supervisors were more likely than students to report lack of resources to run UGR. Thus, resources should be maintained to inspire supervisors and sustain a research-oriented environment to inspire students.

Introduction

There is an overwhelming evidence supporting the value of undergraduate research (UGR) as an enriching teaching experience[1]. UGR helps students to acquire and improve many skills and principals to become active learners and research oriented. Students can therefore build up their scientific research knowledge, master basic laboratory skills, develop research competencies such as critical-thinking, problem-solving, results interpretation and data communication, both orally and in writing[2].

However, many challenges can compromise the quality of the UGR experience. These include, (i) supervisor-related challenges; such as lack of some supervisory skills and research knowledge and aptitudes[3], (ii) student-related challenges; such as difficulties in managing UGR with other courses, lack of commitment and motivation to UGR [4, 5]} and (iii) institution-related challenges including, lack of research capacity, lack of availability of teaching staff to support and engage students in meaningful research driven activities and absence of financial support for research material;[3, 6].

The above limitations can be more sever in universities with heavy teaching load and lack of strong research culture [6]. Many universities in the Middle east and Asia are focused on teaching, which deprive staff from scholarly activities to address local issues. For example, it has recently been argued that the high teaching burden among staff in universities in GCC Countries may undermines the potential for more research output, and development of adequate research culture [7]. The prevailing environment in

such universities may undermine the awareness of the value of creativity and innovation skills development in undergraduate programs. Despite such a limitation, UGR has been widely integrated into the medical curricula in many medical schools in the region including Saudi Arabia [8], UAE [9], Kuwait, Qatar, Bahrain and Oman [9, 10].

In Oman, the College of Medicine and Health Sciences (COMHS), Sultan Qaboos University (SQU), has integrated an undergraduate research module into the medical curriculum in 2009. The module allows undergraduate students to conduct research project under supervision of experienced staff in COMHS and Sultan Qaboos University Hospital (SQUH). The major emphasis is on the principals of the research process; including how to define a research problem, conduct literature reviews, collect and analyse data, write and discuss the results in a research thesis. By the end of 2021, 1655 students have completed the module successfully, and some of the research projects have resulted in publications in international journals. However, a preliminary survey carried out in 2016 among the students who completed in the module has identified some barriers that hinder the research experience [11]. Here we extended the above study and investigated both the students' and supervisors' satisfaction and motivation towards UGR, to identify barriers that hinder engagement of students and integration of this important module in the curriculum.

Material And Methods

Study site and subjects. This cross-sectional study was conducted between 2018 and 2019 in COMHS, SQU, the biggest public governmental medical college in Oman. The UGR module spreads over 3 semesters of phase II (third year) of the MD program, in the first semester students are introduced to research methods and data analysis, formulation of a research question and developing a research proposal. In the second semester, the students undertake the research, data collection through surveys and laboratory experiments in line with the research proposal. Third, at the last semester students write up the research data in the form of thesis and poster.

The present study examined the perception of 5th and 6th year medical students (n = 314) who completed the three UGR courses between 2017–2019. In addition, we evaluated the perception of supervisors (n = 90), in 18 different departments in the COMHS and SQUH, involved in this module in the past 3 years, 2017–2019.

Data collection. Two questionnaires were used in this study, the first for assessment of the students' and the second for supervisors' perception. The questionnaires were developed based on a preliminary study with similar objectives to the present study (Al Balushi H., 2017, Medical students' perception of undergraduate research, Sultan Qaboos University, Oman. MBBS degree thesis), which developed a study tool based on focused group discussion among a sample of clinical and pre-clinical students, who completed the UGR in COMHS, SQU between 2015 to 2016. In addition, the preliminary questionnaire was subjected to subject matter expert review.

However, the final questionnaires used in the current study were developed based on the aforementioned tool and reviewing related literature. The modified versions were further subjected to content validation, reviewed by subject matter experts, and piloted on a small group of participants. Items with good content validation ratio (> 0.9) were preserved. The Cronback alpha was calculated to be 0.96. and 0.97 for the student and supervisors' questionnaires respectively.

The students' questionnaire comprised two sections, **a**) demographics (age, gender, grade, residence and living conditions), which allows testing possible association between these factors and students' perception, and **b**) questions that reflect perception/satisfaction of students towards UGR, ordered in 6 domains including; (i) relevance of research to medical students (ii) research supervisor (iii) research skills and learning skills, (iv) supporting resources, (v) materials time and workload and (vi) teaching & course structure (supplementary Table 1).

Similarly, the supervisors' questionnaire contained two sections, a) demographic data (age, gender, medical specialty, year of experience... etc.). This allows testing possible association between these factors and supervisors' perception. The second section consisted of 6 domains, including; (i) teaching and course structure, (ii) time and workload, (iii) research skills and learning skills, (iv) performance of previous students, (v) samples and materials, (vi) relevance of undergraduate research.

The two validated questionnaires were self-administered and disseminated through e-mails, WhatsApp messages and hard copies. This helped increasing the response rate, which is a known challenge to survey research. The students' and supervisors' e-mails and phone numbers were obtained from the administration of the COMHS. All data was gathered by the students and staff involved in this research project, who were trained on how to use the research tool of the study.

Data analysis. Data was entered and analyzed using the SPSS program version 23. The qualitative categorized variables were represented as frequency and percentages using frequency tables, pie charts, and bar charts. Continuous variables were presented as mean, standard deviation and median. The total and domain satisfaction score was totalled and divided by the total maximum score and then calculated out of 100%. In addition, we categorized the satisfaction according to cut-off points to poor (< 50%), moderate (50–70%) or good (> 70). To assess the univariate associations between satisfaction categorized levels (good/moderate/poor) and factors, Chi-square was used. For multivariate adjusted analysis, we used logistic binary regression. *P* value < 0.05 was considered significant.

Results

Study subjects

Out of 379 targeted students, 314 (82.8%) responded, including 128 (40.8%) males and 186 (59.2%) females, from all governorates, in Oman, with exception of Al Wusta (Table 1). The majority (43.9%) of the participants' achieved a cumulative GPA (cGPA) of > 3, while 8% scored between 2.00 to 2.5 and no students scored < 2.0. However, 72 (23%) students were under academic probation. The vast majority of

the students, scored A (44, 14.1%) or B (171, 54%) in the final UGR course, while 79 (25.2%) scored C (Table 1).

We invited 90 supervisors, in different departments in COMHS and SQUH, involved in UGR between 2017-2019. The majority of supervisors were from the departments of Surgery, Medicine, and Microbiology and Immunology, together representing 31.5% of all respondents. While the lowest proportion of responders were from the departments of Genetics, and Allied Health Science (Supplementary Table 1). This variation reflects the differences in number of staff in different departments.

The overall response rate of the supervisors was 96.7% (87/90), including 55 (63.2%) males and 32 (36.8%) females. The mean year of total experience of the supervisors was18.2 ±7.7, and a mean of 4.5 ± 3.4 years' experience in UGR supervision. The majority (62%) of the participants were aware of the structure and objectives of UGR module (Table 2)

Students' perception

The overall students' satisfaction towards UGR was 57.8 (SD±14.2), with a minimal of 20% and a maximal of 92%. The vast majority of the students were positive about UGR, with good plus moderate perception accounted to 243/314 (77.4%) students, while 71/314 (22.6%) stated poor satisfaction (Table 3).

We explored students' satisfaction towards **six** domains, indicative of perception to UGR. Good satisfaction was noted for (**i**) relevance of research (71.34 ±20.0), (**ii**) research supervisor (68.47 ±23.5) and (**iii**) research skills and learning skills (63.43 ±18.9) (Table 3). Whereas, a moderate satisfaction was reported towards (**iv**) supporting resources and materials (55.91 ±19.0) and (**v**) time and workload (54.92 ±18.3). However, the students were less happy with (**vi**) teaching and course structure (49.36±15) (Table 3).

Factors influencing students' satisfaction

Table 4 shows univariate analysis of factors that impact students' satisfaction towards UGR. Female students were more positive towards UGR compared to Males (P= 0.048). Grade in UGR module was positively associated with the satisfaction (P< 0.00), students with A (35%) and B (27.5%) grades were more positive than those with C (6.3%) and D (0.00%) grade. However, cumulative Grade Percentage Average (cGPA) (P = 9.14) and being under academic probation (P = 0.19) or intension to consider research in future career (P= 0.71) were not associated with perception towards UGR (Table 4).

Interestingly, students living condition can impact their perception to UGR. Students living with parents (45.6%) or alone (27.9%) were more inspired than those living with relatives (7.4%) or with a roommate (19.1%) (p = 0.01) (Table 4).

Nonetheless, multivariate analysis showed that the grade in UGR is the only independent factor for total satisfaction with p value < 0.001.

Supervisors' perception towards UGR

Supervisors showed overall good perception toward UGR, with a mean satisfaction of (72.4 ±13.0), with a minimum of 40% and maximum of 98.4%.   The majority of participants were highly satisfied (64.4%), while only (5.8%) were poorly satisfied (Table 5).

Table 5 shows supervisors' perception to 6 domains related to UGR. The supervisors were highly satisfied with (i) the relevance of UGR (84.4% ±20.7), (ii) the module structure (73.3±14.6), (iii) workload (73.3±14.6) and (iv) the students' performance (71.8%±18). Whereas, there was a relatively lower perception towards (v) the skills that UGR provides the students with (69.0% ±12.8) and (vi) logistics for UGR (67.8% ±16.3) (Table 5).

However, univariate analysis showed no association between the characteristics of supervisors, including, gender, total years of experience, years of research supervision, number of students supervised, attending training workshops, research meeting hours and awareness of UGR module, and the total perception to UGR (Table 6).

Discussion

The vast majority of undergraduate students (mean 77.4 ±14.2) and supervisors (mean 72.4±13.0), in COMHS, SQU, Oman, expressed positive perception towards UGR. Female students were more positive than their male counterparts. The final grade UGR module was the only independent factor influencing the overall students' perception. The students were less positive regarding the course structure while, supervisors were less satisfied with the students' acquired skills (mean = 69.0% ±12.8) and logistics for UGR (mean = 67.8%±16.3).

The positive perception of SQU medical students towards UGR, displays high awareness of advantages of research experience, and potential future career benefits.   This is consistent with the fact that some students tend to put more efforts to complete their data analysis and prepare it for publication. Over the years, undergraduate research, in COMHS SQU, has resulted in many publications in different medical journals. Such a positive attitude towards UGR has also been reported in many medical schools in the region. However, there is a slight variation in the rate of satisfaction in different universities; e.g. King Saud University, Saudi Arabia (97.1%) [12], Ain Shams University, Egypt (74%) [13] and American University of Beirut, Lebanon (4.35 out of 5) [14] and the university of Medical Sciences and Technology, Sudan (91.3%) [15].   The above inconsistencies in the rate of satisfaction can reflect variability in research facilities and culture. In addition, these differences can result from variability in the year of participation, as the perception of research changes as the student becomes involved in research [2]. One possible more reason for the inconsistent findings is the variability in the scale and cut-off values used in different studies. Nonetheless, in general, there is a unanimous positive attitude of medical students, in the region, towards the medical research and its value [16].

Female students in COMHS were more positive (54.4%) towards UGR compared to males (45.6%) (Table 4). Female students can be more inspired and career oriented, they can excel in their studies and outperform their male counterpart [17]. The higher positive attitude among female students has also been reported in other universities in the region [13]Al Achi *et al.,* 2020), with a higher proportion of previous involvement in medical research among female students than males [18]. This agrees with the trend seen in elective undergraduate research programs, in some western universities, where women were more likely to participate than male students, and entering graduate studies at a significantly higher rate than their male counterparts [19].   However, some studies in the region, in Saudi Arabia [18] and Pakistan [20] reported a more positive perception of UGR among male students compared to females. Whereas, some reports showed no apparent gender differences in research perceptions, attitudes, motivations or knowledge [13, 21]. The above discrepancies in gender perception to UGR have been attributed to societal, institutional and personal factors [22].

The present study showed an association between grade achieved in UGR model and perception towards research, students with high GPA were more positive than those with lower grades (Table 4). This is in line with a meta-analysis of 37 studies (1,042,537 participants), that showed a relationship between attitude toward research in science and learning achievement [23]. Students with a higher GPA tend to be more confident in their educational experience and achievements [24]. Consequently, they become more inspired for successful future professional career, and thus possess a good perception to the value of research.   However, a study that examined senior high school students, showed no significant association between grade level and attitude towards research [25]. However, high school students' perception can change once they become engaged with a university program of choice. Some studies have shown that attitude towards science and scientific achievements could vary across different grade levels [23]. In accordance with this trend, it has been suggested that medical students' attitude towards research progressively build up as the students proceed through the medical program [26]. Thus, a clear career orientation, at early stages of the medical school, may raise awareness of students to the value of UGR and its career relevance, and hence a more positive attitude and research experience.

However, a large proportion of the students, in the present study, were less happy with the teaching and course structure. Since the initiation of the UGR module in COMS, SQU, in 2009, there have been regular adjustments to improve on the student research experience. This includes organizational guidelines overall planning, details of timeline for assessment and assessment rubrics. The content of the taught competent of the UGR module has recently been revised, and some material that overlapped with other courses were removed. In addition, the assessment rubrics were revised. Such regular revision of the UGR is critical for engagement and enriched research experience. The students' perception and engagement are likely to be influenced by the clear organization and logical layout of the course [27].

Our results revealed a good satisfaction of supervisors toward UGR (72.4%±13.0). This can partly be explained by the fact that the UGR module has been running for over 10 years, in COMHS, and staff are familiar with the course structure and delivery process. This is reflected in the fact that the supervisors were highly satisfied with the relevance of UGR (mean = 84.4% ±20.7), the module structure (mean =

73.3±14.6), workload (mean = 73.3±14.6) and the students' performance (71.8%±18) (Table 5). However, supervisors were slightly negative towards facilities and logistics to run UGR. Therefore, the above positive perception of supervisors should be sustained by logistic support, such as research fund and integration of the supervision time in the teaching load. UGR supervision is a key factor underpinning the success of the UGR experience, hence in a teaching-intense university, such as SQU modality for integration traditional teaching and UGR should be explore [28].

A major limitation to this study is the modest sample size, including only students from COMHS, which may not be representative of students in other universities in Oman, and countries in the region. Future research in cooperating multiple medical schools in Oman is needed to assess the UGR perception of medical students. The present study did not examine different phases of medical students, preclinical, junior and senior clerkship. Some studies identified a more positive attitude toward research courses in medicine connected to more advance students [26, 29]. This study evaluated the UGR module students' module from students' point of view, yet it is critical to investigate the module efficiency by assessing the students' performance. Therefore, advance studies, using a large sample size, across different medical schools in the region, utilizing open-ended questions will provide a better insight onto students' views will allow development of a sound UGR scheme, that will enhance the education experience and the quality of the graduates.

Conclusions

Undergraduate medical students in COMHS, Oman, were moderately satisfied with the UGR module. This positive perception displays high awareness of advantages of research experience, and potential future career benefits. However, a few factors were found to be influencing this satisfaction.

Abbreviations

SQU: Sultan Qaboos University

SQUH: Sultan Qaboos University Hospital

COMHS: College of Medicine and Health Sciences

Cumulative Grade Percentage Average: cGPA

Declarations

Ethics approval and consent to participate

This research was performed in accordance with the declaration of Helsinki. Ethical approval for the study was granted by the Ethics Committee, COMHS, Sultan Qaboos University, Oman (MREC 1980). The Data tools used in the current study were developed based on preliminary data and reviewing related

literature. An informed written consent was obtained from participants before their enrollment in the study.

Consent for publication:

Not applicable.

Availability of data and materials.

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Competing interests

The authors declare that there is no conflict of interest regarding this project and they approved it for publication

Authors' contributions

HB, MS AR: Conceived and designed the analysis

ZA, AN, HD and FA: Collected data

AR ZA and AN: Analysed data

HB, AR and MS: Wrote the main manuscript text

 MS and AR: Reviewed the manuscript

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Tables

Table 1. Demographic characteristics of medical students in COMHS, Sultan Qaboos University (SQU), involved in the study.

Characteristics		Number (%)
Gender	Male	128 (40.8%)
	Female	186 (59.2%)
cGPA	≥ 3.50	35 (11.1%)
	3.00-3.49	103 (32.8%)
	2.50-2.99	151 (48.1%)
	2.00-2.49	25 (8.0%)
	≤ 2.00	0 (0%)
Being under academic probation	Yes	72 (23.0%)
	No	242 (77.0%)
Future plan to become engaged in research	Yes	285 (90.7%)
	No	29 (9.3%)
Final grade in the research module	A	44 (14.1%)
	B	171 (54.4%)
	C	79 (25.2%)
	D	19 (6.0%)
	F	1 (0.3%)
Residency regions	Muscat	84 (26.8%)
	South Batinah	38 (12.1%)
	North Batinah	64 (20.4%)
	Dakhliyah	59 (18.8%)
	South Sharqiah	14 (4.5%)
	North Sharqiah	12 (3.8%)
	Musandam	3 (1.0%)
	Dahirah	25 (8.0%)
	Burimi	11 (3.5%)
	Dhofar	4 (1.3%)
	Wusta	0 (0%)
Living condition	Alone	109 (34.7%)

	With room mate	93 (29.6%)
	With parents	92 (29.3%)
	With other relatives	20 (6.4%)

Table-2: Characteristics of supervisors involved in undergraduate research in COMHS, Sultan Qaboos University (SQU), and Sultan Qaboos University Hospital (SQUH)

Characteristics	n (%)
Gender	
Male	55 (63.2%)
Female	
Years of experience	
1-10	17 (19.3%)
11-20	41 (47.0%)
21-30	26 (30.1%)
> 30	3 (3.6%)
Mean ± SD:	18.2 ± 7.7
Years of involving in UGR supervision	
1-5	58 (66.7%)
6-10	26 (29.8%)
>10	3 (3.6%)
Mean ± SD:	4.5 ± 3.4
Number of students supervised	
0-5	51 (59.0%)
6-10	20 (22.9%)
>10	16 (18.1%)
Mean ± SD:	8.5 ± 14.8
Attended supervisors' briefing workshop	
Yes	39 (45.2%)
No	48 (54.8%)
Hours meeting per week	
0-5 hrs	55 (63.0%)
6-10 hrs	15 (17.3%)
>10 hrs	17 (19.8%)
Mean ± SD	7.2± 8.1
Awareness of UGR module	
Good	54 (62.1%)

Moderate	27 (31.0%)
Poor	6 (6.9%)

Table 3. Perception of medical students in COMHS, Sultan Qaboos University (SQU), Oman, toward UGR module

Domain	Mean satisfaction (±SD)	Min	Max	Good n (%)	Moderate n (%)	Poor n (%)
Relevance of UGR	71.34 (±20.0)	10.3%	67%	212 (67.5%)	96 (22.0%)	33 (10.5%)
Research supervisor	68.47 (±23.5)	20.1%	56%	176 (56.0%)	75 (23.9%)	63 (20.1%)
Research skills & learning skills	63.43 (±18.9)	21%	42.4%	133 (42.4%)	115 (36.6%)	66 (21.0%)
Supporting resources and materials	55.91 (±19.0)	23.2%	42.7%	73 (23.2%)	135 (43.0%)	106 (33.8%)
Time and workload	54.92 (±18.3)	20%	100%	65 (20.7%)	137 (43.6%)	112 (35.7%)
Teaching and course Structure	49.36 (±15.0)	8.9%	50%	28 (8.9%)	129 (41.1%)	157 (50%)
Overall satisfaction	57.8 (±14.2)	20%	92%	68 (21.7%)	175 (55.7%)	71 (22.6%)

Min = Minimum

Max = Maximum

Table 4. Factors influencing the satisfaction of medical students in COMHS, Sultan Qaboos University, Oman towards the UGR module

Factors influencing the satisfaction		Good satisfaction (%)	Univariate P-value
Grade in the last course UGR	A	75 (23.8%)	<0.001
	B	219 (69.8%)	
	C	20 (6.3%)	
	D	0 (0%)	
	F	0 (0%)	
Living condition	Alone	88 (27.9%)	0.01
	With roommate	60 (19.1%)	
	With parents	143 (45.6%)	
	With other relatives	23 (7.4%)	
Gender	Male	143 (45.6%)	0.048
	Female	171 (54.4%)	
cGPA	>3.50	32 (10.3%)	0.14
	3.00-3.49	148 (47.1%)	
	2.50-2.99	120 (38.2%)	
	2.00-2.49	14 (4.4%)	
Being under academic probation	Yes	65 (20.6%)	0.19
	No	249 (79.4%)	
Future intension for research engagement	Yes	291 (92.6%)	0.71
	No	23 (7.4%)	

Table-5: Satisfaction of supervisors towards UGR in COMHS, Sultan Qaboos University, and Sultan Qaboos University Hospital, Oman

	Mean±SD	Min	Max	Good n (%)	Moderate n (%)	Poor n (%)
Structure	73.3%±14.6	36.9%	100%	55 (63.2%)	26 29.9%	6 (6.9%)
Time/Workload	73.3%±14.6	36.9%	100%	55 (63.2%)	26, 29.9%	6, 6.9%
Skills	69.0%±12.8	40.0%	100%	44 (50.6%)	39, (44.8%)	4, 4.6%
Students	71.8%±18.0	25.0%	100%	61 (69.9%)	18, 20.7%	8, 9.3%
Samples/Material	67.8%±16.8	25.0%	100%	47 (54.0%)	31, 35.6%	9, 10.3%
Relevance of research	84.4%±20.7	20.0%	100%	73 (83.9%)	7 (8.0%)	7, 8.0%
Total	72.4%±13.0	40.0%	98.4%	56, (64.4%)	26, (29.9%)	5, 5.7%

Min = Minimum

Max = Maximum

Table 6: Factors affecting supervisors' perception

Supervisors characteristics		Good satisfaction (%)	Univariate p-value
Gender	Male	67.3%	0.4
	Female	59.4%	
Years of experience	1-10	68.8	0.1
	11-20	56.4	
	21-30	76	
	> 30	66.7	
Years of research supervision	1-5	64.3	0.6
	6-10	64	
	>10	33.3	
Number of students supervised	0-5	63.3	0.6
	6-10	57.9	
	>10	66.7	
Attending training workshops	Yes	67.6	0.6
	No	57.8	
Research meeting hours per week	0-5 hrs	70.6	0.09
	6-10 hrs	50	
	>10 hrs	50	
Awareness of UGR module	Good	63	0.2
	Moderate	74.1	
	Poor	20	

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementaryTable1.docx