



Medical Students and the Level of Their Knowledge on Normal Flora: Results from an Electronic Questionnaire Conducted in a Private Medical School

Forman Erwin Siagian^{1,2*} and Lusia Sri Sunarti^{2,3}

¹Department of Parasitology, Faculty of Medicine, Universitas Kristen Indonesia, Jakarta, Indonesia.

²The Centre of Biomedic Research, Faculty of Medicine, Universitas Kristen Indonesia, Jakarta, Indonesia.

³Department of Microbiology, Faculty of Medicine, Universitas Kristen Indonesia, Jakarta, Indonesia.

Authors' contributions

This work was carried out in collaboration between both authors. Author FES designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author LSS managed the analyses of the study and statistical analysis. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IBRR/2021/v12i230148

Editor(s):

(1) Dr. Dharmesh Chandra Sharma, J. A. Groups of Hospital and G. R. Medical College, India.

Reviewers:

(1) R. G. Jani Vet., Vet. College, India.

(2) K. Padmavathi, PSG College of Arts & Science, India.

Complete Peer review History: <http://www.sdiarticle4.com/review-history/67884>

Short Research Article

Received 15 February 2021
Accepted 21 April 2021
Published 24 April 2021

ABSTRACT

Introduction: So far, study on medical student's knowledge regarding human normal flora is not available in the internet. Normal flora is initially beneficial for their host, but what was once part of the normal flora can later become dangerous to their host, e.g become the agent of endogenous disease. The knowledge regarding normal flora is important for medical students, because it related with many aspects of their recent and future education and trainings, especially in the clinical phase. The aim of this simple cross sectional, questionnaire based study is to measure the level of knowledge regarding normal flora.

Study Design: Cross sectional, electronic questionnaire-based survey

Place and Duration of Study: Faculty of Medicine, Universitas Kristen Indonesia, Jakarta, Indonesia and conducted for 1 month (March 2021).

*Corresponding author: E-mail: forman.siagian@uki.ac.id;

Methodology: The questionnaire is divided into two parts, the demographic section and the knowledge section that consist 20 question regarding normal flora. By using popular social media, WhatsApp™, survey conducted to all of our medical students.

Results: 628 students responded, and they were representing the class of 2014-2020, 190 male students and 438 females with mean age 20.16 years old (min. 16 and max 25). The result showed us that the level of knowledge is good and but the level of understanding regarding normal flora also gets better as they become senior students.

Conclusion: The level of knowledge of our students regarding normal flora is good, although it still needs to be improved continuously.

Keywords: Education; interaction; microorganism; host; microbiology; hematogen.

1. INTRODUCTION

Normal flora are the bunch of microorganisms that live on another living organism (human or animal) without causing any symptom of disease or any obvious negative effects [1,2]. In case of human body, actually it is not sterile at all; colonization by certain bacteria or fungus took place since very early in life. The oral cavity, the intestine, the skin, and the vaginal epithelium are some classic examples of anatomical locations which inhabited by normal flora.[1,3]

The most important beneficial effect of normal flora which can be mentioned is that they have the capability to control colonization by other organisms considered as pathogens, by competing for attachment sites or for essential nutrients or simply prevent the existence of 'new kids on the block' in area which they already inhabited for a long time [1,2,4]. But on contrary to its beneficial effects, normal flora can also be harmful to their host, e.g if due to a certain condition, they be able to reach a site or tissue where they cannot be restricted or tolerated by the host defenses/immune system and as the consequences caused an endogenous disease [5]. The route of their invasion to the host's inner organ mostly through bloodstream/hematogen. The spread to other deep organ can took place via the skin, the lungs, and the GI tract. The behaviour of the host, e.g taking long-term oral antibiotics without doctor's prescription, also can affect the composition of normal flora [6].

Considering the importance of normal flora to their host, teaching normal flora to medical students should be conducted properly and reinforced throughout the entire education in medical school. In general, medical students in Indonesia are already taught about this topic since their first year, including our students in the Faculty of Medicine Universitas Kristen Indonesia located in Jakarta, Indonesia. Our faculty is the

oldest private medical school in Indonesia. Annually, at least there are 900+ of clinical and pre-clinical phase active students, and the number dynamically change over time due to the entrance of new students to our faculty and completion of education period. Good knowledge regarding normal flora with their benefits and the potency of detrimental effect to their host is crucial for future medical doctor. The aim of the study is to measure the level of knowledge of our students regarding normal flora.

2. METHODOLOGY

This simple cross-sectional study conducted from March 1st to 31st. We conducted an electronic questionnaire-based survey to all of our students using snow ball method, which is propagated through popular social media, WhatsApp™. The questionnaire was created based on Todar's Online Textbook of Bacteriology in the section of "Normal Flora" (available in the internet) and the standard textbook of Microbiology used in our campus [7]. In the introduction part of the questionnaire, we explain about the research objectives and related informed consent and ends with the statement "by filling in the questionnaire it means that you already understood the importance of this study and are willing to participate". The questionnaire divided in to 2 major part: the first is demographic (age, gender, entry year) and the second is knowledge about normal flora questions. At the end of the question, the respondent is asked about their subjective opinion whether they are confident enough about their knowledge regarding normal flora All data collected in an excel worksheet, then exported to SPSS for further analysis.

3. RESULTS AND DISCUSSION

During the days of study, 628 students responded (68.33% of total our active students

(n= 919, which consist of 472 preclinical phase student, and 447 clinical phase) registered in the national college database named Pangkalan Data Perguruan Tinggi). Demographically, there are 190 male (30.25%) and 438 females (69.75%), with mean age 20.16 years old. All of our respondents represent all of our active students from the year of entry 2014 to 2020. In the following table, we present the data regarding the respondent's knowledge of normal flora.

Data showed us that among those 20 questions about normal flora, most of our students (>50%) able to answer those questions correctly. The lowest percentage of our respondents who answered correctly was for question regarding definition, 58.75% (369 respondents) and the highest percentage is on the question regarding

anatomical predilection/site 614 respondents answer correctly (97.77%).

Data on Fig. 1 showed us that the more senior our respondents, the better their knowledge on normal flora. The range of level of our respondent's knowledge quite varied among the pre-clinical students (2017 to 2020) but when the students already in the clinical phase, their level of knowledge on normal flora gets better.

From the class of 2020, data showed us that the wide range of respondent's knowledge with the lowest number of correct answers are 5. In the class of 2019 and 2018, the lowest number of correct answers are 8 while in the class of 2017 are 11. In the class of 2016 and 2015, the number of correct answers are 12 and in the class of 2014, the lowest number of correct answers are 17.

Table 1. Distribution of our respondents correct answers to 20 questions regarding normal flora

No	Questions about	Respondents that answered correctly	%
1	Definition	369	58.75
2	The host of the normal flora	429	68.31
3	Anatomical predilection/site	614	97.77
4	Organism considered as normal flora	552	87.89
5	In human, function of normal flora considered as beneficial	502	79.93
6	Ability to caused disease	592	94.26
7	Predisposing factors that might contribute to pathogenesis	506	80.57
8	The normal flora synthesise and excrete vitamins (e.g., K, B12)	473	75.31
9	The normal flora prevent colonization by pathogens	546	86.94
10	The normal flora may antagonize other bacteria	567	90.28
11	The normal flora stimulates the development of certain tissues	475	75.63
12	The normal flora stimulates the production of natural antibodies	495	78.82
13	the normal flora behaves as low grade antigens in their host	379	60.35
14	Flora normal may facilitate bacterial synergism	492	78.34
15	member of the normal flora supplying vitamin or some other growth factor that a pathogen needs in order to grow (cross-feeding)	526	83.75
16	Competition for nutrients	413	65.76
17	Transferable to susceptible host	450	71.65
18	Induction of a low-grade toxemia	527	83.91
19	The normal flora may be agents of endogenous disease	579	92.19
20	Some member of the normal flora actually have the potency of being a pathogens	594	94.58

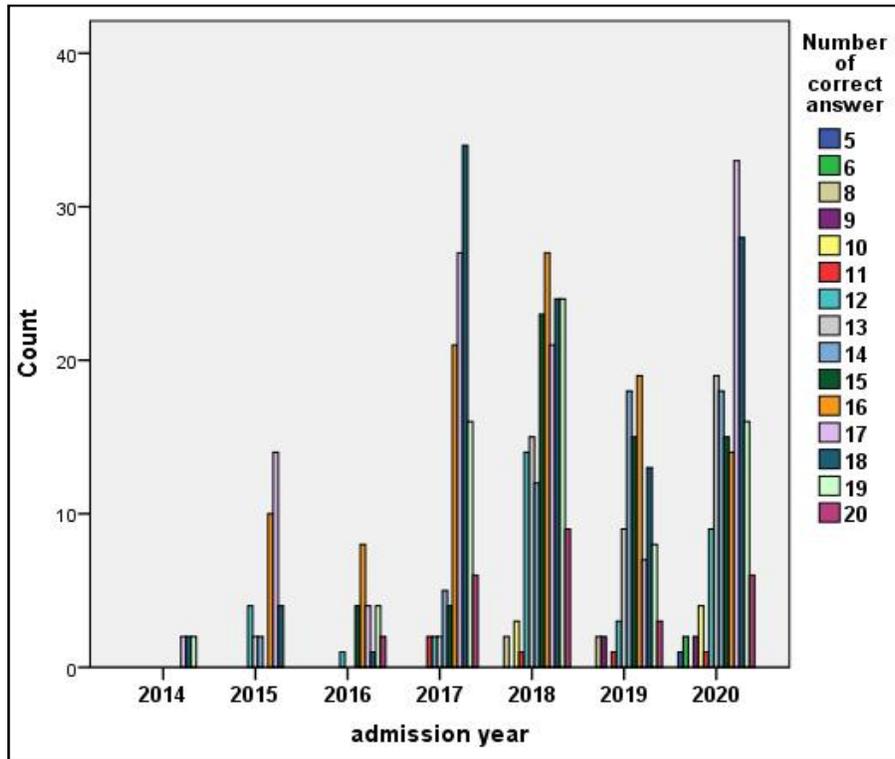


Fig. 1. Distribution of number of correct answers based on our respondent's admission year

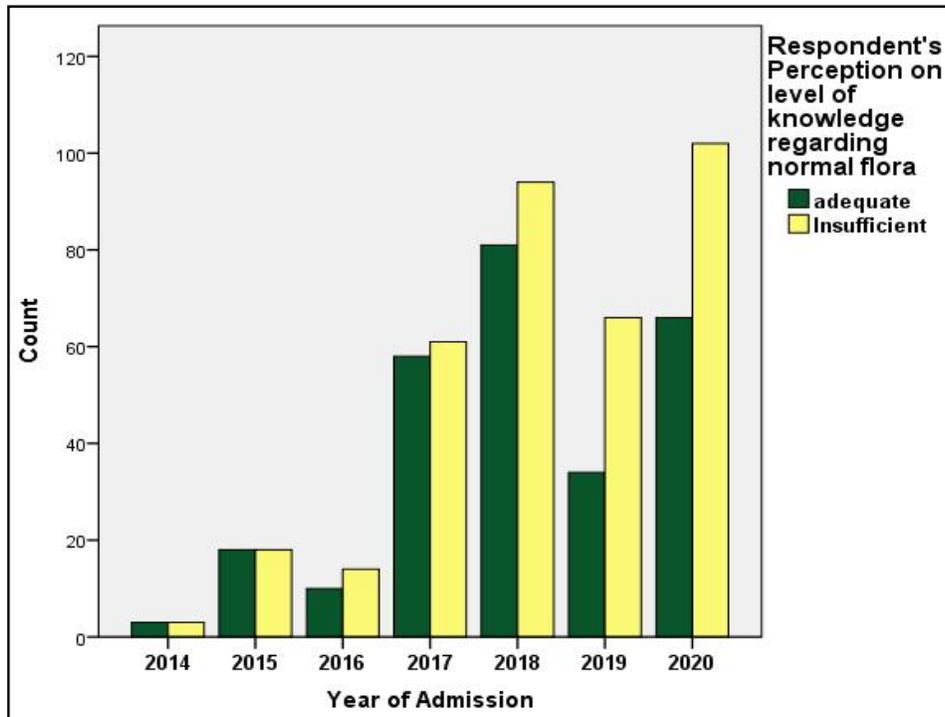


Fig. 2. distribution of respondent's own perception on level of knowledge regarding normal flora

Based on the number of correct answer, the number of respondent who can only answer 5 questions correctly is 1 (0.0015%) and this respondent is from class 2020 and 26 respondents able to answer all the questions correctly (41.4%); the group with the largest number of respondents who managed to answer is 108 respondents that able to answers 17 questions correctly. The median knowledge level score among the survey participants was 80.25 (min: 25; max: 100).

At the end of the question session, after answering all the survey questions, the respondent is being asked about their subjective opinion whether they are confident enough about their knowledge regarding normal flora, and the data presented in Fig. 2.

Data on Fig. 2 showed us that most respondents from the class of 2016 to 2020 considered themselves as having insufficient knowledge regarding normal flora, but more senior students considered themselves as already having adequate knowledge. Perhaps after several years being a medical students, our respondent started to have an ideal basic knowledge regarding normal flora.

Medical students actually build their basic clinical knowledge on the grounds of previously obtained basic knowledge during their pre-clinical years. Routine evaluation of the medical student's knowledge to answer questions regarding normal flora using all the knowledge and skills gained during their undergraduate medical training, and it should be conducted more often in order to convince them of its importance.

So far, study on medical student's knowledge regarding human normal flora is rare. The knowledge regarding normal flora is important for medical students, because it related with many aspect of their recent education, e.g to some extent in some way related to the pathogenesis of a disease or some normal function of the human body; and in the future, good knowledge about normal flora will shape them to become doctor who has a more holistic understanding about interaction that might took place, e.g if they give antibiotics to their patients, they must be aware that this antibiotics might interfere with the composition of normal flora in other parts of the patient's body.

Knowledge of the normal flora of the human body allows doctors to make Prediction of the

pathogens causing infection as bacteria tend to grow in specific body sites e.g. *Streptococcus pneumoniae* from the upper respiratory tract causing pneumonia or *Staphylococcus aureus* from the skin causing intravenous cannula infections [1,3-5]. Interaction between normal flora, the host and their behaviour and possible invading microorganisms are so dynamic and the good basic knowledge regarding normal flora will help these future doctor to have a better understanding regarding their patients [7].

Other type of study regarding medical students level of knowledge actually are widely available on the internet, but once again rare data regarding normal flora is scarce and very rare [7,8]. During their years of pre-clinical and clinical education, medical students receive basic knowledge of medicine, namely Anatomy, Biochemistry, Histology, Physiology and then Microbiology and Parasitology, etc. As they stepped up to higher levels, e.g 1st year to 2nd year and so on, the basic lessons that they already received become the fundamental of their future training and education. According to Gowda *et al*, [8] students retain basic science subjects better and appreciate the importance of basic sciences in patient diagnosis if they are reinforced in the context of clinical situations.

Clinical learning is then become the essence of entire medical education. Many factors have been demonstrated to influence students' development of clinical competence [9-12]. These factors contributes to enrichment of medical students education, and that include students' exposure to a large volume and variety of clinical experiences, learning in authentic clinical settings, self-directed learning, and the provision of a supportive environment [9,10]. It will be very interesting to conduct further study regarding these factors on our faculty.

Clinical teachers, as a role model, also have an important role in the effectiveness of pre-clinical and clinical education in supporting their learners, and in the same time encouraging reflection, and for the faculty policy maker it will provide constructive and regular feedback for further continuous improvement [11-14]. Identifying effective teaching practices which best suits to our faculty is also a future challenge [14-16].

Early and frequent clinical experiences should be planned and integrated in curricula, even though according to Quintero *et al*, [12] there is also

disadvantage beside the advantage of doing such an integration. The provision of such opportunities is associated with the development of appropriate attitudes and the acquisition of commendation and diagnostic skills among undergraduate medical students [16]. Further study need to be conducted to measure the effect on our students.

4. CONCLUSION

As students move up to the senior level, the level of their knowledge about normal flora increases. In general, the level of knowledge of our students regarding normal flora is good, although it still needs to be improved continuously.

CONSENT

"All authors declare that 'written informed consent was obtained from the respondent prior the survey conducted after sufficient explanation about the aim of the study."

ETHICAL APPROVAL

It is not applicable.

ACKNOWLEDGEMENTS

FES and LSS would like to thank Roni SO Hutabarat for preparing the e-questionnaire and taking care of raw data.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Sureshkumar M, Suriyapraha R, Priyadharsini RI. Study on Microbial flora on skin of health care providers in a Tertiary Care Hospital in Southern India. *Journal of Clinical and Diagnostic Research*. 2018;12(11):DC09-DC11. DOI: 10.7860/JCDR/2018/37717.12266
2. Role of microbial flora and probiotics in host immune homeostasis. *Journal of Applied Pharmaceutical Science*. 2018;8(10):136-49. DOI: 10.7324/JAPS.2018.81018
3. McFarland LV. Normal flora: Diversity and functions. *Microbial Ecology in Health and Disease* 2009;12:193–207. DOI: 10.1080/08910600050216183
4. Ramakrishna BS. The normal bacterial flora of the human intestine and its regulation. *J Clin Gastroenterol*. 2007;41(Supp. 1):S2-6.
5. Edlund C, Nord CE. Effect on the human normal microflora of oral antibiotics for treatment of urinary tract infections. *J Antimicrob Chemother*. 2000;46(Suppl 1):41-8;discussion 63-5. PMID: 11051623.
6. Sullivan A, Edlund C, Nord CE. Effect of antimicrobial agents on the ecological balance of human microflora. *Lancet Infect Dis*. 2001;1(2):101-14. DOI: 10.1016/S1473-3099(01)00066-4
7. Todar KG. *Todar's online textbook of bacteriology*; 2004. Available:<http://textbookofbacteriology.net/normalflora> [Accessed 28 February 2021].
8. Çalışkan F, Mıdık O, Baykan Z, Şenol Y, Tanrıverdi EC, Funda İfakat Tengiz FI, et al. The knowledge level and perceptions toward COVID-19 among Turkish final year medical students, *Postgraduate Medicine*. 2020;132:8,764-772. DOI:10.1080/00325481.2020.1795486
9. Gowda VB, Nagaiah BH, Sengodan B. A study of the competency of third year medical students to interpret biochemically based clinical scenarios using knowledge and skills gained in year 1 and 2. *Biochem Mol Biol Educ*. 2016;44(2):202-7. DOI: 10.1002/bmb.20936
10. Shipton EE, Steketeer C, Bate, Franka B, Visser EJ. Exploring assessment of medical students' competencies in pain medicine—A review, *PAIN Reports*. 2019;4(1):e704. DOI: 10.1097/PR9.0000000000000704
11. Al Haqwi Al, Taha WS. Promoting excellence in teaching and learning in clinical education. *Journal of Taibah University Medical Sciences*. 2015;10(1):97-101. Available:<https://doi.org/10.1016/j.jtumed.2015.02.005>
12. Magnier KM, Wang R, Dale VH, Peard MJ. Challenges and responsibilities of clinical teachers in the workplace: An ethnographic approach. *J Vet Med Educ*. 2014;41(2):155-61. DOI: 10.3138/jvme.0813-111R1 PMID: 24637357.
13. Quintero GA, Vergel J, Arredondo M, Ariza MC, Gómez P, Pinzon-Barrios

- AM. Integrated medical curriculum: Advantages and disadvantages. J Med Educ Curric Dev. 2016;3:JMECD.S18920.
DOI: 10.4137/JMECD.S18920
14. Kebritchi M, Lipschuetz A, Santiago L. Issues and challenges for teaching successful online courses in higher education: A literature review. Journal of Educational Technology Systems. 2017;46(1):4-29.
DOI:10.1177/0047239516661713
15. Baticulon RE, Sy JJ, Alberto NRI. Baron MBC, Mabulay REC, Rizada LGT, Tiu CJS, et al. Barriers to online learning in the time of COVID-19: A national survey of medical students in the Philippines. Med.Sci.Educ; 2021.
Available:<https://doi.org/10.1007/s40670-021-01231-z>
16. Bansal A, Singh D, Thompson J, Kumra A, Jackson B. Developing medical students' broad clinical diagnostic reasoning through gp-facilitated teaching in hospital placements. Adv Med Educ Pract. 2020;11:379-388.
DOI: 10.2147/AMEP.S243538

© 2021 Siagian and Sunarti; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
<http://www.sdiarticle4.com/review-history/67884>