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Research Article

The Competency Level of Ambient (Outdoor) Air Pollution Health Literacy among Medical Students

Literasi Kesehatan Tingkat Kompetensi Polusi Udara Luar Ruangan di Kalangan Mahasiswa Kedokteran

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Abstract

Ambient (outdoor) air pollution causes worldwide health problem. One of the strategies for reducing ambient air pollution is to increase public participation, which depends on individual ambient air pollution health literacy (AAPHL). Medical professionals, including medical students, require a high level of AAPHL to support adequate health literacy in the community. However, the level of AAPHL of medical students is still unclear, particularly in areas with high levels of ambient air pollution in Indonesia, such as Jakarta and Tangerang. This study aims to evaluate the level and factors associated with AAPHL of medical students. The health literacy of ambient air pollution was assessed using a 24-item AAPHL questionnaire. This study included 107 participants whose mean of age was 19.63. Most participants were female (70%) and third-year medical students (51%). The mean of the total AAPHL scores was 2.85 out of 4. The highest score of competencies was noted for understanding health information, while the lowest was noted for appraising health information. No association between age, gender, and year of study with AAPHL score was found. In conclusion, the AAPHL level among medical students in Indonesia was considered moderate. The low appraising competency of AAPHL indicates a potential area for improvement.

Keywords*: ambient air pollution; medical students; health literacy*

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Abstrak

Polusi udara ambien (luar ruangan) merupakan penyebab masalah kesehatan di dunia. Salah satu strategi untuk mengurangi polusi udara ambien adalah dengan meningkatkan partisipasi masyarakat yang bergantung pada literasi kesehatan mengenai polusi udara ambien (*ambient air pollution health literacy*/AAPHL) setiap individu. Para tenaga medis, termasuk mahasiswa kedokteran memerlukan tingkat AAPHL yang baik untuk mendukung literasi kesehatan yang memadai di masyarakat. Akan tetapi, tingkat AAPHL pada mahasiswa kedokteran di wilayah yang tinggi masalah polusi udara ambien, seperti Jakarta dan Tangerang, masih belum diketahui. Penelitian ini bertujuan untuk mengevaluasi tingkat dan faktor-faktor yang berhubungan dengan AAPHL pada mahasiswa kedokteran. Literasi kesehatan mengenai polusi udara ambien dinilai menggunakan kuesioner AAPHL terdiri dari 24 pertanyaan. Penelitian ini melibatkan 107 responden dan rerata usia responden adalah 19,63. Sebagian besar responden merupakan perempuan (70%) dan mahasiswa kedokteran tahun ketiga (51%). Rerata total skor AAPHL adalah 2,85. Nilai kompetensi tertinggi pada pemahaman informasi kesehatan, sedangkan skor terendah pada kompentensi penilaian informasi kesehatan. Tidak ditemukan hubungan antara usia, jenis kelamin, dan tingkat pendidikan dengan skor AAPHL. Sebagai simpulan, AAPHL di kalangan mahasiswa kedokteran di Indonesia tergolong sedang. Rendahnya kompetensi yang berhubungan dengan evaluasi mengenai informasi kesehatan pada mahasiswa kedokteran menunjukkan perlunya adanya peningkatan pada kompetensi tersebut.

Kata kunci: polusi udara ambien; mahasiswa kedokteran; literasi kesehatan

Introduction

Ambient (outdoor) air pollution is an environmental problem worldwide and has implicated in adverse health effects.[1, 2] Exposure to ambient fine particulate matter of 2.5 or less micrometre in diameter (PM 2.5) has been associated with increased mortality, premature mortality, and morbidity.[1] Indonesia is the world's fourth most populous nation, with Jakarta and Tangerang being listed as the most polluted cities due to rapid economic, industrial, urbanization, and transportation development.[3, 4] In 2021, it was estimated that air pollution contributed to over 10,000 mortality, more than 5,000 hospitalizations, and over 7,000 ill-health conditions on children in Jakarta.[5]

The ambient air pollution problem is complex, hence the strategy for controlling ambient air pollution requires multilevel interventions from various sectors.[5, 6] Increasing public participation in improving air quality is one of the strategies for reducing air pollution.[5] Previous studies have shown that the importance of health education interventions in formal education or the community to increase the knowledge of environmental health that enhances individual understanding and awareness of potentially harmful environmental exposures encourages individual behavioural change, therefore promotes collective action in the community to remove or reduce environmental problems.[7, 8] Therefore, the assessment of ambient air pollution health literacy (AAPHL), which is defined as the ability of an individual to access, understand, appraise, and apply health information to make appropriate health decisions, reduce health risks, improve

quality of life, and protect the environment, is essential starting point for determining effective mitigation to tackle air pollution problem.[6, 9]

Previous studies have shown that the level of AAPHL in the general population ranges from low to high.[6, 10, 11] Gender, age, education, living environment, living arrangements, and health status have been associated with health literacy.[6, 10, 11] However, studies of health literacy related to ambient air pollution in health professionals, such as medical students, are limited. Considering the negative effect of inadequate health literacy of medical students, who will become future healthcare providers, in their skills for communication, providing healthcare, and health promotion to patients, the AAPHL of medical students needs to be evaluated. This study aims to evaluate the AAPHL of medical students and the determinant factors of AAPHL among medical students in areas with high levels of ambient air pollution in Indonesia, such as Jakarta and Tangerang.

Methods

A cross-sectional study was performed among medical students at the University of Pelita Harapan between February 2024 and March 2024. The targeted respondents are preclinical medical students resided in Jakarta or Tangerang. The University of Pelita Harapan is one of the biggest private universities in Tangerang city, Indonesia whose most students resided in Tangerang and its surrounding area, such as Jakarta. This study was approved by the Pelita Harapan University research ethics committee (No: 040/K-LKJ/ETIK/I/2024). Written informed consent was obtained before the respondents completed the study questionnaire, which was disseminated through Google Forms or social media platforms such as Line and WhatsApp.

To evaluate the respondent's AAPHL, we used the 24-item AAPHL questionnaire.[6, 12] The AAPHL questionnaire was developed based on the existing conceptual framework of health literacy recommended by the European Health Literacy Consortium, which consists of 12 dimensions of health literacy that measure four competencies of an individual, including accessing/obtaining, understanding, appraising/processing, and applying/using the health information within three domains of health contexts refer to healthcare, disease prevention, and health promotion.[6, 12] The reliability and validity of the AAPHL questionnaire was previously reported with Cronbach's alpha value of 0.93, and the factor loading ranged from 0.61 to 0.88.[6, 12] Respondents' response was scored with a four-point Likert scale response (1= very difficult, 2 = fairly difficult, 3 = fairly easy, 4 = very easy). A few adjustments to the questionnaire have been made, particularly in questions related to air quality detection and law regulation, to implement the AAPHL questionnaire according to the current ambient air pollution situation in Indonesia.

Research Article

We performed a validity analysis of the modified AAPHL questionnaire used in the current study by calculating Pearson's correlation coefficient *r* of the scores of the participant's responses to each item with the total AAPHL scores. The result of 30 respondents showed that the *r* value was significantly higher ($r>0.349$, $p<0.05$) compared to the *r* value of the product-moment table with 30 respondents, indicating the validity of the modified AAPHL questionnaire in our current study. The score for each dimension in the questionnaire was calculated as a mean of two corresponding items, and a total score for the AAPHL was determined as a mean of 12 dimensions, ranging from 1 to 4. A higher AAPHL score indicated greater competency. Further, the AAPHL score was interpreted using the triple scale of class intervals, as previously described.[13] The score interval between 1 and 2 indicated as low AAPHL, 2.01 and 3 represented moderate AAPHL, and 3.01 and 4 indicated high AAPHL. Additionally, the four matric-specific scores, namely accessing, understanding, appraising, and applying matrices, were calculated to indicate an individual's health information processing competency within three domains of health contexts. The demographic variables, including age, gender, and year of study, were collected using a questionnaire.

The numeric variables were described as mean with standard deviations (SD), and the nominal variables were presented as counts and percentages. The Mann-Whitney U test was used for two independent group comparisons. The Kruskal-Wallis, followed by Dunn's tests, was applied for multiple comparisons. Correlation analysis was performed using the Spearman test. GraphPad Prism (version 10.0) was used for statistical analysis and graph drawing. A two-tailed p-value of less than 0.05 was considered statistically significant.

Results

The total number of medical students participating in this study was 107 respondents. The mean (SD) age of participants was 19.63 (1.09), and 70% (75/107) participants were female. The participants consist of 24% (26/107) first year, 25% (27/107) second year, and 51% (54/107) third-year medical students.

As shown in Figure 1, the mean (SD) of the total AAPHL scores was 2.85 (0.37). Among the four competencies in processing health information, the highest and lowest mean (SD) scores were noted for understanding competency (2.91±0.45) and appraising competency (2.68±0.45), respectively. The significant difference in the mean (SD) score of appraise competency was observed when compared to access competency score (2.89 (0.45), $p<0.01$), understand competency score (2.91 (0.45), $p<0.01$), and apply competency score (2.89 (0.42), $p<0.01$).

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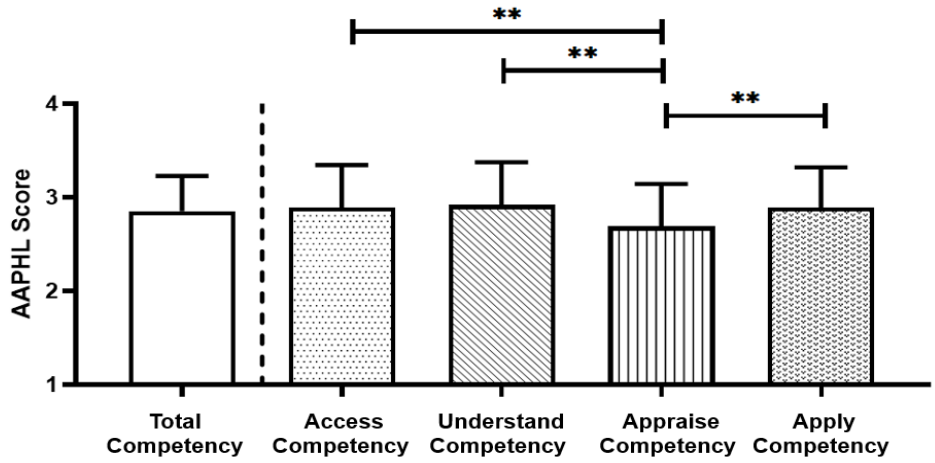

Figure 1 The Score of Ambient Air Pollution Health Literacy (AAPHL) Among Medical Students

Data was presented as mean (SD). The score of four competencies (access, understand, appraise, and apply) was compared using Kruskal-Wallis and Dunn's test. **p<0.01.

A strong and positive correlation was observed between each competency score and the total AAPHL scores, with the correlation coefficient (r) ranging from 0.76 (apply competency and total scores) to 0.88 (understand competency and total scores) (Table 1). However, the positive inter-correlations between each competency score were shown to be only moderate, ranging from 0.53 (appraise and apply competencies score) to 0.66 (appraise and understand competencies score) (Table 1). Furthermore, we observed no significant correlation between age and AAPHL scores (Figure 2A), and no significant differences in AAPHL scores according to gender and year of study (Figures 2B and 2C).

Table 1 The correlation analysis between the total and four matric-specific scores of ambient air pollution health literacy (AAPHL)

	Access	Understand	Appraise	Apply	Total
Access	1.00	0.65****	0.56****	0.50****	0.80****
Understand		1.00	0.66****	0.59****	0.88****
Appraise			1.00	0.53****	0.82****
Apply				1.00	0.76****
Total					1.00

****p<0.0001

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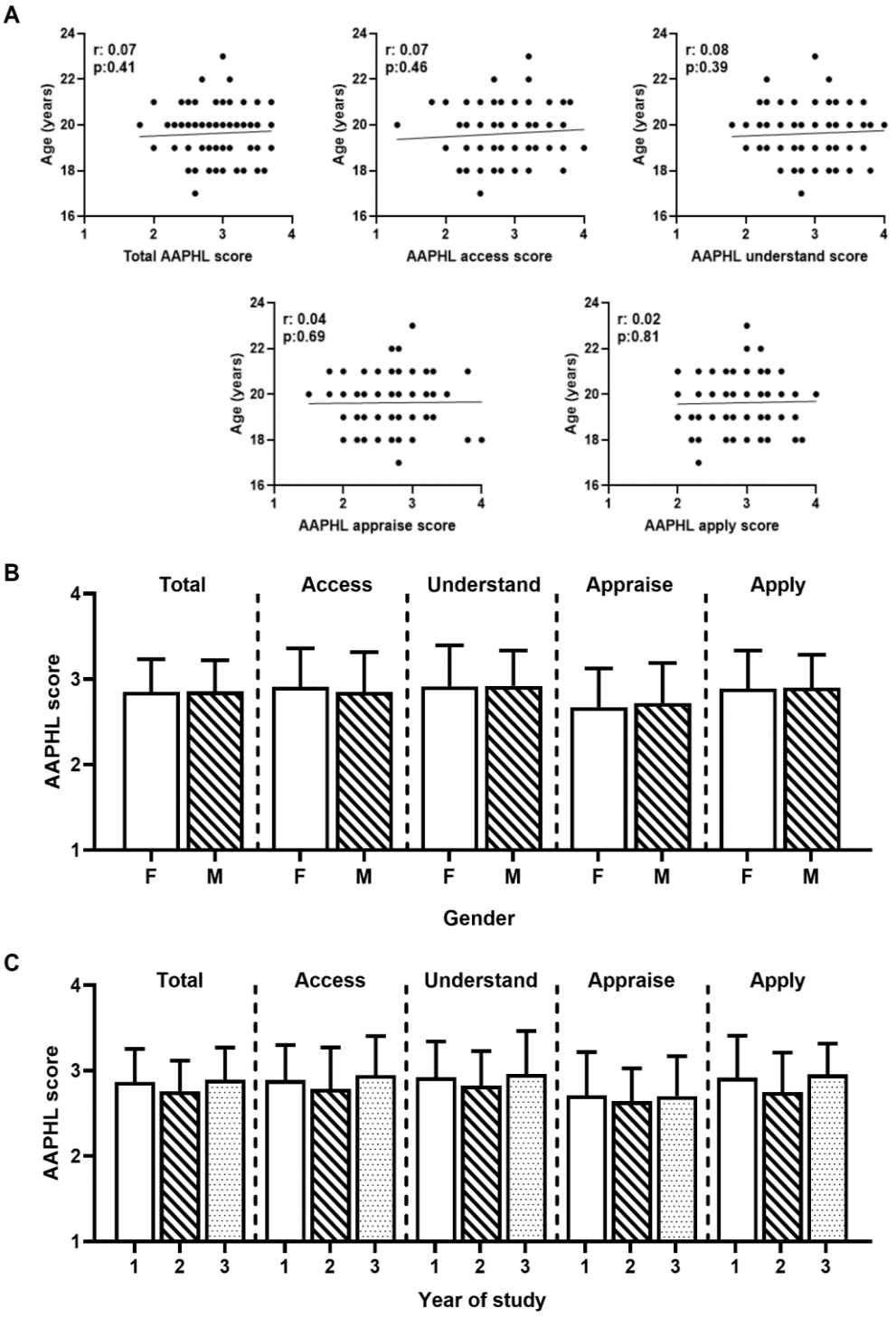

Figure 2 The Association of Age, Gender, and Level of Study with AAPHL Scores

(A) The association between age and AAPHL scores was determined using the Spearman test.
(B) The difference in AAPHL scores between females (F) and males (M) was compared with the Mann-Whitney U test. Data was presented as mean (SD)
(C) The difference in AAPHL scores according to year of study was compared with the Kruskal Wallis test. Data was presented as mean (SD).

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Discussion

Ambient (outdoor) air pollution is one of the major environmental risk factors for health.[10, 14] Finding satisfactory and sustainable solutions to ambient air pollution requires multilevel interventions, which heavily rely on the population's health literacy of ambient air pollution. Health literacy represents the cognitive and social skills that determine individuals' motivation and capacity to access health information, understand and evaluate the information accessed, and apply health information in daily life to improve health.[15] Inadequate health literacy has been associated with poor health outcomes and insufficient understanding of medical conditions, medical information, and preventive care.[16, 17]

Most medical students will have more opportunities to interact with patients and the community when they work as health professionals. Therefore, they require a high degree of health literacy to effectively communicate health information, enabling patients to make informed decisions and encouraging behavioural changes to reduce health risks. This study found that the overall AAPHL score among medical students was considered moderate based on the classification of the mean total AAPHL score using the triple scale of class intervals (low; total AAPHL score 1 to 2, moderate; total AAPHL score 2.01 to 3, and high; total AAPHL score 3.01 to 4). The health literacy level among medical students was approximately identical to the AAPHL level, measured using a similar AAPHL questionnaire, among the adult population in Taiwan, demonstrating a total AAPHL score of 2.90.[6] A comparable AAPHL score with that of the general population may suggest that medical students' AAPHL scores need to be enhanced.

In terms of the four competencies of accessing, understanding, appraising, and applying health information, the mean scores for each competency across three domains in the health context are all close to 3 (similar to being considered as easy), where the maximum mean score is 4 (identical to being regarded as very easy). Our study observed that the competency with the lowest score is appraising health information, consistent with the previous general health literacy survey conducted in Asia and Europe.[6, 18-21] Appraising health information was the most complex competency because it involved various skills, attitudes, and knowledge.[22] In order to be able to appraise health information, individuals need to have a capacity of (1) basic competency in literacy skills and knowledge about health and science, (2) personal qualities and cognitive skills that able to adopt appropriate health information, (3) identifying the quality of health information, (4) performing critical evaluation of health information, (5) selecting the health information from the most trustworthy and credible resources, and (6) applying the health information to make health decisions.[22] In sum, appraising health information entails the ability to integrate the newly found information with the pre-existing knowledge still a barrier for medical students and the

general population possible due to the varying levels of basic and scientific literacy about health and science and the limited availability of freely accessed the reliable, comprehensive, and understandable health information resources.[18, 20] In addition, our result demonstrated that four health processing competencies strongly correlate with the total score of AAPHL, with the highest and lowest correlation noted for understanding and applying competency, respectively. This finding indicates that the self-reported AAPHL questionnaires preferentially measured the knowledge level of air pollution health literacy rather than the skill or behavior concepts, which has been consistently reported in previous observations.[6]

This study showed no correlation between age factor and AAPHL scores. This finding contrasts with prior studies in health sciences students that reported the age factor is associated with health literacy.[23-25] The discrepancy in these findings may be due to the participants' ages not varying in the current study, with most of the participants' ages distributed in the range of 19 to 20 years. The total AAPHL scores and four matric-specific scores were similar between females and males, consistent with previous findings that found no difference between gender and health literacy among students in health sciences programs.[24, 26] However, inconsistent findings about the higher health literacy scores, whether among female or male participants, have also been reported.[23, 25, 27-29] Previous studies that reported the difference in health literacy level based on gender mainly include participants with various levels of education, for example, undergraduate and postgraduate participants. No differences in health literacy levels were reported according to gender factors in the study that included the same level of education of participants [24, 26], similar to our study. Furthermore, our study revealed no significant differences in AAPHL scores among first-, second-, and third-year medical students. The lack of specific health literacy content in medical education programs for undergraduates, or the use of problem-based learning approaches in current medical education programs, could contribute to the equal levels of health literacy among medical students in our study.[30, 31]

The positive aspect of this study is that it provided information on medical students' health literacy in areas where ambient air pollution is the leading environmental issue, and this is the first study in Indonesia that measures health literacy of ambient air pollution using the validated AAPHL questionnaire. Several limitations should be acknowledged from the current study. First, the study was conducted at a single institution, which may limit the generalizability of the results. Second, convenience sampling may have led to unbalanced proportions of participants' socio-demographic characteristics, potentially impacting the statistical analysis results. Third, there may be information bias due to the self-reported AAPHL questionnaire in this study. Fourth, we did not collect covariates data, such as living status, health status, parental

education background, or economic background, which could have contributed to the health literacy level.

Conclusion

In conclusion, our result attempts to establish the AAPHL level among medical students in Indonesia, particularly in Jakarta and Tangerang, where the issue of ambient air pollution is the most prevalent among other cities in Indonesia. The overall AAPHL level of medical students was found to be moderate. Age, gender, and years of study were not associated with AAPHL level. Among the four competencies of health information processing measured in the AAPHL questionnaire, the appraising competency had the lowest score, suggesting a potential area for improvement in the current medical curriculum design. Medical educators must evaluate medical education programs that promote students' health literacy, aiming to provide "health-literate" medical professionals that are beneficial for maintaining individual health and public health. Further research using the larger medical student samples is needed to conclusively identify the association between age, gender, and education level with AAPHL.

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