Original Article

Knowledge, attitude, and perception of radiologists about artificial intelligence in Nigeria

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Abstract

Introduction: Artificial intelligence (AI) can be described as a set of tools and programs that operate in similar ways to normal human brain functions during regular tasks. Radiology is a medical specialty that is naturally related to technology, and the introduction of AI to radiology offers opportunities to improve the speed, accuracy, and quality of image interpretation. The applications of AI to radiology have gained a lot of grounds in the developed world, but this is still considered alien in some of the low-middle-income countries.

Aim: This study aims at evaluating the knowledge level, attitude, and perception of radiologists in Nigeria toward the introduction of AI to the practice of radiology.

Materials and Methods: This was a cross-sectional survey carried out on a group of radiologists from all over Nigeria, who were attending an update course in medical imaging. The survey was carried out using a structured interviewee-administered questionnaire to assess knowledge, attitude, and perception of the respondents on the use of AI, machine learning, and deep learning systems in medical imaging.

Results: One hundred and sixty-three radiologists participated in the study. It was observed that only 12% had good knowledge of AI. Fifty-eight percent of the respondents were willing to embrace the applications if these were introduced in their hospitals. Sixty percent of the respondents had a positive perception toward the opportunity of using of AI systems in radiology practice within their facilities. There was a strong association between the respondents' knowledge levels and their respective attitude levels with 82% of those with good knowledge having a positive attitude ($P < 0.001$).

Conclusion: Knowledge of AI systems in medical imaging is still limited in developing countries like Nigeria, and acceptability of these systems is dependent on the level of knowledge of their applications in medical imaging.

Keywords: Artificial intelligence, attitude, knowledge, machine learning

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INTRODUCTION

Artificial intelligence (AI) is an interdisciplinary approach that uses principles and devices from computation, mathematics, logic, mechanics, and even biology to solve the problem of understanding, modeling, and replicating the intelligence and cognitive processes.[1] A simpler definition by Oxford Living Dictionary is computer

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systems able to perform tasks normally requiring human intelligence, e.g., visual perception, speech recognition, decision-making, and language translating.[2]

AI which was first coined in 1956 by computer scientists at IBM who referred to it as a machine or computer that demonstrates intelligence in performing tasks commonly associated with human beings.[3] It is an umbrella term that comprises two components, namely, machine learning (ML) and brain-inspired deep learning (DL).[4] ML is a term introduced by Arthur Samuel in 1959 to define a field of AI, which focuses on the ability of machines to train themselves without being explicitly programmed. It is a traditional AI method, which relies largely on predefined engineered feature algorithms with explicit parameters based on expert knowledge and learns automatically from data accumulation.[5-7]

DL is a "subset of ML and it is a complex interconnection, which improves ML function in systems." DL means that "the computer has multiple layers of algorithms interconnected and stratified into hierarchies of importance. These layers accumulate data from inputs and provide an output that can change step-by-step once the AI system learns new features from the data. Such multilayered algorithms form large artificial neural networks." DL algorithms can automatically learn feature representations from data without the need for prior definition by human experts.[8-11]

AI has been introduced to almost all sectors of life and one of its most practical applications is in the field of medicine.[4] It has become a major constituent of many applications in health care, including drug discovery, remote patient monitoring, medical diagnostics, and radiology.[12-14] Radiology is a medical specialty that is naturally related to technology and is very much dependent on machines. This is a major reason why it has experienced nearly constant evolution in comparison to other medical specialties.[4]

In less than a decade, computers and algorithms based on DL have gained the power to equal or exceed humans in a number of simple tasks, such as the detection of pneumonia on a chest X-ray or the analysis of white matter lesions on MRI scans of the brain. AI can and will optimize radiologists' workflows, facilitate quantitative radiology, and assist in discovering genomic markers.[10,14]

There are many AI applications that have already been deployed in high-income countries, and a lot of controversies have also arisen on its use in medical diagnosis and oncology worldwide. A crucial and pertinent question that concerns radiologists is what expectation level is realistic and how severe will the impact of the new technology be on the radiological profession?[15,16]

While some radiologists feel that it should be completely embraced, others are skeptical on the future of radiology practice and potential for abuse and misuse of AI systems.[4]

In the developing/resource-poor setting countries, the use of AI remains relatively nascent[17] and little has been documented in the academic literature on AI applications for health in these settings.

The aim of this study was to evaluate the knowledge of the use and application of AI, ML, and DL systems in medical imaging among radiologists in Nigeria and to assess their acceptability (attitude and perception) of the introduction of these systems into radiology practice in their localities.

MATERIALS AND METHODS

This was a cross-sectional survey carried out on a group of resident doctors who were attending an update course in medical imaging from all over Nigeria and consultant radiologists, who were lecturers at the update course. The update course was conducted at the University College Hospital, Ibadan, in August 2019. Total sampling of the update course attendees was done after obtaining informed consent from the participants. The survey was carried out using a hard copy, structured, interviewee-administered questionnaire, which covered information on the sociodemographic characteristics (age, sex, specialization, and current job status) and awareness and knowledge on the use of AI, ML, and DL systems in medical imaging. It also assessed the attitude of radiologists toward the use of AI, ML, and DL systems in imaging as well as their perception on their benefits in medical imaging. A classification module was derived to categorize the knowledge level, attitude, and perception on AI, ML, and DL systems. The level of knowledge was assessed based on the classification of score 0–9 (poor knowledge), 10–20 (fair knowledge), and 21–29 (good knowledge).

The data collected from the structured questionnaires were entered into a Statistical Package for the Social Sciences (SPSS) software version 20 (SPSS Inc., Chicago, IL, USA) spreadsheet and were analyzed. The descriptive data were summarized using frequency tables and charts. Chi-squared test was used to test the association between two categorical variables, Student's *t*-test was used to test the association between a categorical and a continuous variable, and analysis of variance was used to analyze the association between a

continuous variable and two or more categorical variables. To corroborate the results obtained from Chi-square test of independence, the Pearson's Product-Moment Correlation was used to check the association between the variables. $P \leq 0.05$ was considered statistically significant.

RESULTS

One hundred and sixty-three doctors from all over the country participated in the study. These included 99 (61%) male and 64 (39%) female participants.

The age distribution of the participants was between 23 and 60 years, with a mean age of 36 ± 4.89 years. The distribution of the participants by the work status showed that 8 (5%) were consultant radiologists, 70 (43%) were senior registrars, and 84 (52%) were junior registrars.

Knowledge about the uses and applications of artificial intelligence

The participants were asked some questions on whether they have heard about AI, ML, and DL. They were also asked if AI is more proficient in reading some medical imaging compared with human beings and their knowledge about the different jobs/disciplines where AI is currently being deployed. The overall scores of the knowledge assessment of the respondents were pooled together, and out of a total obtainable score of 29, the average score was approximately 13, with lowest and highest score of 1 and 26 respectively.

It was observed that only about 12% of the respondents had good knowledge, 38% of the respondents had a poor knowledge, and about half of the respondents (50%) had fair knowledge of the use and application on AI, ML, and DL systems in general as well as in medical imaging [Figure 1].

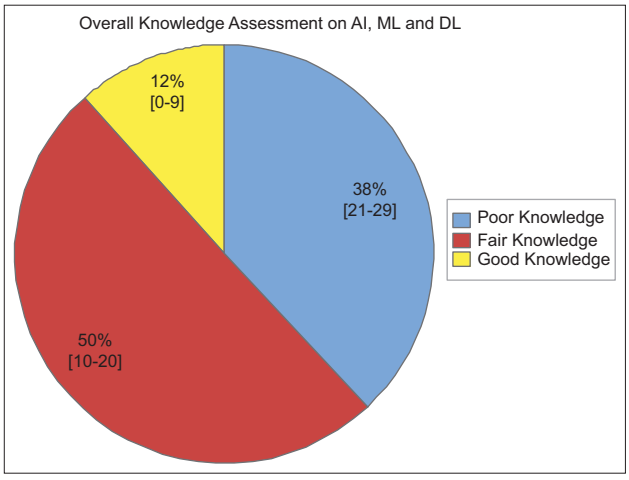

Figure 1: A pie chart showing the overall knowledge of the participants about artificial intelligence, machine learning, and deep learning

The distribution of knowledge level on the use of AI, ML, and DL systems among the different categories (consultant radiologists, senior registrars, and registrars) showed that most of the respondents across these different categories had only fair knowledge or poor knowledge on the use of these systems (77% of the consultant radiologists, 87% of the senior registrars, and 90.5% of the junior registrars). Those with good knowledge were only 22%, 12.9%, and 9.5% of the consultant radiologists, senior registrars, and junior registrars, respectively [Figure 2]. Although the level of knowledge appeared to increase with participants' current job status, this was not statistically significant ($P = 0.724$).

Only about a quarter (24%) of the respondents were duly aware of the disciplines (such as law enforcement agents, jury members, counselors, and board directors), where AI is not being currently employed.

Attitude of participants toward the introduction of artificial intelligence to medical imaging

Participants were asked if they will be willing to embrace AI if introduced to their facilities or whether they would rather work in a facility without AI. They were also asked if they would choose another career path if in future IR becomes an integral part of medical imaging.

Fifty-eight percent of the respondents were willing to embrace AI, ML, and DL systems if these were introduced in their hospitals, whereas about 8% of the respondents had a negative attitude toward embracing the use of AI/ML/DL systems. About a third (34%) of the respondents were neutral in their attitude [Figure 3].

The responses of the participants' attitude toward the use of AI and ML systems distributed by current job status showed that more than half of the resident doctors (about

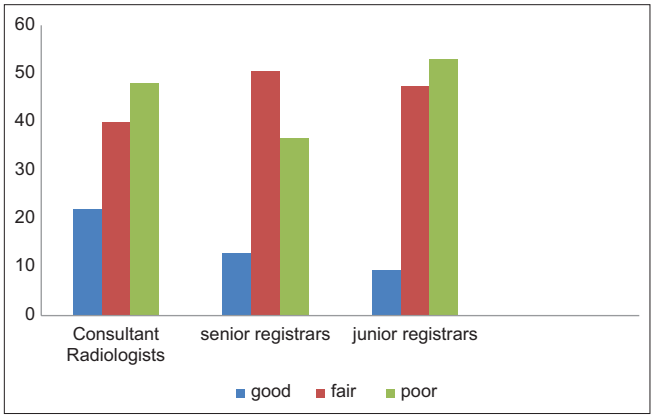

Figure 2: A bar chart showing the knowledge of the participants about the use and application of artificial intelligence based on status categories

56% of the senior registrars and 57% of the junior registrars) and 75% of the consultants had a positive attitude. Less than 10% of the resident doctors and none of the consultant radiologists had a negative attitude toward the use of AI and ML systems. The rest (25% of the consultant radiologists, 36% of the senior registrars, and 33% of the junior registrars) were neutral. There was no statistically significant association between current job status and the respondents' level of attitude ($P = 0.82$).

It was further revealed from the study that 120 (80.6%) of the participants indicated that they were in agreement toward upgrading their knowledge on the use of AI, ML, and DL, whereas 94 (59%) claimed that they were interested in undergoing further trainings on AI-, ML-, and DL-related programs even if they had to pay out-of-pocket to acquire it.

Perception of the participants on the opportunities available with the use of artificial intelligence and the effect it will have on the profession

Opinions of the respondents were sought on whether AI would enhance and augment imaging interpretation and increase productivity or replace human radiologists. They were also asked if AI was going to be subjected to misuse and abuse.

Up to 72% of the respondents were in agreement with the claim that AI systems will offer a major opportunity to enhance and augment image interpretation. About 59% of the respondents expressed their agreement to the assertion that radiological practice would certainly benefit from AI and ML systems that can read and interpret multiple images quickly due to the increasing number of images to be read by the radiologist.

Only 47 (29.4%) of the respondents agreed with the fact that AI, ML, and DL systems will take over the job of radiologists if they are integrated into radiological image analysis and reporting. Sixty-five (40.6%) respondents disagreed, whereas the remaining 30% were undecided.

Fifty-one (32.2%) respondents agreed with the claim that some medical students have reportedly decided not to specialize in radiology because they fear that the radiologist's job will cease to exist due to introduction of AI systems; 22.2% of the respondents expressed disagreement to the assertion and 51% were undecided. It was observed that 121 (75.7%) respondents were in agreement with the fact that AI is subject to abuse and misuse, whereas 91 (58%) agreed that AI software should be licensed and renewed yearly for strict control to prevent quackery.

Sixty percent of the total respondents had a positive perception toward the opportunity of using of AI, ML, and DL systems in radiology practice within their facilities, whereas only 5% of the respondents had a negative perception toward the use of AI/ML/DL systems. About a third (35%) of the respondents, however, were indifferent [Figure 4].

There was no statistically significant association between current job status and the respondents' level of perception ($P = 0.38$).

Relationship between the respondents' knowledge levels and their respective attitude levels

There was a strong association between the respondents' knowledge levels and their respective attitude levels with 82% of those with good knowledge having a positive attitude ($P < 0.001$). A higher proportion (74%) of those with good knowledge had a positive perception, compared with 52% of those with fair knowledge and 66% of those

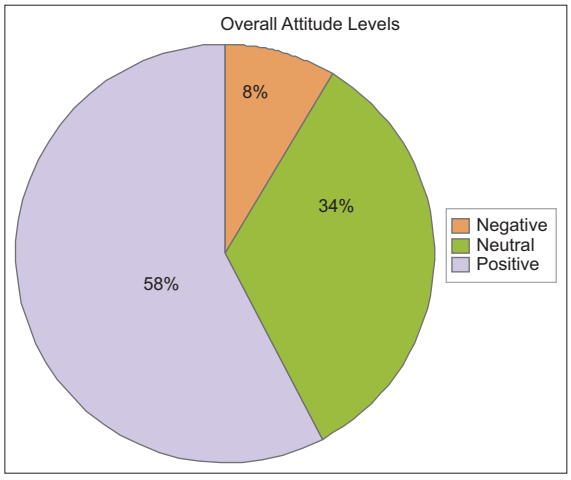

Figure 3: A pie chart showing the overall attitude of the participants toward the introduction of artificial intelligence to medical imaging

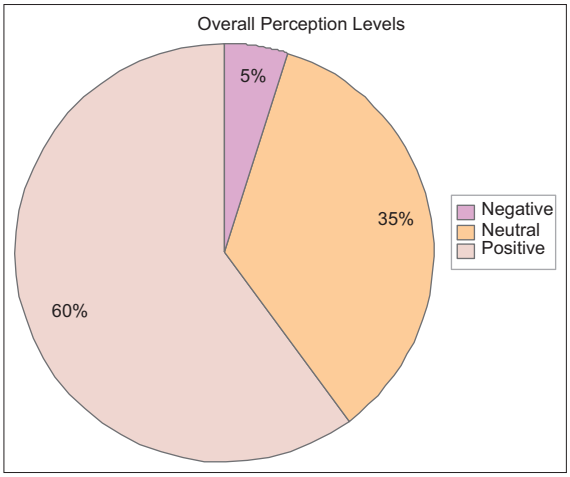

Figure 4: A pie chart showing the overall perception of the participants on the role of artificial intelligence and the opportunities available in medical imaging

with poor knowledge. This was, however, not statistically significant ($P = 0.25$).

To corroborate the results obtained from the Chi-square test of independence, the Pearson's Product-Moment Correlation was used to check the association between the variables.

It was deduced that there was a positively, fairly weak correlation between respondents' knowledge on AI/ML systems and their attitude levels to the use of the system, an association that was found to be statistically significant at 5% significance level ($r = 0.376$, $P < 0.001$).

It was also deduced that there was a negatively, very weak correlation between respondents' knowledge on AI/ML systems and their perception levels to the use of the system, an association that was found to be extremely insignificant ($r = -0.01$, $P = 0.901$).

DISCUSSION

AI is defined as a set of tools and programs that make software "smarter" to the extent that it operates in similar ways to normal human brain functions during regular tasks, and an outside observer will think that the output is generated by a human being. Examples of such tasks include common sense reasoning, forming an opinion, or social behavior'.[18]

The introduction of DL, a subset of AI, to radiology offers opportunities to improve the speed, accuracy, and quality of image interpretation and diagnosis.[11,12] Consultant radiologists, trainees, and potential future radiologists, however, need to understand the roles of AI and the impact it will have on the radiological profession.

This study captures the views of radiologists in a developing country at different levels of their careers as it pertains to AI and its subsets, namely, DL and ML. The findings from the study showed that radiologists in the study setting are not very knowledgeable about the use and applications of AI and its subsets and that the knowledge increased with the number of years in practice with the junior residents having the least knowledge. The increased knowledge among older practicing radiologists can be attributed to exposures during international/regional conferences and refresher courses.

Some radiologists believe that AI is a threat to the specialty and some have predicted that AI will put radiologists out of business in 5–10 years, along with other medical image interpreters, such as pathologists.[19] There is also the fear of job loss by radiologists, which will reduce training opportunities in the near future. This was not corroborated in this study as 72% of the participants claimed that AI systems will offer a major opportunity to enhance and augment image interpretation, whereas 59% agreed that radiological practice would certainly benefit from AI and ML.

In some developing countries, medical students are being advised against considering radiology as a postgraduate option, because they believe that the radiologists' jobs would be replaced by AI.[20,21] This advice is causing a lot of anxiety among junior medical trainees in radiology, who are now having a doubt about having a career in diagnostic radiology.[15,22]

Only 32.2% of the respondents agreed with this fact in this study, while majority had a positive perception toward opportunity of using of AI, ML, and DL systems in radiology practice within their facilities.

Since AI is still a new field in the low socioeconomic countries, there is a concern that the concept might not be embraced by the radiologists. The findings from this study showed that more than half of the consultant radiologists were willing to embrace AI if introduced to their facilities. They were also ready to undergo additional training in AI even if they had to pay out of pocket. However, majority of the resident doctors were indifferent about whether they will embrace AI or not. This indifference may be ascribed to their little knowledge about its role and application in medical imaging. To overcome these challenges, specific AI and informatics module should be included as a matter of urgency in the radiology training curricula to integrate the knowledge of AI early in their carrier.[23,24]

A crucial question that concerns many radiologists on a global level is what expectation is realistic and how severe will the impact of this new technology be on the radiological profession? So much fear has been generated by statements in public media globally, predicting the imminent extinction of radiology due to AI taking over the jobs of radiologists.[15,16,22]

A primary driver behind the emergence of AI in medical imaging has been the desire for greater efficacy and efficiency in clinical care, especially in developed countries, but in the developing country, the desire for AI is to augment the acute shortage of radiologists.[25,26] Many respondents in this study agreed with the statement that "routine tasks in the radiology workflow will now be performed faster and better by AI algorithms"[16,17,27] and therefore welcome

the incorporation of AI into radiological practice. A major concern of radiologists seems to be the abuse and misuse of AI by unqualified nonmedically qualified people, who are rich enough to acquire imaging modalities on private practice level. These nonmedically qualified individual may then do away with the services of radiologists or reduce drastically the number in their employment to maximize gain. It is, therefore, advocated that AI licenses should be strictly controlled at global level with a provision for yearly renewal to prevent quackery.

CONCLUSION

Knowledge of AI, ML, and DL systems in medical imaging is still limited in developing countries like Nigeria, and acceptability of these systems depends on the level of knowledge of their applications in medical imaging. There is a need for more awareness and training on the application of AI, ML, and DL systems in imaging among consultant radiologists and trainees in developing countries as well as provision of technological support for AI advancement in this region. There is also a call for strict control of AI application to prevent misuse and quackery.

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Conflicts of interest
There are no conflicts of interest.

REFERENCES

1. Frankish K, Ramsey WM, editors. Introduction. In: The Cambridge Handbook of Artificial Intelligence. Cambridge, UK: Cambridge University Press; 2014. p. 1-14.
2. Oxford Living Dictionaries. Artificial Intelligence Description in English. Available from: https://en.oxforddictionaries.com/definition/artificial_intelligence. [Last accessed on 2019 Oct 12].
3. Knapp S. Artificial Intelligence: Past, Present, and Future; 2006. Available from: https://www.dartmouth.edu/~vox/0607/0724/ai50.Html [Last accessed on 2019 Oct 15].
4. Pakdemirli E. Artificial intelligence in radiology: Friend or foe? Where are we now and where are we heading? Acta Radiol Open 2019;8:2058460119830222.
5. Samuel A. Some studies in machine learning using the game of checkers. IBM J 1959;3:211-29.
6. Suzuki K. Pixel-based machine learning in medical imaging. Int J Biomed Imaging 2012;2012:792079.
7. Kononenko I. Machine learning for medical diagnosis: History, state of the art and perspective. Artif Intell Med 2001;23:89-109.
8. Ravi D, Wong C, Deligianni F, Berthelot M, Andreu-Perez J, Lo B, *et al*. Deep learning for health informatics. IEEE J Biomed Health Inform 2017;21:4-21.
9. Shen D, Wu G, Suk HI. Deep learning in medical image analysis. Annu Rev Biomed Eng 2017;19:221-48.
10. Hosny A, Parmar C, Quackenbush J, Schwartz LH, Aerts HJ. Artificial intelligence in radiology. Nat Rev Cancer 2018;18:500-10.
11. Erickson BJ, Korfiatis P, Akkus Z, Kline TL. Machine learning for medical imaging. Radiographics 2017;37:505-15.
12. Jiang F, Jiang Y, Zhi H, Dong Y, Li H, Ma S, *et al*. Artificial intelligence in healthcare: Past, present and future. Stroke Vasc Neurol 2017;2:230-43.
13. Murdoch TB, Detsky AS. The inevitable application of big data to health care. JAMA 2013;309:1351-2.
14. Patel VL, Shortliffe EH, Stefanelli M, Szolovits P, Berthold MR, Bellazzi R, *et al*. The coming of age of artificial intelligence in medicine. Artif Intell Med 2009;46:5-17.
15. Ranschaert E. Artificial intelligence in radiology: Hype or Hope? J Belg Soc Radiol 2018;102:20, 1-2.
16. Collado-Mesa F, Alvarez E, Arheart K. The role of artificial intelligence in diagnostic radiology: A survey at a single radiology residency training program. J Am Coll Radiol 2018;15:1753-7.
17. Wahl B, Cossy-Gantner A, Germann S, Schwalbe NR. Artificial intelligence (AI) and global health: How can AI contribute to health in resource-poor settings? BMJ Glob Health 2018;3:e000798.
18. Available from: https://www.ubs.com/microsites/artificial-intelligence/en/new-dawn.html. [Last accessed on 2019 Oct 20].
19. Obermeyer Z, Emanuel EJ. Predicting the future – Big data, machine learning, and clinical medicine. N Engl J Med 2016;375:1216-9.
20. Rau VM. RSNA President Calls for Radiology Leaders to Explain AI. Available from: https://ai-med.io/rsna-presidentcalls-for-radiology-leaders-to-explain-ai/. [Last accessed on 2018 Dec 24].
21. Royal College of Radiologists (RCR) Census Report; 2017. Available from: https://www.rcr.ac.uk/system/files/publication/field_publication_files/bfcr185_cr_census_2017.pdf. [Last accessed on 2019 Oct 22].
22. Coiera E. The fate of medicine in the time of AI. Lancet 2018;392:2331-2.
23. European Society of Radiology (ESR). What the radiologist should know about artificial intelligence – An ESR white paper. Insights Imaging 2019;10:44.
24. Allen B Jr. Five reasons radiologists should embrace clinical decision support for diagnostic imaging. J Am Coll Radiol 2014;11:533-4.
25. Grossmann P, Stringfield O, El-Hachem N, Bui MM, Rios Velazquez E, Parmar C, *et al*. Defining the biological basis of radiomic phenotypes in lung cancer. Elife 2017;6:e23421.
26. Kahn CE Jr. From images to actions: Opportunities for artificial intelligence in radiology. Radiology 2017;285:719-20.
27. Jalal S, Nicolaou S, Parker W. Artificial intelligence, radiology, and the way forward. Can Assoc Radiol J 2019;70:10-2.