Assessment of imaging diagnosis ability of skin tumors in Chinese dermatologists

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Skin tumors begin from normal skin cells, and some parts of them may transform with the potential to reproduce in an out-of-control manner.[1] Skin tumors are exceedingly common and the incidence is increasing at an alarming rate across the globe. There is a significant cost burden in the care of skin tumors for many countries and health expenditure for which will continue to grow as the incidence increases.[2] The common processes for skin tumors diagnosis include an initial clinical screening, radiological image, and histopathological examination.[3] In the field of dermatology, there are various kinds of skin diseases and there is a vast amount of patients with skin diseases in China. However, there are only around 24,000 dermatologists in China, and on average, there is only one dermatologist for every 60,000 people; even in the underdeveloped areas, there is only one dermatologist for every 100,000 people.[4] Dermatologists in China have a large patient volume, as Dr. Zhang described in “A Day in the Life of a Chinese Dermatologist.”[5] The imaging diagnosis ability of skin tumors is inconsistent among different regions and hospitals by Chinese dermatologists.

With the development of imaging technologies, a series of skin imaging diagnostic methods have emerged, which have significantly improved dermatologists’ diagnostic level and work efficiency. Based on the work in the past decade, Chinese experts formally launched “Chinese Skin Image Database (CSID)” in 2017; CSID has gradually developed into a systemic platform for the research, education, and application of skin imaging in China. Experts from CSID designed a questionnaire [Supplementary File 1, http://links.lww.com/CM9/A76] to assess the imaging diagnosis ability of skin tumors with Chinese dermatologists when presented with a brief medical history, clinical images, and dermoscopic images. This questionnaire composed of 20 questions, includes seven malignant, two borderline, and 11 benign skin tumor cases, whereas all skin tumor cases were previously diagnosed by pathological examination.

More than 20,000 Chinese dermatologists were registered on Youmai (a professional online study platform) at the time of this study. We published the questionnaire on Youmai and encouraged dermatologists to complete the test. Participants were asked to fill their respective basic information. They were then instructed to recognize the classification (benign, or malignant, or borderline) of each case and diagnose the disease. For the 20 questions, we stipulated that participants would receive five points for each correct answer, so we calculated the classification recognition score and disease diagnosis score for each participant. Differences between groups of accuracy and mean score were investigated using the Chi-square test for categorical variables and the analysis of variance for continuous variables. A two-sided P value <0.05 was considered significant in all analysis.

A total of 963 dermatologists from 31 provinces, autonomous regions, or municipalities in China [detailed distribution is shown in Supplementary Figure 1, http://links.lww.com/CM9/A76] completed all the 20 questions and were included for further analysis. Of the 963 dermatologists who participated were from 616 medical institutions, including 23 (3.7%) dermatologists from primary hospitals, 221 (35.9%) from secondary hospitals, 359 (58.3%) from tertiary hospitals, and 13 (2.1%) from other medical institutions. The professional titles of the 963 dermatologists were: 204 (21.2%) dermatologists with senior professional titles (professor, or associate professor, or chief physician, or associate chief physician), 382 (39.7%) with intermediate professional titles (attending physician or lecturer), 344 (35.7%) with primary professional titles (physician, or resident physician, or...
teaching assistant), and 33 (3.4%) dermatologists with other titles or without a professional title.

The disease diagnosis and classification recognition accuracy of skin tumors by dermatologists from different level hospitals and with different professional titles were assessed. For the first question, the disease diagnosis and classification recognition accuracy among different level hospitals were statistically significant \( P < 0.01 \), while the disease diagnosis and classification recognition accuracy among dermatologists with different professional titles are not significant \( P > 0.05 \). Comparison results about the accuracy of disease diagnosis and classification recognition among different level hospitals and dermatologists with different professional titles are shown in Supplementary Table 1, http://links.lww.com/CM9/A76.

The mean scores of disease diagnosis and classification recognition in dermatologists were compared with varying factors such as hospital level, professional titles, and provinces [Supplementary Table 2, http://links.lww.com/CM9/A76]. The mean score about classification recognition among different level hospitals was statistically significant \( P < 0.01 \), the mean score of the tertiary hospitals was higher than that of primary and the secondary hospitals. Additionally, the mean score about disease diagnosis of the tertiary hospitals was much higher than that of primary and the secondary hospitals \( P < 0.01 \). The mean score difference of classification recognition and disease diagnosis of dermatologists with different professional titles are not significant \( P > 0.05 \). Meanwhile, we compared the mean scores of dermatologists who came from different provinces [Supplementary Table 3, http://links.lww.com/CM9/A76], the mean scores among different provinces about classification recognition and disease diagnosis are both statistically significant \( P < 0.01 \).

This is the first online assessment in regards to the imaging diagnosis ability of skin tumors in Chinese dermatologists. The number of participants from Shandong province rank at the first place, and the distribution of participants almost in accordance with the ratio of dermatologists in each province in China. Of the 963 dermatologists, most of them are from the tertiary and secondary hospitals, and most dermatologists with intermediate and primary professional titles, these also in line with the phenomenon that the tertiary hospitals have the largest proportion of dermatologists, and most dermatologists with primary and intermediate professional titles in China. We further analyzed the accuracy of disease diagnosis and classification recognition in Chinese dermatologists from different level hospitals and with different professional titles. Comparison results about disease diagnosis and classification recognition were varied, indicating that this questionnaire may be used to distinguish the imaging diagnosis ability of skin tumors by Chinese dermatologists.

For the mean scores of disease diagnosis and classification recognition of dermatologists from different level hospitals, the differences are statistically significant. Further, both the mean score of classification recognition and disease diagnosis in the tertiary hospitals are higher than that of the secondary hospitals, and the secondary hospitals share the same relationship with primary hospitals. The dermatologists with senior professional titles yielded the highest mean score of classification recognition and disease diagnosis, which is in accordance to the level of professional titles, but the differences are not statistically significant. However, the mean score of disease diagnosis is below 50 points, suggesting that the imaging diagnosis ability of skin tumors in China is relatively low. The mean scores of classification recognition and disease diagnosis of dermatologists from different provinces have a large variation range, which indicates that the imaging diagnosis ability of skin tumors is uneven when comparing distinct regions.

The relatively low imaging diagnosis ability of skin tumors by Chinese dermatologists is alarming, and therefore action should be taken. Initially, Chinese skin image experts should promote the education of skin image analysis, through mediums such as conferences, videos, textbooks, etc. Subsequently, Chinese dermatologists should receive support from the administration of their hospitals and import necessary imaging equipment to carry out their work. Finally, Chinese dermatologists should learn expertise from international dermatologists, collaborate, and strengthen the research process. Furthermore, contributions to the skin image dataset of the Chinese population are necessary, as it is urgent to develop a series of suitable dermatological intelligent supporting diagnosis systems. Dermatologists trained to read skin tumor images would allow for better care of skin tumors, and eventually lead to preventative care of skin tumors for the general population.

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**Conflicts of interest**

None.

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