PEER REVIEW HISTORY

ARTICLE DETAILS

TITLE (PROVISIONAL)	Trends, Composition, and Distribution of Nurse Workforce in China: A Secondary Analysis of National Data from 2003 to 2018
AUTHORS	Lu, Han; Hou, Luoya; Zhou, Weijiao; Shen, Liqiong; Jin, Shida; Wang, Mengqi; Shang, Shaomei; Cong, Xiaomei; Jin, Xiaoyan; Dou, Dou

VERSION 1 – REVIEW

REVIEWER	Lee, Shen-Ming FCU Taiwan
REVIEW RETURNED	22-Jan-2021

GENERAL COMMENTS	BMJ Open bmjopen-2020-047348 Title: Trends, Composition, and Distribution of Nurse Workforce in China: An Analysis from 2003 to 2018 Author(s): Han Lu,Luoya Hou, Weijiao Zhou, Liqiong Shen, Shida Jin, Mengqi Wang, Shaomei Shang,Xiaomei Cong, Xiaoyan Jin, Dou Dou This paper consider the trends, composition, and distribution of nurse workforce in China by using the national public datasets in China from 2003 to 2018. Authors use the methodology of the descriptive statistics to present the change of nurse and physician workforce, gender, age, experience and Education. They also consider the Gini coefficient and Theil L index to evaluate the inequality of the nurse distribution. This results should be important and might provide the policy reformation to strengthen the health care services in the increased aging population. However, the expression of Gini coefficient and Theil L index should provide more explanation and should discuss about these difference between provinces or rural-urban areas. In addition, if authors could compare nurse workforce in different provinces or rural-urban areas including the information the aging population, these results can strengthen the healthcare policy services. The paper is well written and its contribution to finding the nurse workforce the trends of variation about quantity and quality from 2003 to 2018. This finding is potentially very substantial. Nevertheless, I have few comments for improvements. Comments: 1. Though authors stated Gini coefficient and Theil L index had measured inequalities in health workforce by WHO. There need more explanation about the results in reference [18] to let reader understand the purpose and be easy to know these meaning of inequalities measurement. 2. The formulas of Gini and Theil L index should provide more explanation the notations about ci , Ci , Bi , bi , Bij , · · ·. 3. From the Table 2, the most nurse are concentrated age around 25-44, around associate's and vocational education. Authors should provide some suggestions about this situation to let government strengthen reformation.

REVIEWER	Chang, Lichun

	Chang Gung University of Science and Technology, Nursing
REVIEW RETURNED	22-Jan-2021

GENERAL COMMENTS	This is a secondary analysis using national public datasets in China from 2003 to 2008. The changes in the nursing workforce are closely related to the country's demographic structure, the incidence of chronic diseases, and economic development. From this research we can learn the change of the nursing workforce from a national level for Mainland China, which has a population of more than one billion people. Although the authors demonstrate the changes in nurse workforce at different levels, international readers are not familiar with the evolution of China's health policy, population structure, and national policy in the past 15 years. Moreover, the definition and description of data collection for the national dataset used in this study are insufficient, so it is difficult to me to understand the results of the descriptive data. 1. P4, line 49, Strengths and limitations of this study #3, I could not know why the results could be used for providing robust policy prescriptions and how use it for healthcare administration and education? 2. P5, line 24, authors stated" as a middle-income country, China…." I guess that authors try to stress the need of the increasing nurse workforce for heavy load of caring aging population. If so, authors need to descript more information of the distributions of aging population in China for urban and rural areas (p 6, line 35-36) in your study. 3. In discussion (p12), authors used the data of other countries to compare with yours finding. However, some different policy, nurse preparation, hospital system and license examination standards between China and Europe countries need to be explained carefully. I really appreciate authors for their efforts to provide the important study of nurse workforce in China. Hope the suggestions could help your revised work.

REVIEWER	Ma, Yana Soochow University, Public health college
REVIEW RETURNED	26-Jan-2021

GENERAL COMMENTS	From the perspective of nursing human resources, this paper analyzed the changing trend, composition and distribution of nursing personnel in China from 2003 to 2018.The data are detailed and accurate, especially the inequality among regions is determined by the Gini coefficient and Theil index, which provides a scientific basis for the Chinese health administration department in the training and distribution of nursing human resources in the future.I recommend the adoption of this draft. Just a little problem, please modify the author. 1. Gini coefficient and Theil coefficient are not stated in the abstract, please add. 2.Please check carefully the formula for the Gini coefficient on page seven, line four.

VERSION 1 – AUTHOR RESPONSE

Reviewer: 1
Dr. Shen-Ming Lee, FCU Taiwan
Comments to the Author:
(1) Though authors stated Gini coefficient and Theil L index had measured inequalities in health workforce by WHO. There need more explanation about the results in reference [18] to let reader understand the purpose and be easy to know these meaning of inequalities measurement.
Thank you for your kind suggestion. The study "Measuring health workforce inequalities: methods and application to China and India" by WHO proposed methods for measuring inequalities in the distribution of health workers in a country, which include Gini coefficient and Theil L index that used in our study. And that study applied these methods to measure the inequalities of health workforce in China and India. We have added this explanation in the second paragraph of "Data analysis".
"As for the inequality of nursing distribution, we adopted the Gini coefficient and Theil L index, which have been proposed by the WHO to describe the inequality of the health workforce and applied in measuring the health workforce in China and India."

(2) The formulas of Gini and Theil L index should provide more explanation the notations about ci;Ci, Bi; bi, Bij , ...
Thank you for your suggestion. We have explained all the notations of the formulas in the second paragraph of "Data analysis".
"If b_i= number of nurses in province unit *i* and c_i= number of people in province unit *i*, then the total number of nurses in the country is $B=b_1+b_2+...+b_n$ and the total number of people in the country is $C=c_1+c_2+...+c_n$. If we value $B_i=b_i/B$, $Ci=c_i/C$, then the Gini coefficient ."

$$G = 1 - \sum_{i=1}^{I} C_i \left(2\sum_{i=1}^{I} B_i - B_i\right)$$

"If j means urban or rural, then Bij means the proportion of urban or rural nurses in province unit i in the total nurses, and Cij means the proportion of the urban or rural population in province unit i in the total population."
(3) From the Table 2, the most nurse are concentrated age around 25-44, around associate's and vocational education. Authors should provide some suggestions about this situation to let government strengthen reformation.
Based on your recommendation, the discussion of policy suggestion was expounded in the fourth and fifth paragraph of "Discussion".
"When the policymakers are seeking solutions to overcome the nurse shortage, it is crucial to consider and develop strategies to retain the nurses in the workforce and extend their career. Nursing workforce development and retention strategies need to promote different gender, and age and experience groups of nurses. For instance, research has shown that young nurses are more likely to leave due to the imbalance between effort and reward, high psychological demands, and elevated job strain, which suggests that policymakers need to provide young nurses with sufficient social support and the balance between effort and rewards such as salary, recognition, and career opportunities to attract and retain young nurses.[32, 33] "
"It is urgent to improve the education level of nurses in China. At the policy level, while encouraging the development of advanced nursing education, it is necessary to consider providing a broader career development path for highly educated nurses, so as to attract nurses to pursue high education and retain highly educated nursing talents. In addition, considering that many nurses in China have only received an associate's and vocational education, continuing education needs to be vigorously developed. Potential strategies include providing financial advising, academic advising, and open access to programs (e.g. flexible schedules, and/or online courses). [37, 38] Also, a higher education expectation and supportive approaches from the employer may motivate nurses to continue their education.[37, 39]]"

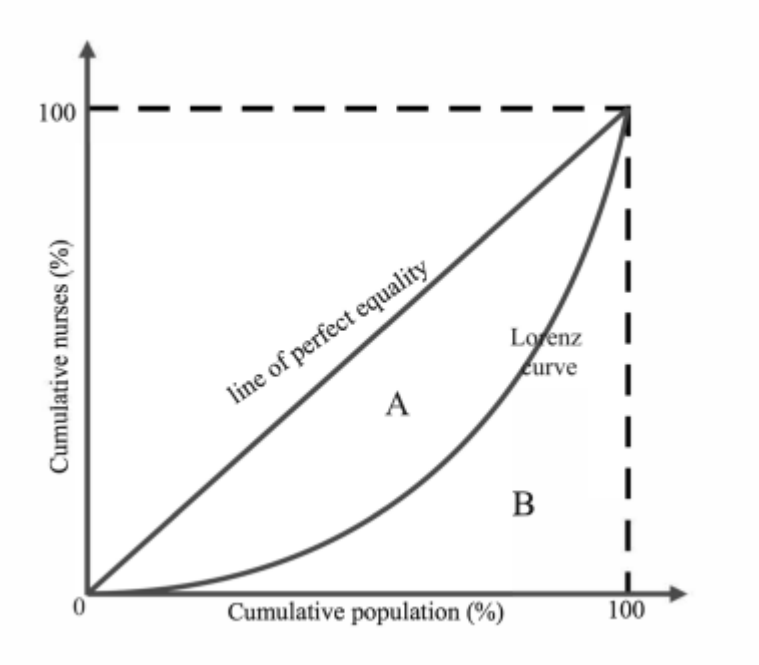
Reviewer: 2
Ms. Lichun Chang, Chang Gung University of Science and Technology
Comments to the Author:
(1) P4, line 49, Strengths and limitations of this study #3, I could not know why the results could be used for providing robust policy prescriptions and how use it for healthcare administration and education?
Thank you so much for your comments. We have made revisions and clarified the statement that the finding will provide epidemiologic evidence for policy making, health care administration, and education. We also explained the reasons in the discussion.
"3.This study will provide epidemiologic evidence for policy making, healthcare administration, education, and further research to strengthen the nurse workforce."

(2) P5, line 24, authors stated" as a middle-income country, China…." I guess that authors try to stress the need of the increasing nurse workforce for heavy load of caring aging population. If so, authors need to descript more information of the distributions of aging population in China for urban and rural areas (p6, line 35-36) in your study.
Thank you for your kind suggestion. We added information about the distribution of older adults in urban and rural areas and changed the description in the third paragraph of "Introduction"
"As a middle-income country, China has been experiencing a very fast pace of the population aging process and has the largest older population: more people are going to need more care for longer. In particular, the degree of aging is showing an unbalanced trend. The proportion of people over 60 years old in rural areas (20.6%) is higher than that in urban areas (16.4%), while rural health resources have been largely underinvested and remain in deficit. These disparities lead to heavy healthcare burden in rural areas."

(3) In discussion (p12), authors used the data of other countries to compare with yours finding. However, some different policy, nurse preparation, hospital system and license examination standards between China and Europe countries need to be explained carefully.
Thank you for your comments. We have added discussion about policy/cultural contexts when comparing with the results of other countries in the "Discussion".
"Female nurses dominate and males (2.3 %) remain largely underrepresented in the nursing profession in China, in comparison with the proportion of male nurses in the US (9.6%) and the UK (10.7%), which may be related to different cultures and efforts to increase the gender diversity in nursing.[30, 31] "
"Notably, China's nurse workforce has been also dominated by young and middle-aged nurses, with more than 70% of nurses being 22-44 years old but the proportion of nurses with more than 30 years of experience consistently below 10%. This unbalanced composition of age and working experience may result from the continuous nurse shortage in the past 30 years and rapid expansion in the past decades, for instance, in 1990, China had 1.14 billion people but only fewer than one million nurses. The severe shortage of nurses in the past has led to a shortage of senior and clinically experienced nurses today, significantly, the proportion of nurses over 55 years old in China (4.9%) is small, compared to the US (46%) and the UK (19%).[30, 31] This is mainly due to China's retirement policy, where most women retire at the age of 55."

Reviewer: 3
Dr. Yana Ma, Soochow University
Comments to the Author:
(1) Gini coefficient and Theil coefficient are not stated in the abstract, please add.
Thank for your recommendation. We have stated Gini coefficient and Theil index in the Primary and secondary outcome measures and added relevant statistical results in the Results section.

(2) Please check carefully the formula for the Gini coefficient on page seven, line four.
Thank you for your kind remind. We check the formula for the Gini coefficient many times but didn't find any mistake. The I in the formula means number of total provinces. The Gini coefficient is twice the area enclosed by the Lorenz curve and the perfect equality line. The detail of
Gini coefficient formula was as follows:
As the picture shows, G=2A=1-2B
$B=1/2C_1B_1+[1/2C_2B_2+C_2B_1]+...+[1/2C_IB_I+C_I(B_1+B_2+B_3+...B_{n-1})]$
$=1/2[C_1(2B_1-B_1)+C_2(2B_1+2B_2-B_2)+...+C_I(2B_1+2B_2+2B_3+...+2B_I-B_I)]$
$2B=C_1(2B_1-B_1)+C_2(2B_1+2B_2-B_2)+...+C_I(2B_1+2B_2+2B_3+...+2B_I-B_I)$
=
G=1-
bi= number of nurses in province unit i and ci= number of people in province unit i, then the total number of nurses in the country is B=b1+b2+...+bn and the total number of people in the country is C=c1+c2+...+cn. We value Bi=bi/B, Ci=ci/C.



VERSION 2 – REVIEW

REVIEWER	Lee, Shen-Ming FCU Taiwan
REVIEW RETURNED	16-Jun-2021

GENERAL COMMENTS	Authors had provided the responses of my comments. I have only suggestion in Page 7, line 12 about the formula of the Gini coefficient G=1- ∑_{i=1}^{I} C_i(2 ∑_{i=1}^{I} B_i-B_i) should be G=1- ∑_{i=1}^{I} C_i(2 ∑_{j=1}^{I}B_j-B_i). I don't have any other comments.

REVIEWER	Chang, Lichun Chang Gung University of Science and Technology, Nursing
REVIEW RETURNED	13-Jun-2021

GENERAL COMMENTS	Authors need to list the % in the table 2 and recheck the total number for the 100%.