Predictive Value of Institutional Impact Factor as an Indirect Measure of Maternal Mortality in Nigeria: A Systematic Review

Philip C. Njemanze, Iheanyichukwu O. Okoro[1]

International Institutes of Advanced Research and Training, Chidicon Medical Center, Public Health Policy Institute, Owerri, [1]Department of Surgery, Babcock University Teaching Hospital, Ilishan-Remo, Ogun State, Nigeria

Abstract

Background: This study developed a novel measure termed as an institutional impact factor (IIF), which was used for predicting the trends of maternal mortality ratio (MMR) resulting from poor management of the health system. **Methods:** A total of 3518 publications from Nigeria in PubMed from 1975 to 2005, were used to obtain IIF for each institution studied. The study periods compared, were period A (1975–1989), period B (1990–2004), and period C (1990–2005). **Results:** The public health sector period A mean ± standard error (SE) IIF was 1.423 ± 0.09, and dropped significantly in period B, to IIF of 0.704 ± 0.024, $P < 0.001$. Conversely, in period A, the mean ± SE MMR, was 508.8 ± 115.7/100,000 live births, and rose significantly in period B to MMR of 1895.5 ± 363.7/100,000 live births, $P < 0.05$. The linear regression model suggested a negative correlation between IIF and MMR. The overall, F (1,18) =15.5, $P < 0.001$, R^2 was 0.463, BETA coefficient was − 0.68, $P < 0.0001$. The intercept 2957.6 was significant, $P < 0.0001$. We predicted that the Millennium Development Goals 5 required a 75% drop in MMR to 127/100,000 live births, and IIF rise to 1.69, in 2015. **Conclusion:** The IIF may be a health metric index for monitoring efficiency of the health workforce.

Key words: Brain drain, capacity building, impact factor, maternal mortality ratio, Millennium Development Goals

Introduction

As we approach 2015 as the critical deadline to evaluate the performance of all nations of the world facing the quality of life (QoL) challenges, for which, the eight Millennium Development Goals (MDGs) were set as points of consideration, to address the gap between the developed and the developing nations, there is an urgent need to evolve health metrics for efficiency and policy environment in countries facing huge challenges.[1] Importantly, six of the MDGs are health-related, confirming the link between health and QoL. Specific measures have been advocated that address maternal, newborn, and child health. However, there are no reliable health metrics for quality and efficiency of the institutional human capacity of the health workforce, and their preparedness to take on the challenges within their environment. In Africa, 75% of maternal deaths are attributable to direct obstetric complications, which include obstructed labor plus ruptured uterus, obstetric hemorrhage, eclampsia, and sepsis.[2] Other causes of death include anesthetic, amniotic fluid embolism, jaundice in pregnancy, congestive cardiac failure, pulmonary embolism, and severe anemia.[3] These medical conditions are not necessarily associated with poor outcome or death, provided that they are timely and competently addressed. In sub-Saharan Africa, as causes of high maternal deaths, emphasis has been placed on failures of governance and leadership, lack of clear policies to provide strategic direction in the health system, as well as severe poverty, and economic deprivation of the people. However, these factors are not new and were even more acute during the postindependence era, as many African nations were caught up in the crisis of leadership, civil wars, and military dictatorship. Paradoxically, in Nigeria, the most populous African country with the highest maternal deaths, there is a perception that the maternal mortality ratio (MMR) was lower in the post-civil war period (1975–1989) compared to the recent past (1990–2004). The deterioration in health indices has been attributed to several factors, including socioeconomic, poor governance, corruption in the public sector, and most importantly "brain drain" of the better educated doctors, who were mentors and builders of institutional human capacity within the public health sector. The phenomenon usually described as "brain drain," is the trend whereby well trained professionals leave their countries of origin and migrate to other countries with better conditions of service, greater opportunities for personal, and professional development. In sub-Saharan Africa, the

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Address for correspondence: Dr. Philip C. Njemanze, International Institutes of Advanced Research and Training, Chidicon Medical Center, No 1 MCC/Uratta Road, P.O. Box 302, Owerri, Imo State, Nigeria. E-Mail: philip.njemanze@chidicon.com

migration of experienced doctors to Western countries and Gulf States starved the public health sector of crucial specialists and teachers of the trainers within the public health sector. Although, the extent of the "brain drain" in the public health sector has never been fully quantified, it could be presumed that, it had a devastating effect on the quality of public health services in most African countries.

In 1988, the government of Nigeria set up a Presidential Committee on "Brain-Drain," which reported that, Nigeria, between 1986 and 1990, lost 10,694 professionals from tertiary institutions alone. However, it must be acknowledged that, until the collapse of the Soviet bloc by 1991, there was a substantial influx of doctors trained overseas, particularly from Eastern Europe into sub-Saharan Africa, which cushioned the initial effects of "brain-drain" in the health sector. On the other hand, after 1990, there was an accelerated exodus of Western trained doctors. According to the United Nation's Human Development Report, in 1993, at a time when Nigeria's healthcare system was severely deficient there were more than 21,000 practicing Nigerian physicians in the United States alone.[4,5] Similarly, a good number of practicing Nigerian physicians were in the Gulf States, United Kingdom, Europe, Australia, and in other African countries. As one of the follow-up consequences of the "brain-drain," in 2000, the World Health Organization ranked the Nigerian health system in 187th place out of 191 countries evaluated.[6] According to United Nations Development Programme, life expectancy in Nigerian has declined to 43 years (2006) from 47 in 1990. Even though only 2% of the global population lives in Nigeria, the country, accounts for 10% of the world's maternal death.[7] The falling workforce and rising disease burden created a new sense of urgency for governments in sub-Saharan Africa.

Africa has 24% of the world's burden of disease, but only 3% of the world's health workforce,[8] and the problems were made even more acute by "brain-drain." In the postindependence era, the problem of "brain-drain" was not as acute as it is today. Although, the role of socioeconomic factors has been highlighted, there is a growing realization that the prime motivation for "brain-drain" phenomenon is beyond financial reasons, but rather the lack of professional self-actualization within the home country institutions. The process of "brain-drain" from sub-Saharan Africa to the developed countries may become even more accelerated because of the growing demand on retirement of the "baby boomer" generation in the United States. Although, in the past decade, 1995–2005, the governments of sub-Saharan Africa have invested in health workforce scale-up plans, and have developed retaining strategies.[9] However, the shortfall in qualitative and quantitative human capacity building in the health sector remains intense. To the best of our knowledge, until now, there are no health metrics for quality and efficiency of the institutional human capacity of the health workforce that relates to MMR. Therefore, we sought to examine if the mean journal impact factor (JIF) of publications from a given institution, referred to here as institutional impact factor (IIF) could be used to characterize the status of institutional human capacity of the health workforce, and if it is correlated with changes in MMR. Moreover, the MDG 5 targets reduction of MMR by 75% between 1990 and 2015. The JIF is a ratio of the numerator, which is the number of citations in the current year to items published in the previous 2 years, and the denominator, which is the number of substantive articles and reviews published in the same 2 years. The impact factors reported by the Journal Citation Reports (JCR) imply that all editorial items including correspondence, letters, commentaries, perspectives, news stories, obituaries, editorials, interviews, and tributes are not included in the JCR's denominator. Even though they may be cited, especially in the current year, they do not significantly affect impact calculations. The impact factor is determined by citation density, age of the literature cited, and the size of a field of study will increase the number of papers with very high citation.[10] The JIF may be assessed over longer periods of time, and rankings based on 1-, 7, or 15-year impact factors do not differ significantly.[11,12] It would, therefore, follow that, assessment of IIF may provide at least a rough assessment of the status of the institutional human capacity of the health workforce during a given period under consideration and may be used for comparisons. However, the JIF™ (Thomson Reuters) is a registered trademark with limited access. Comparison of JIF could be made using the open access Cites per Doc. (2y) from the SCImago Journal and Country Rank (SJR) website.[13] The Cites per Doc. (2y) measures the scientific impact of an average article published in a journal, using the same formula as JIF. The SJR indicator measures the scientific influence of the average article in a journal, and how relevant is an average article in the journal to the global scientific discussion.

Our hypothesis is that, the MMR is negatively correlated with IIF. We set out to accomplish the following objectives: (1) Examine if the mean JIF of publications from a given institution may be used to develop the equivalent parameter, the IIF; (2) develop IIF that could be used as a variable in the problem to measure outcome of QoL related to MMR; (3) to determine if this measure IIF, correlates with changes in MMR. In other words, this study was undertaken to develop a measure for IIF as an indirect measure of the level of institutional human capacity of the health workforce and use this measure to determine the relationship between institutional human capacity and MMR. The findings in this study would provide empirical evidence for policy guide and support to strengthen measures, which will raise the level of academic and clinical proficiency of health workers critically needed in Family and Reproductive Health. In so doing reposition Nigeria and other developing countries with high maternal death rates and associated decay in their public health system.

Methods

Definitions

Deaths during pregnancy or <42 days after termination of pregnancy were defined as early MMR, and those after

42 days up to 1-year were defined as late MMR.[14] The causes of maternal deaths were classified as: (A) Direct obstetric causes; (B) indirect causes aggravated by pregnancy; (C) HIV infection; and (D) incidental causes unrelated to pregnancy. The International Classification of Diseases 10th revision (ICD 10)[14] was used for vital registration systems. Only deaths in categories A (direct), B (indirect), and C (HIV) were included in MMR.[14-16] Cites per Doc. (2y) was defined as JIF, determined as a ratio of the numerator, which is the number of citations in the current year to items published in the previous 2 years, and the denominator, which is the number of substantive articles and reviews published in the same 2 years.[13] The IIF was determined as the mean JIF of all published articles credited to each institution.

Study design – inclusion and exclusion criteria

The study design was based on systematic review of published papers from various medical institutions, in all medical faculties credited in-part or whole to the institution, as cited in PubMed National Library of Medicine (NLM) journal catalog. We included only PubMed cited publications in journals with assigned JIF scores retrieved from the SJR website, as of July 2011.[13] Publications in journals without a JIF score were excluded. Before we analyzed the data, further inclusion criteria for health institutions, were no less than a total of seven publications in the PubMed database in the period 1975–2005, to allow for sufficient data for statistical analysis, and the publication must be clearly marked as domicile in that institution. We took care to adhere strictly to internal validity issues related to publications stating maternal mortality as recommended.[16]

Data sources

We systematically searched the internet (PubMed) for all publications in medicine from 1975 to 2005, credited to each health institution in Nigeria studied. We used search terms that included the name of the institution and place of location. We included all teaching hospitals, national hospitals, national orthopedic hospitals, federal medical centers, and private hospitals. The search produced 3518 titles, of which 3037 published articles were considered as relevant. For maternal mortality, we relied on published works, which reported population-based studies of MMR, both sub-national and facility-based. We used the search terms "maternal mortality" and Nigeria, which yielded 654 studies as of July 24, 2011 from which we reviewed all abstracts, and read relevant studies reporting consistent data in accordance with ICD 10 and WHO criteria.[14,15]

We searched for the JIF of journals at the website of the SJR website,[13] by name or by ISSN number obtained from the PubMed. Journals that were not found in the SCImago database by name or ISSN number were not ranked and were not included in the analysis. The JIF was obtained as Cites per Doc. (2y) for the year 2006 for all journals. The IIF of publications from the major University Teaching Hospitals that have been in existence before 1975, were used as the dominant institutions, since they constituted the bulk of the teachers of the trainers within the health system in Nigeria. The IIF for these major university teaching hospitals were analyzed for the period A (1975–1989), period B (1990–2004), and period C (1990–2005), for trend analysis. Private institutions which met the criteria for IIF calculations were also included in the analysis to examine the impact of the private sector. We obtained published MMR for each major university teaching hospital and health institution for the period A (1975–1989), and period B (1990–2004).

Statistical analysis

We extracted the JIF for 2006 for all journals with publications credited to each medical institution and entered it into Microsoft Excel spreadsheet. The Excel worksheets were subdivided into period A (1975–1989), period B (1990–2004), and period C (1990–2005). Similarly, the published data of MMR[3,17-33] for both periods A and B were entered into the same Microsoft Excel spreadsheet. The data were further analyzed using the software package, Statistica, StatSoft, Tulsa, OK. We applied analysis of variance with repeated measures (ANOVA) for the comparison of periods A and B, to examine the changes in IIF and MMR. We computed the descriptive statistics for IIF and MMR for the major university teaching hospitals in periods A and B and plotted the mean ± standard error (SE) for comparison. Furthermore, we plotted the mean ± SE of IIF for the first 20 health institutions in Nigeria, ranked by IIF in period C (1990–2005), and used the data for prediction of MMR and trend analysis. We examined if there was a need for transformation of the MMR and IIF data into a continuous variable to enable mean and standard error of means to be used in further statistical treatment. The central limit theorem states that in many situations, the sample mean does vary normally if the sample size is reasonably large. However, considering the large sample size and no evidence of substantial skew in the data, we did not transform the data to a symmetric distribution before constructing a confidence interval; rather we applied the original scale of the naturally occurring variables. For the prediction, we modeled the relationship between IIF and MMR using a linear regression analysis, and evaluated the seriousness of the outlier problem using the plot of residuals versus deleted residuals. The regression model was applied to predict the dependent variable MMR from the independent variable IIF, for all medical institutions in the period C (1990–2005), for the public sector alone and for all combined. The null hypothesis was that, MMR has no relationship to IIF and was tested using the linear regression model. The linear regression model was fitted using the least squares approach because such a line minimizes the sum of squared residuals. The regression line in a two-dimensional or two-variable space was defined by the equation:

$$Y = a + b \times X;$$

Where the dependent variable Y (MMR) could be expressed in terms of a constant or intercept (a) and a slope or the B coefficient (b) times the independent variable X (IIF). If the

B coefficient is positive, then the relationship of independent variable (IIF) with the dependent variable (MMR) is positive; if the *B* coefficient is negative then the relationship is negative. If the B coefficient was 0 then there is no relationship between the variables MMR and IIF. R^2 is the proportion of the variance in the values of the dependent variable MMR, explained by all the independent variable IIF, in the equation; the adjusted R^2, is the correction made to reflect the number of variables in the equation. F expresses if the equation as a whole is statistically significant in explaining MMR. We evaluated the seriousness of the outlier problem using the deleted residuals statistics. This represents the standardized residual for the respective case that one would obtain if the case were excluded from the analysis. The model was applied in two stages: First we estimated the linear model using IIF and MMR at all major public university teaching hospitals from 1975 to 2004. Then we applied the formula derived, to estimate the dependent variable MMR from the derived IIF for period C (1990–2005), including all public and private institutions studied. We calculated the MDG 5 required reduction of MMR by 75% of 1990 level and estimated the IIF needed to attain it. Furthermore, we calculated effect size (ES) as a measure of the magnitude of a treatment effect. Unlike significance tests, these indices are independent of sample size. The Cohen's *d* ES was calculated as the difference between the means, M_1–M_2, divided by standard deviation, σ, of either group. A low ES of 0.0 indicates that the distribution of scores for the treated group overlaps completely with the distribution of scores for the untreated group, there is 0% of nonoverlap. A large ES of 0.8 indicates a nonoverlap of 47.4% in the two distributions. An ES of 1.7 indicates a nonoverlap of 75.4% in the two distributions.

Results

Table 1 summarizes the IIF and MMR for the six major university teaching hospitals in periods A (1975–1989) and twelve major university teaching hospitals in period B (1990–2004). In the period A, the IIF was 1.423 ± 0.09, and MMR was 508.8 ± 115.7/100,000 live births. In period B, the IIF was decreased to 0.736 ± 0.044, but MMR increased to 1676.8 ± 241/100,000 live births. The six major university teaching hospitals were compared in the period A versus period B, using ANOVA with repeated measures. In period A, the IIF was 1.423 ± 0.09 and dropped significantly in period B to 0.704 ± 0.024, F (1,5) =53.6, MSE = 1.548, $P < 0.001$ [Figure 1a]. Conversely, the MMR in period A was 508.8 ± 115.7/100,000 live births, but rose significantly in period B to 1895.5 ± 363.7/100,000 live births, F (1,5) =13.1, MSE = 5,768,534, $P < 0.05$, [Figure 1b]. The Cohen's *d* ES between MMR and IIF was 0.708, which indicates a nonoverlap of 43% in the two distributions. Figure 1a and b, suggest that, there was a negative relationship between IIF and MMR. To determine the relationship between IIF and MMR, the dataset from all public university teaching hospitals with published MMR and IIF in the period (1975–2004) were entered into a linear regression model with IIF (*x*-axis) as the independent variable, and MMR (*y*-axis) as the dependent variable. A total of 20 MMR and 20 IIF data points were analyzed. Figure 2a and b shows the linear regression of IIF and MMR [Figure 2a], and the plot of the residuals versus deleted residuals [Figure 2b], to examine the role of outliers. The overall F statistics, F (1,18) =15.5,

Table 1: Institutional impact factor and MMR 1989-2004

Type	Name of Institution in period A (1975-1989)	No. of Publ.	Mean± IIF	MMR /100,000	Ref.
Public	University of Benin Teaching Hospital, Benin City	17	1.762±0.53	563	[17]
Public	Lagos University Teaching Hospital Lagos	63	1.676±0.29	340	[18]
Public	Ahmadu Bello University Teaching Hospital, Zaria	14	1.457±0.45	1050	[19]
Public	University of Ilorin Teaching Hospital, Ilorin	17	1.37±0.3	450	[20]
Public	University of Nigeria Teaching Hospital, Enugu	28	1.1 69±0.21	270	[21]
Public	University College Hospital, Ibadan	114	1.101±0.11	380	[22]
	Summary: Total or Mean±SE (Public Sector Only)	253	1.423±0.09	508.8±115.7	
	Name of Institution in period B (1990-2004)				
Public	University of Calabar Teaching Hospital, Calabar	75	1.09±±013	1420.2	[23]
Public	Nnamdi Azikiwe University Teaching Hospital, Nnewi	68	0.949±0.13	330	[24]
Public	Lagos University Teaching Hospital, Lagos	91	0.77±0.11	2920	[25]
Public	University of Nigeria Teaching Hospital, Enugu	70	0.745±0.07	2283	[26]
Public	Ahmadu Bello University Teaching Hospital, Zaria	62	0.731±0.08	2420*	[27]
Public	University of Benin Teaching Hospital, Benin City	118	0.703±0.05	765	[28]
Public	Jos University Teaching Hospital, Jos	75	0.708±0.1	1060	[29]
Public	University of Maiduguri Teaching Hospital, Maiduguri	47	0.676±1.11	1736	[30]
Public	Obafemi Awolowo University Teaching Hospital, Ife	113	0.694±0.06	1467	[31]
Public	University of Ilorin Teaching Hospital, Ilorin	163	0.669±0.06	825	[32]
Public	University College Hospital, Ibadan	337	0.607±0.04	2160	[33]
Public	University of Port-Harcourt Teaching Hospital, Port-Harcourt	50	0.484±0.06	2736	[34]
	Summary (Public Sector Only)	1269	0.736±0.044	1 676.85±241	

*MMR obtained in population-base in Kano State. MMR: Maternal mortality ratio

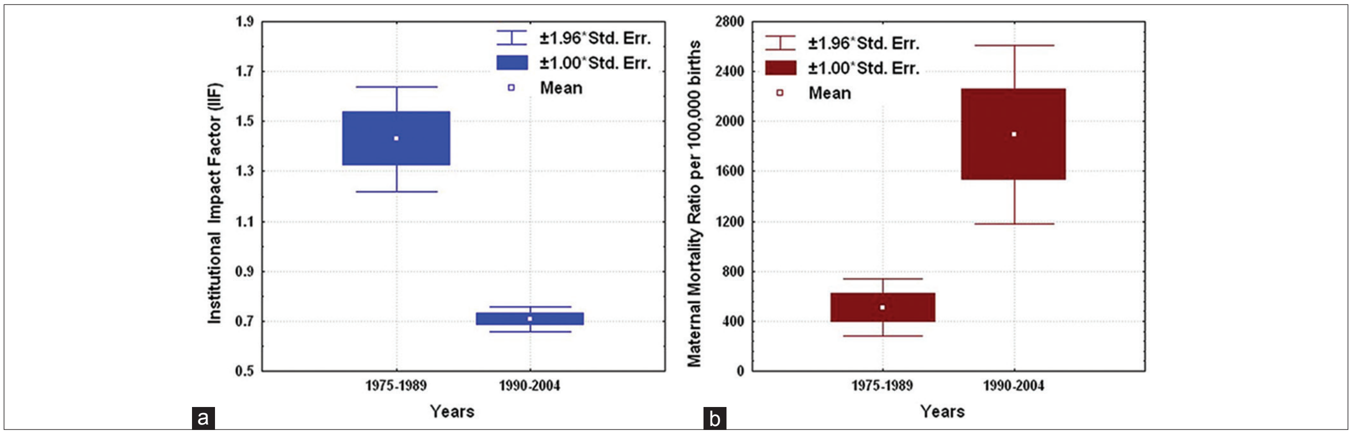

Figure 1: (a and b) Institutional impact factor (a) and maternal mortality ratio per 100,000 live births (b) in the six major university teaching hospitals in period A (1975–1989) and period B (1990–2004)

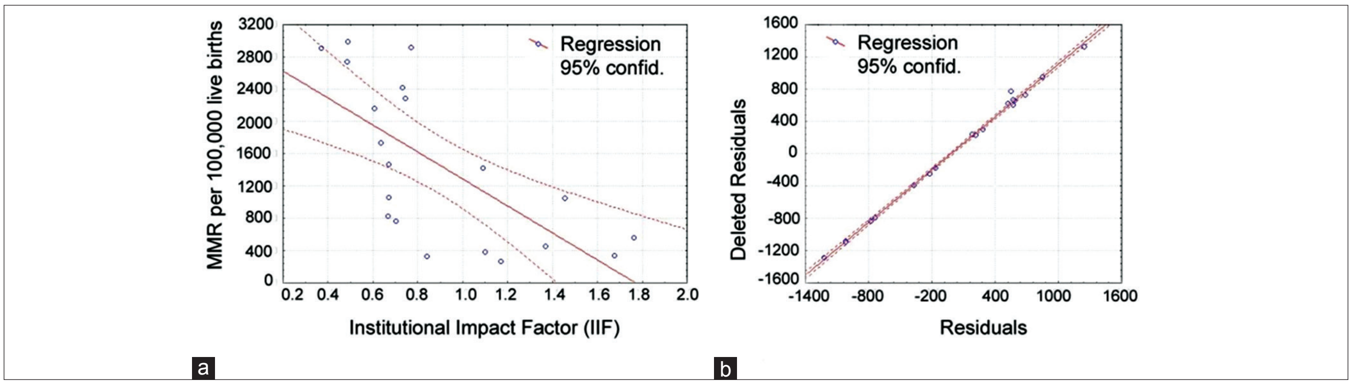

Figure 2: (a and b) Linear regression model of the relationship between maternal mortality ratio per 100,000 live births and institutional impact factor (a), and the plot of residuals versus deleted residuals

$P < 0.001$, $R^2 = 0.463$, suggesting that 46.3% of the variance in MMR could be explained by IIF. The BETA coefficient was − 0.68, $P < 0.001$. The intercept (2957.6) was significant $P < 0.0001$. The linear regression equation was given by:

MMR = 2957.6 − 1670.1 × IIF

The *priori* research hypothesis was tested against the null hypothesis, and accepted on the basis the linear regression line showing that there was a negative correlation between IIF and MMR, in Figure 2a. Figure 2b shows the scatter plot of the residual versus deleted residuals, which did not show any extreme outlier. Figure 3 shows the histogram plot of mean ± SE, IIF for period C (1990–2005) for all institutions in Nigeria included in the study. The mean ± SE, IIF was 0.774 ± 0.103 for all public and private institutions studied, but IIF was 0.698 ± 0.05 for the public health sector only.

We predicted the MMR in period C for the public and private health sectors given by:

MMR = 2957.6 − 1670.1 × 0.774

MMR = 1665/100,000 live births.

But the MMR in period C for the public sector only was given by:

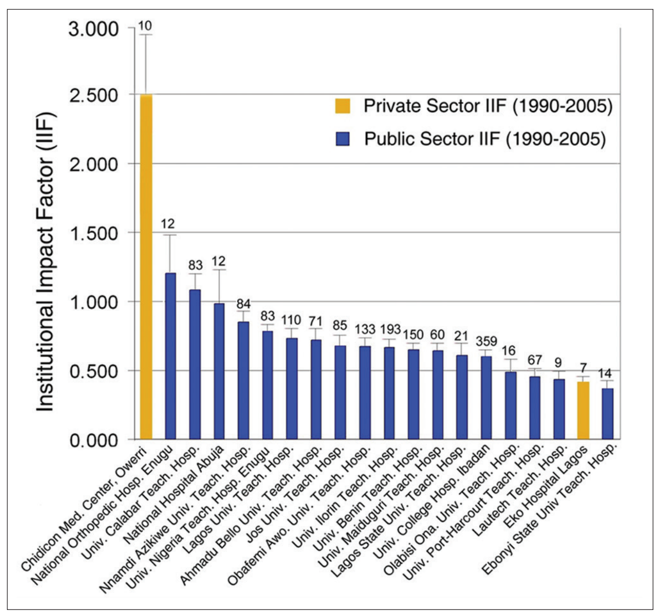

Figure 3: Institutional impact factor (IIF) for all 20 public and private health institutions in Nigeria in the period C (1990-2005), included in the study

MMR = 2957.6 − 1670.1 × 0.698

MMR = 1792/100,000 live births.

In the public sector, the MMR in period B (1990–2004) had a mean of 1677/100,000 live births, but was predicted to rise to 1792/100,000 live births in period C (1990–2005), an increase in maternal deaths by 115/100,000 live births or 6.85%/year in the public health sector. We predicted the MMR and IIF that would be necessary to attain the MDG 5 requirements. During the period A (1975–1989), when the IIF was 1.423, MMR was 509/100,000 live births. A reduction of MMR by 75% of 1990 level would suggest an MMR of about 127/100,000 live births. The skills and competence of the health workforce in the public sector in Nigeria should be such that, the IIF would be given by:

$$\text{IIF} = (2957.6 - 127)/1670.1 = 1.69$$

The MMR has to be at 127/100,000 live births, and IIF at about 1.69 for Nigeria to attain MDG 5 by 2015.

Discussion

We accomplished our initial objectives which included to demonstrate (1) that the mean JIF of publications from a given institution might be used to develop the equivalent parameter, the IIF; (2) that IIF could be used as a variable in the problem to measure outcome of QoL related to MMR; (3) and that IIF inversely correlated with changes in MMR. Our dataset clearly showed that, there was a temporal variation in the negative correlation between IIF and MMR, in the observed periods. The temporal variation was such that, there was high IIF in period A (1975–1989) which correlated with low MMR, but low IIF in period B (1990–2004) with corresponding high MMR. Other investigators have observed similar temporal variations in MMR in Nigeria. In one facility-based study at the University of Nigeria Teaching Hospital Enugu, MMR of 1406/100,000 live births was significantly higher in the period II (1991–2000) compared to MMR of 270/100,000 live births in the period I (1975–1985).[34] The investigators noted that in period II, there was significant decrease in number of medical personnel (midwives, physicians and nurse anesthetists, significant increase in decision-intervention interval (1.5 ± 0.5 vs. 5.8 ± 1.2 h) and low personnel moral.[34] The authors concluded that, since the launch of the Safe Motherhood Initiative[35] at the University of Nigeria Teaching Hospital Enugu, MMR has increased five-fold.[34] Others have identified that, the factors influencing high mortality include lack of antenatal care, advanced maternal age, and multi-parity.[21,23] The majority of these maternal deaths are avoidable through adequate attention to details and better case management; other measures include blood transfusions, improved medical services, recognition of severe problems by patients and family, and prompt medical intervention. It is clear that these complications are not necessarily fatal; they cause deaths only because of the systemic failure in the public health sector in an environment of poverty and socioeconomic deprivation in African countries. Our findings suggest that the reason for the rise in MMR in Nigeria may be related to critical deficiency in the skills and competence of the health workforce to carry out their duties in regard to preventing an adverse event associated with pregnancy and delivery. In the later period B (1990–2004) compared to earlier period A (1975–1989), there was a lower level of academic output of the medical doctors at all major university teaching hospitals across Nigeria, who should be the teachers of the trainers within the health sector. The latter caused a ripple of systemic failure of the health sector, unable to respond to this day, to the challenges of high maternal mortality. This coincided with the phenomenon of acute "brain drain" from the public health sector. The outcome has been devastating to the health of the Nigerian people reflected in the very poor health indices. The temporal synchrony with the "brain drain" phenomenon is not surprising, as well as its occurrence in the then prevailing socio-political environment of military dictatorship (Babangida – 1985–1993; and Abacha – 1993–1998), and misrule.

However, the crucial theoretical question arises, as to why IIF would be sensitive to MMR and may be related to overall skills and competence of the health workforce? To attribute low IIF to only the simple issue of lack of training of the health workforce would be overly simplistic. Rather, IIF reflects the prevailing overall socioeconomic, political, environmental, technical, academic and human factors that facilitate the peaceable practice of medicine and development of proficiency in skills. The interaction with MMR would therefore not be surprising since either factor would vary in opposite directions under the same overall prevailing conditions. Our analysis suggests that, while IIF may account for 46.3% of the maternal deaths, the other factors including general socioeconomic factors of poverty, illiteracy, and deprivation may contribute to the rest. The measures to mitigate these factors as outlined by other investigators that include clinical and nonclinical interventions would contribute to alleviating the condition[26,30-36] only to some extent. However, it must be emphasized that the prevailing socioeconomic conditions were not drastically different in the two periods A and B examined, for the majority of ordinary Nigerians, who have only known poverty and deprivation even to the present day. Moreover, the drastic contrast between the high maternal deaths in the public health sector compared to the lower maternal deaths in some of the private sector faith-based hospitals,[26] point to the fact that, the background conditions played an important but limited role. Our analysis of the sequence of events suggest that, the deciding factor for the rise in maternal mortality in the period B (1990–2004) was "brain drain," which was most acute in the Babangida-Abacha military dictatorship period (1985–1998), when the Nigerian intelligentsia was relegated. Even with the restoration of democracy, efforts toward reparation have been too little too late, and hence the damage caused to the health system persists.

The migration of well-trained doctors from university teaching hospitals in Nigeria to work in Western countries and Gulf States beginning in the late 1980s had a profound effect on the health system. There was a virtual collapse of the public health services and lack of doctors with skills to manage pregnancy-related complications across the country. In some cases, the migration has been internal, with many leaving the public health sector for the private sector, and hence the disparity in maternal mortality rates between the private and public health sectors. In one study, within a 5-year period (1999–2003), at the University of Nigeria Teaching Hospital, Enugu, there were 88 maternal deaths from 3,854 live births (MMR of 2283/100,000 live births), while in a nearby private mission hospital, Mother of Christ Specialist Hospital, Enugu there were 12 deaths from 6,232 live births (MMR of 192/100,000 live births), during the same period.[26] This would suggest that while some private hospitals function at a level that could attain the MDG 5 target, the public health system shows MMR indices only observable in an environment with poor skilled medical personnel.

Nigeria has 10% of the global disease burden due to its relative large population in the African continent.[37] In 2006, Nigeria had 39,210 Doctors (0.3/1,000).[37] By 2008, of the doctors from Nigeria, 55% were in the private sector, 18% migrated abroad, 10% of the doctors were engaged in the public sector, 9.1% were in residency, and 7.9% were no longer engaged in the health sector.[37] These numbers prove that there is a quantitative shortfall of doctors in the public health system. Our findings of low IIF suggest that the deficiency of doctors was affecting overall academic output. Therefore, solutions to adequately address the problem of high maternal mortality in Nigeria must include radical measures to improve conditions for clinical and academic development of the doctors and other medical personnel at the university teaching hospitals. The approaches advocated for the reduction of MMR has until now been more of patient-centered measures. We advocate a more comprehensive approach that combines patient-centered and practitioner-centered measures, by creating the enabling systemic environmental fundamentals, which includes universal access to primary health care services, telecommunication, transportation and emergency medical services. However, a number of stop-gap measures could be implemented as soon as possible. First, the repatriation of Nigerian specialists doctors overseas, who may be willing to return and work in the public health system, a process of reverse "brain drain." The drive would increase the number of doctors engaged in the public health sector as well as improve the quality of care. This process would not be easy because the most prevailing impediment to return to Nigeria has been the problem of personal security. Although much is being done by the present democratic administration, the rise of kidnapping of doctors and terrorism by fundamentalists has compounded the overall security situation in Nigeria. However, most doctors in Diaspora are favorably disposed to coming back to Nigeria, before the reach the age of retirement to serve, provided the security situation improves. This will require a national campaign with the education of the populace on the importance of the returnees to the national development. The Federal Government of Nigeria should undertake special recruitment drives across Europe, America and the Gulf States for obstetricians and gynecologists with high academic productivity evidenced by high author impact factor, to work and teach as leaders in the public health system. These teachers of the trainers in the university teaching hospitals and national hospitals will revitalize the academic environment of the tertiary health institutions within a short time. Furthermore, specific incentives including loan schemes should be offered to doctors with business initiatives, prerequisite skills and research capabilities in all specialties. Both the doctors at home and abroad, who are willing to setup private health infrastructures to address the health needs of the Nigerian people must be supported by government grants and foreign aid donors, as a way to make aid more effective.[38,39]

The sensitivity of the IIF to health system index such as MMR, is not surprising, however, it remains to be demonstrated that it offers a convenient qualitative and quantitative measure of academic productivity and clinical skills, which correlates negatively QoL indices such as MMR. Some countries are already adopting similar approaches of using JIF for disbursement of research funds. In the United Kingdom, shortage of research funds means that funds are targeted where they are most effective. The universities in the UK have chosen as one of their criteria the impact factor for publications for awarding funds.[40]

Funding of the public health sector has diminished in recent years and may have a role in the rise in MMR. Moreover, lack of funding for research in university teaching hospitals have limited academic output and hence reduced IIF. Although, on the global scale, assistance for healthcare development has increased by an estimated 26% between 1997 and 2002, from $6.4 billion to $8.1 billion,[41] and efforts have been made to improve effectiveness of aid.[38,39] While the increased investment is a positive trend, the vast majority of this foreign aid has been allocated toward disease-specific vertical programs rather than toward more broad-based strengthening of the health system. Nonclinical measures are of crucial importance for reduction of MMR, basic fundamentals like potable drinking water from solar powered ground water pumps, solar electric power for primary health care centers, mobile telecommunication and internet access for hospitals. These fundamentals have not received sufficient support from donor funds. The governments of African countries on their part have failed in the development of basic infrastructure, such as prioritizing access roads to primary health care centers, provision of potable water and sanitation, health education of the populace on even simple hand washing, as a measure to prevent diarrheal diseases. Considering the urgency to reduce MMR and the overriding importance of these nonclinical interventions, there should be a 30% surcharge to improve basic fundamentals from every $1 USD investment in health by government or donor funds. It is this basic infrastructure, which would create the enabling conditions of work and incentives for doctors in the public health sector. Some of the foreign donor funds could be used to provide basic infrastructure such as potable drinking water from solar powered ground water pumps, sanitation, and solar electric power for lighting at primary health care centers, which accommodate the vertical programs designated for funding. To date, foreign aid comprises <7% of Nigerian health budget,[37,42] and has been focused on a few priority areas. World Organization of Family Doctors (WONCA) has proposed that, by 2015, 15% of the budgets of vertical programs like HIV/AIDS, Tuberculosis and Malaria, be invested in strengthening local primary health care systems, with as stepwise increase in the ensuing years.[43] This would improve the capacity of African countries to create the fundamentals for a well-structured comprehensive primary health care system, improve funding of research and development in the health sector, build human capacity for specialized training, improve health indices and enhance equitable development at the local level.

Our analysis has shown that Nigeria with one of the World's worst indices for MMR, has to refocus attention on institutional human capacity building, which could be monitored using IIF and MMR. In the next 4 years, as the countdown to MDGs begins, a new realization of the urgency for genuine health reform aimed at building strong fundamentals for the health sector has to be undertaken in areas of health financing, health research and human capacity building. Progress must be accelerated by prioritizing maternal and child health as a matter of national security, given the high rates of deaths, only similar to the conditions of Nigerian-Biafran War (1967–1970). National health reform plans must take into cognizance the huge reserve in the private sector and seek to create a universal health system based on public-private partnerships. International donors must restructure aid and form partnerships with African national governments as well as the private health care providers, with focused attention on creating sustainable development of primary health care services, on which vertical disease-specific programs could be integrated. It is questionable at this time if most sub-Saharan African countries would attain the MDGs by 2015, but the journey towards these goals, by itself is a major developmental effort that is worth the investment.

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