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Predicting Nursing Human Resources: An Exploratory Study

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Abstract

The nurse-to-population ratio (NPOP) is a standard indicator used to indicate a country's health care human resources capacity for responding to its disease burden. This study sought to explore if socioeconomic development indicators could predict the NPOP in a country. Mexico served as the case example for this exploratory study, with the final five variables selected based on findings from a qualitative study analyzing the development of nursing human resources in the country. Multiple linear regression showed that two variables proved significant predictors of the NPOP and the model itself explained 70% of the variance ($r2 = .7$; $p = .0000$). The findings have multiple implications for nursing human resources policy in Mexico and at a global level as governments attempt to build human capital to respond to population health needs.

Introduction

A country's nurse-to-population ratio (NPOP) is one of the standard measures of its human resources capacity for responding to health problems (WHO, 2008). In many countries, NPOP statistics include all nursing personnel, from nurses' aides to those with graduate level education. Most studies using the NPOP as a variable examine the impact of the NPOP on health outcomes (Bigbee, 2008; Courtney, 2005; Robinson & Wharrad, 2000). Only one study attempted to predict the NPOP in developed countries using economic indicators (Hussey, Anderson, & Cylus, 2003). For developing countries, identifying variables that can predict the NPOP may help explain nursing human resources differences between regions or countries. Policymakers could then direct policy toward actions that promote the contextually specific development and retention of the nursing workforce.

The purpose of this exploratory study was to identify and test relationships between the NPOP and socioeconomic development variables to see which ones predicted the NPOP in the states of a single country. Mexico served as the case example and variable selection drew from previous qualitative research conducted by Squires (2007). The results from this study may have implications for nursing human resources policies not only in Mexico, but also in other countries.

Background

Health care human resources researchers view the NPOP as one measure of a country's capacity to operationalize direct patient care services in hospitals and communities (World Health Organization [WHO], 2008). Experts concur that developing countries face multiple challenges for producing an adequate number of nursing human resources (NHR) to staff their

healthcare systems, but admit to only a superficial understanding of the dynamics involved (Biscoe, 2000; Dussault, 2008; WHO, 2006, 2008).

WHO's (2008) current research efforts in this area focus on establishing benchmark goals for human resources for health (HRH) policymaking with fourteen low and low-middle income countries around the world serving as test cases. Researchers seek to develop standardized methodologies across countries to help establish HRH production and retention goals for countries. These analyses, however, aim to set minimum standards for production based on population health needs. They do not examine the factors external to the profession that may influence the production of healthcare personnel and are rarely specific to nursing.

Other nursing specific workforce studies by PAHO provide either a broad regional overview of the general issues faced by the profession or superficial historical accounts of the evolution of the nursing in different countries in the region (Malvárez & Castrillón, 2005; PAHO, 2004; Valdéz, 2001). They do not link development with nursing human resources production nor does the historical analysis address how the broader national events influenced nursing's development over time, leaving out many possible explanations for low NPOPs in the countries.

Additionally, from the United States there are two general models used by the National Center for Health Workforce Analysis to forecast the present and future supply and demand of registered nurses (Unruh & Danesh, 2009). These models are the nursing supply model (NSM) and the nursing demand model (NDM). Forecast of the supply of nurses starts with baseline values of licensed registered nurses in a particular cohort based on age, highest educational level, and state and projects its changes in each forecasted year (Biviano, Tise, Fritz, & Spencer, 2004). Forecasts of the demand for nurses are based on the rates of health care use and the rates of the use of nurses in the delivery of those services. The model keeps rates fixed in relation to the population's characteristics (Unruh & Danesh, 2009).

Both these models, however, require survey data at the nurse and hospital levels. The NSM, for example, requires nursing-level values by age, sex, and type of nurse. The NDM requires data on inpatient days, outpatient visits, emergency visits to short-term hospitals, inpatient days at long-term hospitals, nursing facility residents, and home health visits. To our knowledge, these types of data are mostly nonexistent or inconsistently reported in developing countries. Thus, there is the need to develop alternative methodologies for identifying relationships between the NPOP and socioeconomic development variables to predict the NPOP in the states of a single developing country.

Mexico and Nursing Workforce Data

Mexico's NPOP averages about 2.3 per 1,000 population. Mexico was specifically selected for this study because it has a consistent history of quantitative data collection for healthcare human resources, a well-established nursing profession, is an Organization for Economic Cooperation and Development (OECD) member, and a high-middle income developing country. Health system reforms in the past thirty years in Mexico have also had profound effects on financing, with some of the more significant effects affecting healthcare human resources (Arredondo, Parada, Orozco, & Garcia, 2004; Fleury, Belmartino, & Baris, 2003; Homedes & Ugalde, 2005a, 2005b; Laurell, 2007; Squires, 2007).

In terms of Mexican NHR, the potential dynamics influencing the NPOP are complex. Mexican nursing has multiple entry options into the profession and graduate education options. Approximately 7% of all Mexican nurses have a bachelor's degree in nursing (BSN), known as a *licenciatura* in Mexico, while the remainder have technical or generalist training in nursing (Salas Segura, Rubio Domínguez, & Zárate Grajales, 2002). A technical degree requires two

to three years of education after high school and is more or less equivalent to the U.S. associate's degree in nursing. Generalist training takes place in a vocational high school setting providing education equivalent to a U.S. licensed practical nurse (LPN). Auxiliary nurses, equivalent in scope and role to the nurse's aide in the U.S., have as little as a few weeks of training to a few months. It is important to note that due to underemployment problems, many new technical and BSN nurses may work roles not equivalent to their level of education. For example, a *licenciatura* nurse may work as an generalist nurse, the title of her hospital job, because that is where she could obtain full time work. The nurse may perform duties consistent with her education but be paid only for generalist nursing services. Unemployment among nurses is also a common problem.

Otherwise, Mexican nurses have multiple career advancement options, have an incentive system that rewards them for completing higher education, and can earn middle class salaries (Squires, 2007). Changes in the epidemiologic profile of Mexico to a chronic disease one will begin affecting health services delivery and require more nurses to care for these complex patients (Arredondo, Zúñiga, & Parada, 2005; Martinez & Leal, 2003). Finally, Mexico is also a "premigration" state in that the migration of NHR is not yet a problem, despite the legal work provisions for nurses found in the North American Free Trade Agreement (NAFTA; 2008).

Methods

We make the argument that the NPOP is a cumulative representation of the State's policies (both local and federal) toward the production, recruitment, and retention of NHR in a country. The NPOP may also show how the profession handles the consequences of State policies. This is the reason the NPOP serves as the dependent variable for the analysis.

To predict the NPOP, we selected independent variables based on themes from a qualitative study by Squires (2007) for a multiple linear regression analysis. Squires' qualitative case study of the professionalization of Mexican nursing identified eight themes affecting the overall process and subsequent production of NHR. The eight themes were: Economic, Political, Sociocultural, Intraprofessional Development Dynamics, the Workplace, Unions, Historical Factors, and International Influences. The themes covered factors influencing nursing human resources development in Mexico that are not captured in WHO's current work, like the legacies of colonialism.

From these themes, five of them could be quantified with predictor variables for the regression model. The variables chosen for the analysis are sensitive to the gender dynamics of Mexico. The five variables for prediction in the model are median income, average years of education in a state, the average number of children under 18 per family (CPF), total number of nursing schools in the state, and the proportion of public and private healthcare facilities. The qualitative data from that study provided specific information about we could hypothesize the significance of the variable and helped rationalize our final selection of the five variables.

For the independent variable representing the economic situation of nurses, we ultimately selected median income because nurses employed in full time positions tend to earn salaries close to this value in their home states. We additionally tested per capita income (PCI), but decided not to use it because it varied too much due to the large income inequalities found in Mexico and had multi-collinearity issues with other variables tested in the models.

Average years of education of the state's population and the number of children under eighteen per female represent the sociocultural theme. The number of children per family also serves as a proxy indicator for potential childcare issues experienced by nurses and potential challenges to career advancement. We also selected the total number of nursing schools (TNS) in each Mexican state with the idea that the number of schools would reflect a state's ability

to produce more nurses and illustrate educational access. That variable also represents the Intraprofessional Development Dynamics theme. Of note, at the time of this study, we did not have access to data differentiating the type of educational program, vocational vs. university-based, so we could not factor those characteristics into the analysis.

Studying all work places individually was beyond the scope of this study. Nonetheless, we still needed a variable to represent the workplace as it is known to be a factor influencing retention of the nursing workforce and possibly, the overall NPOP. Thus, to represent the nursing workplace we chose to look at the proportion of private and public (defined as State owned and managed) facilities in each State. While it is more common to study bed size of hospitals as an institutional measure, in Mexico, many facilities have only half of their beds in service. Frequently, this pattern occurs in decentralized facilities that do not have enough financial resources to support operating at full capacity even though the demand for services exists. Thus, bed size is not the best measure in this context.

When working with the facilities ratio, we found that the total numbers of private and public facilities are highly correlated (0.64, $p < 0.0001$); therefore, they could not be included in the same multivariate model. Instead, one variable was created by taking the ratio of private to public facilities (RPr-P). In this way, we test both, the effect of higher number of private facilities relative to public, as well as higher number of public relative to private facilities.

With variables selected, nursing workforce data from the year 2000 were drawn from the Secretaría de Salud y Asistencia's website that has a publicly available database of NHR (Secretaría de Salud y Asistencia, 2008). We performed the analysis using two approaches. First, we used bivariate techniques to test for the association between each selected predictor and the NPOP per 1,000 people. We estimated correlation coefficients and their significance. A high correlation coefficient between two variables, however, does not necessarily imply that there is a linear association between them; thus, we estimated a simple linear regression to test the linearity of each association. In addition, we use a non-parametric smoothed curve (lowess method (Cleveland, 1979) to help us confirm the regression function chosen. Second, we implemented a multivariate technique by fitting a multiple linear regression model where NPOP is the dependent variable.

There is an important methodological issue when estimating a linear regression model with the Mexican data. Because of the economic policies and history of Mexico, most of the development in industry and infrastructure has occurred in three major metropolitan cities: Mexico City, Guadalajara and Monterrey. Thus, the States where those cities are located tend to have a disproportionately large number of privately managed healthcare facilities, as well as better outcomes related to education, income, and similar development variables.

This methodological issue relates to the sensitivity of the estimated regression model with respect to influential states with major metropolitan areas. We addressed this issue by first identifying possible outlying observations through studentized deleted residuals and the hat matrix leverage values (Neter et al 1996). Then, influential cases were identified by computing the Cook's distance, DFITS, and DFBETAS. We identified outlying observations and influential cases using recommendations from Neter et al. (1996). In addition, we estimated the linear model by implementing an iteratively reweighted least squares robust regression method that allow us to dampen the effect of influential observations. Thus, it is important for researchers seeking to evaluate the NPOP in different contexts to remember that they may have to account for population distribution and other geographic factors in the analysis.

Results

The NPOP varies from about 1 nurse per 1,000 people (Mexico State) to about 3.1 (State of Baja California Sur) (Table 1), with a country average of about 2.1 nurses per 1,000 people. All States have similar average numbers in terms of education and children per family; but there are important differences in income, nursing schools and health care facilities across States.

Bivariate results

Bivariate analysis shows significant associations between NPOP and the development sensitive predictors selected for the analysis (Figure 1). To begin, there is a positive, significant association between NPOP and average education ($p<0.000$), and a weak association with median income (Figure 1). This is consistent with previous research that shows that there is an increase in people's demand for health care services as their income increases. The association of NPOP with CPF and TNS, however, turns negative. These findings imply that States with a high average number of children per family and with a large number of nursing schools tend to have lower number of nurses; thus coinciding with our previous findings that sociocultural factors, particularly those related to childcare and family dynamics, could be associated with a reduced number of nurses.

The number of nursing schools may reflect market dynamics in the states in terms of NHR demand. In addition, after NAFTA, both public and private schools created many nursing programs and graduate quality varies widely. The finding suggests that the TNS may not be the best indicator in terms of production capacity. Tracking the number of accredited nursing programs may prove to be a better indicator as that distinction indicates a higher quality, establish nursing program.

The next finding demonstrates an inverse link between NPOP and the ratio of private to public facilities. Thus, everything else being constant, the analysis shows increases in private facilities, relative to public ones, is linked to declines in the number of nurses per 1,000 people; but increases in the number of public facilities relative to private links with increases in NPOP.

A simple linear regression and a non-parametric curve (lowess fit) show that there is a linear association between each predictor variables and NPOP (Figure 1). Median income and the ratio of private-to-public facilities show small deviations from linearity. This is due to some outlying data points. Thus, we estimated a multivariate linear regression in which the influence of those outlying values is diminished in order to obtain a better fit. Our linear models predicted 70% of the variance in explaining the NPOP (adjusted $r^2 = .7$; $p=.0000$).

Multivariate results

Table 2 shows the results of the linear model. In the case of Mexico, there are two themes that appear to determine the States' ability to produce nurses: sociocultural (average education) and nursing working place (ratio of private-to-public facilities). This result shows the importance of performing multivariate analysis to elucidate association that bivariate methods are unable to detect.

Consistent with our previous finding from bivariate analysis, the model suggests that each additional increase in the mean years of schooling is associated with an average addition of about 6 nurses per 10,000 people, after controlling for other factors.

To illustrate the potential effects on the NPOP and the capacity to operationalize the healthcare system, we use one of the poorest states in Mexico, Oaxaca, as an example. The state of Oaxaca

has a population of about three and a half million people with an NPOP of 1.34 per 1,000 people and an average level of education of 5.6 years. If the average education increased to the equivalent of junior high school education (about 9 years) with its population size remaining constant, on average, the state could double its current NPOP level, creating the potential to add about 5,200 more formally educated nurses (at a minimum) to staff the health care system, and achieve an NPOP of about 2.8.

Contrary to our bivariate results, the ratio of private-to-public health facilities is significantly associated with NPOP, controlling for other factors. Increases in the number of private facilities, relative to public ones, inevitably reduce the NPOP in a State. Continuing to examine the case of Oaxaca, there are 48 and 1,140 private and public health facilities, respectively. Thus, according to our model, having 10 new private health centers would be associated with an average decline in NPOP from 1.34 to 1.32, keeping everything else constant. One possible explanation for this association may be due to salary differences between institutions. Generally, private hospitals in Mexico pay significantly less than public institutions; thus, nurses may migrate domestically or internationally to better paying positions, consequently causing shifts in the NPOP when private institutions increase in number. Furthermore, a 0.02 drop in the NPOP may not appear as a significant reduction but with so few nurses, any drop decreases the health system's capacity to respond to population health needs.

The rest of the covariates, as shown in Table 2, are not statistically associated with the NPOP. Median income is positively linked with the NPOP, while the total number of nursing schools remains with a negative relationship with NPOP. The latter result may be due to different types of nursing schools available in a State, but we did not have that information for this study.

In this multivariate framework, children-per-family turns out to be positively related with NPOP, contrary to the bivariate result, as States with larger families have higher NPOPs (controlling for other factors). This may be due to how health system administrators distribute nursing personnel in areas where residents have low educational levels, lower income, and consequently, larger families.

Discussion

The effects of the global shortage of NHRs on patients make defining the variables shaping the NPOP even more important and this study provides a start. The results show that predicting the NPOP at the country level is complex and that specific variables will directly affect nursing and its country-level numbers. In turn, these numbers will affect how the State can respond to population health needs and the complex variables that comprise population health.

Defining the influential variables will help improve the conceptual definition of the NPOP for research and policy purposes. Historically, the NPOP has lacked a conceptual definition and served only as a functional measure of health system capacity without any real understanding of its complexity as a variable. Based on the findings of this study and the qualitative case study used for variable selection, conceptually the NPOP appears to reflect the quality of the political relationship between the nursing profession, the State, the private sector, and their combined policies for NHR recruitment, production, and retention. The NPOP may serve as quantifiable indicator of the NHR policy consequences of national, local, and decentralized entities. It may also reflect the internal capacity of the nursing profession to access the capital it needs, both political and financial, to support its own growth and development.

Policymakers can use this new view of the NPOP for locally specific, a.k.a. decentralized, policymaking for nursing human resources development. For example, a state with a low NPOP could examine the status of population access to different levels of education. It would look graduation rates from different types of education programs, secondary through university.

Policymakers would then need to examine the barriers to creating nurses, teachers of nursing, and other career advancement issues rooted in education. States would also be able to examine if they had too many of one type of nursing program or not enough of the right kind of educational program for the population's health needs. This strategy could prove useful for balancing rural and urban healthcare access issues that depend on access to nursing personnel, at a minimum.

Policy Implications for Mexican Nursing

With Mexico's transition to a chronic disease epidemiologic profile, patients' needs and demand for acute and primary care services will increase. More nurses are necessary to meet their needs and demands. The policy implications of the findings focus specifically on NHR development at the country level through a combination of education infrastructure and economic development. It is important to focus NHR development policies on education because the findings showed a strong link between education, economic, and sociocultural variables. As development studies consistently show, an investment in education pays off in the long term in multiple areas, not just nursing.

In the case of Mexico, education focused NHR policies start with developing ones that support nurses attaining technical or bachelor's levels of education at any age, a critical component for producing efficient NHRs for the health care system. By efficient, we mean NHRs that can work at the bedside or as teachers with the same degree until policymakers standardize entry into nursing practice or graduate education becomes widely available and accessible to nurses seeking faculty positions. Such measures would include developing policies that help provide financial support to students so they can complete nursing programs, thereby reducing the high attrition rates in Mexican nursing schools.

Policies supporting professional education also help address the nursing faculty shortage that, like the US, exists in Mexico. Recent changes in the salary status for BSN and higher prepared nurses upgraded salaries to professional levels (Squires, 2007). That policy change created an influx of experienced nurses into nursing schools to complete their BSN and graduate degrees. These nurses, often between the ages of 45 and 52 and close to or at retirement age in Mexico, could be encouraged to take on teaching roles in nursing schools through a series of economic incentives that would ultimately increase their pensions, keep them actively working, and address some of the pension reform issues currently present in the country. It may encourage other experienced nurses to leave bedside nursing for new roles and open doors for less experienced but more recently educated nurses to enter into full time positions with benefits. Failure to address these human capital problems increases the likelihood that Mexican nurses will migrate outside of the country for work.

In another largely untested policy alternative, a combined State and private sector investment in facilitating nursing education across the lifespan could produce significant, sustainable benefits for a country like Mexico. As average education levels rise, the earning capacity of women and men from lower and middle classes increases and they are able to earn salaries that could actually encourage saving in private retirement accounts or the purchase of private health insurance. It solves problems of worker stagnation within a health system by creating new roles and domestic career opportunities for nurses and may offer alternative solutions to "pension tensions" experienced by many countries.

Changes in hiring policies in Mexico's public acute care systems may also positively affect the NPOP. These institutions have shifted toward hiring mostly nurses with technical and BSN degrees, i.e. those with the better salaries. Their main challenge is the lack of funding for full time positions, the most attractive employment option for a Mexican nurse. Private hospitals, with few exceptions, often have full time work with low nurse-to-patient ratios, but it is poorly

paid, often as low as $360 per month even in the most expensive cities in the country. Private hospital management has little incentive to invest in continuing education for nurses, create institutionally-based career development opportunities, or develop a work environment that improves retention rates.

Current market structures, mostly the result of neoliberal economic reforms, create a continuous pool of underemployed nurses that work in multiple per diem positions. A private hospital's lack of a consistent nursing workforce to care for its patients reduces its capacity to care for complex patients and increases operating costs because it constantly recruits and trains inexperienced staff without retaining them long enough to make up those costs. Public facilities' inability to hire the number of nurses required for the nurse-to-patient ratios that produce the most optimal patient outcomes likely does not save the system as much money as previously thought. Recent research in the US suggests that optimal nurse staffing of hospitals there could save the US healthcare system billions of dollars thanks to reduced numbers of mistakes, reduced length of stay, and improved patient outcomes during hospitalization (Dall, Chen, Seifert, Maddox, & Hogan, 2009). The amount the right number of nurses saved the system paid for the addition of 133,000 jobs to the workforce. If a similar policy took place in Mexico, the amount of savings to healthcare in Mexico could pay for the unfunded full time positions and potentially save millions of dollars through improved patient outcomes. At present, however, the new salary incentives and better-educated nurses working in public facilities demonstrates a greater chance of improving nursing opportunities in these facilities. Furthermore, if the market only produces technical and bachelor's prepared nurses, in a generation or less, private facilities will have to raise nursing salaries in order to remain competitive with public ones or they will be unable to staff their institutions.

Nonetheless, numerous institutionally-based studies about nurses and their work environments in developed countries has shown, even when the infrastructure for producing NHR is at top levels, organizational characteristics can still drive nurses away from the workplace and affect retention rates both within the profession and the healthcare system. For example, when health system reforms or corruption decrease the supplies and medications nurses need to care for their patients, it will drive them away from their jobs. Those policies also affect the NPOP. Therefore, examining the nursing work environment and the technical capacity for managing nurses working in centralized and decentralized facilities in Mexico may help explain institutionally based sources for NPOP differences between states at similar levels of economic development.

Global Policy Implications for Nursing Human Resources

Many of the policy implications described for Mexican nursing may apply to other countries, especially those in the region of the Americas. On a broader scale, however, the analysis provides a foundation for analyzing the relationship between gender sensitive sociocultural and infrastructure variables on the production of NHR at the country level. Since many of the variables are also common international development indicators, the gender sensitivity should remain constant in other analyses. It is uncertain, however, whether the "gender" effect will change in countries with more male nurses in the workforce.

Replicating this approach individually in other countries will confirm the sustainability of the analytic approach used in this model, as well as additional longitudinal studies examining the link between policy changes and nursing workforce trends. Researchers seeking to use this method to compare countries should be cautious as other variables may influence the NPOP. For example, different types of governments may affect the relationship between the nursing profession and the State; therefore, intercountry comparisons would have to account for this effect.

Two other factors to consider during both comparative and individual country analyses are HIV/AIDS infection rates in the population and international nurse migration. In Mexico, comparatively HIV/AIDS infection rates are low relative to other regions of the world and thus, were not included in this analysis. In other regions, however, researchers may need to incorporate or weight HIV/AIDS incidence rates in a model and help explain another dimension in NHR production and retention.

The second factor is the effect of international nurse migration (INM). Mexico was unique as a middle-income country involved in a large, multi-lateral trade agreement that does not yet have a large-scale problem with their nurses migrating abroad for work. Countries where INM is a problem may require it as another explanatory variable affecting the NPOP.

Limitations

The limitations relate primarily to the analytic methods used and data quality. Due to the small sample size, there is still the possibility that the variables that are not statistically significant in this study may provide important insights in predicting the NPOP at the State level. In addition, the accuracy of data from a country that consistently ranks high on international corruption indices is always a concern.

Nonetheless, since we conducted a large number of statistical tests to comply with the assumptions of the linear model, we believe the results of this study are robust and account for data inadequacies. Of particular methodological importance is the iteratively reweighted least squares robust regression method that should have controlled for any inconsistencies in the data that were not random.

Conclusion

To the best of our knowledge, this study is the first to quantify the relationship between key development and infrastructure variables to the NPOP in a developed or developing country. It is one of a few studies to examine factors external to the workplaces of nurses and one of the few nursing workforce studies conducted in Latin America outside of the purview of health system administrators or international institutions. Policy strategies provided here also support key targets for capacity development in other developing countries.

This article added two new dimensions for NHR studies. First, it helped develop a conceptual definition of the NPOP that can inform future research and policymaking for the global nursing workforce. Second, through both qualitative and quantitative methods, the approach provided a foundation for analyzing the complexities of NHRs. With the policy recommendations developed from the results, Mexico and other countries may find new tools to help address human resources production issues related to the nursing workforce.

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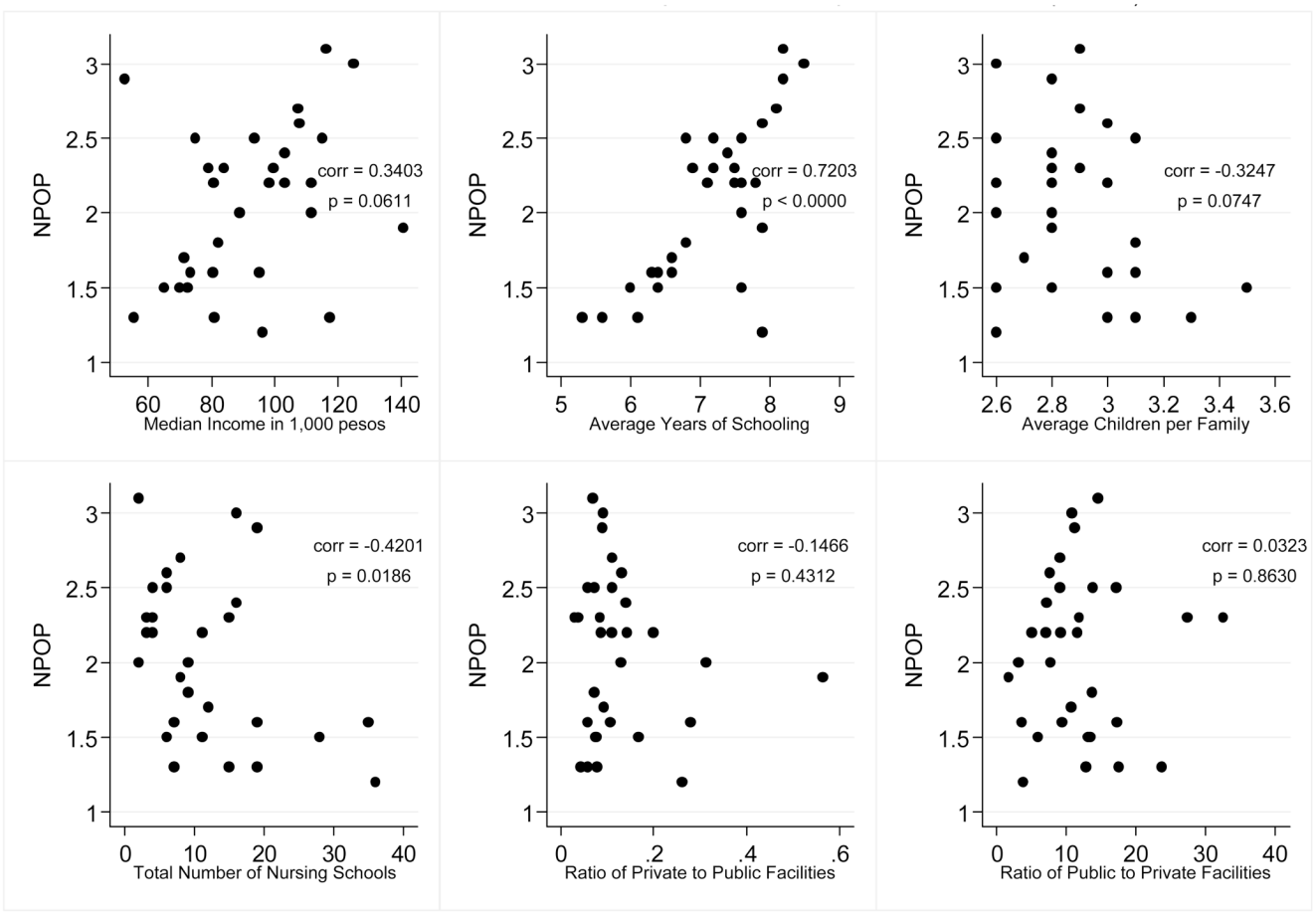

Fig 1.
Bivariate Associations of Nurse-to-Population Ratio per 1,000 people (NPOP)
NOTE: corr represents the correlation coefficient.

Table 1

Descriptive Values and Bivariate Associations of Nurse-to-Population Ratio (NPOP) per 1,000 people

Variables	Mean	Std. Dev.	Min	Max	Source
NPOP	2.1	0.5	1.2	3.1	SSA
Median Income[a]	92.0	20.9	52.6	140.7	INEGI
Average Education[b]	7.2	0.8	5.3	8.5	INEGI
CPF	2.9	0.2	2.6	3.5	INEGI
Nursing Schools	11.2	9.0	2.0	36.0	SSA
Private Facilities	63.6	70.6	8.0	390.0	SSA
Public Facilities	545.7	382.4	115.0	1528.0	SSA
RPr-P	0.13	0.11	0.03	0.56	Own computation based on SSA data

NOTE: CPF = average number of children less than 18 years per family; RPr-P = ratio of private to public health care facilities; SSA = Secretaría de Salud y Asistencia; INEGI = Instituto Nacional de Estadística Geografía e Informática.

[a]Median Income in $1,000 mexican pesos;

[b]Average education estimated from single years of schooling.

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Table 2

Robust Regression Estimates for the NPOP

Variables	Coefficient	p-value
Median income	0.001	.582
Average education	0.600	.000
Children per family	0.104	.662
Total nursing schools	−0.004	.410
Ratio private to public facilities	−1.685	.001

Note: NPOP = Nurse-to-population ratio.

Source: Authors' calculations based on an iteratively reweighted least squares robust regression applied to State level values (see methods section for more details).