



# Gender equality policies, nursing professionalization, and the nursing workforce: A cross-sectional, time-series analysis of 22 countries, 2000–2015

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## ABSTRACT

**Background:** Nursing professionalization has substantial benefits for patients, health care systems, and the nursing workforce. Currently, however, there is limited understanding of the macro-level factors, such as policies and other country-level determinants, influencing both the professionalization process and the supply of nursing human resources.

**Objectives:** Given the significance of gender to the development of nursing, a majority-female occupation, the purpose of this analysis was to investigate the relationship between gender regimes and gender equality policies, as macro-level determinants, and nursing professionalization indicators, in this case the regulated nurse and nurse graduate ratios.

**Design:** This cross-sectional, time-series analysis covered 16 years, from 2000 to 2015, and included 22 high-income countries, members of the Organisation for Economic Co-operation and Development. We divided countries into three clusters, using the gender policy model developed by Korpi, as proxy for gender regimes. The countries were grouped as follows: (a) Traditional family – Austria, Belgium, France, Germany, Greece, Italy, Netherlands, Portugal, and Spain; (b) Market-oriented – Australia, Canada, Ireland, Japan, New Zealand, South Korea, Switzerland, United Kingdom, and the United States; and (c) Earner-carer – Denmark, Finland, Norway, and Sweden.

**Methods:** We used fixed-effects linear regression models and ran Prais-Winsten regressions with panel-corrected standard errors, including a first-order autocorrelation correction to examine the effect of gender equality policies on nursing professionalization indicators. Given the existence of missing observations, we devised and implemented a multiple imputation strategy, with the help of the Amelia II program. We gathered our data from open access secondary sources.

**Results:** Both the regulated nurse and nurse graduate ratios had averages that differed across gender regimes, being the highest in Earner-carer regimes and the lowest in Traditional family ones. In addition, we identified a number of indicators of gender equality policy in education, the labour market, and politics that are predictive of the regulated nurse and nurse graduate ratios.

**Conclusion:** This study's findings could add to existing upstream advocacy efforts to strengthen nursing and the nursing workforce through healthy public policy. Given that the study consists of an international comparative analysis of nursing, it should be relevant to both national and global nursing communities.

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## What is already known about the topic?

- The macro-level factors impacting both nursing professionalization and the forecasting of the future nursing workforce supply are not completely understood.
- Given nursing's largely female workforce, gender plays a fundamental role in the development of nursing.

## What this paper adds

- This paper uses a macro-level gender regime and policy framework, fixed-effects linear regressions, and multiple imputation to examine the effects of various measures of gender equality policies on nursing professionalization and nursing human resources indicators in 22 high-income countries.
- The findings suggest that:
  - The *gender wage gap*, the *female share of employment in managerial positions*, and the *female share of seats in national parliaments* are predictive of both the regulated nurse and the nurse graduate ratios.
  - In addition, the *female share of tertiary education graduates* is predictive of the regulated nurse ratio, and the *female labour force participation rate* is predictive of the nurse graduate ratio.

## 1. Introduction

Health human resources, of which nurses constitute a majority in most health systems, are essential for health promotion and the successful provision of health care (WHO, 2016a). Consequently, nursing and nurses are frequently targeted within initiatives to improve health system efficiency (Willis et al., 2017). Nursing professionalization, the process undertaken by nurses to achieve professional status, has been linked to the strengthening of the nursing workforce and the advancement of nursing, given that this process involves a mixture of strategies that expand the body of nursing knowledge, establish professional standards and ethical principles, increase educational requirements for both admission and entry-to-practice, enhance role autonomy and involvement in decision-making, extend roles/responsibilities, and establish strong professional organizations (Black, 2013; Keogh, 1997; Smith, 2009).

Higher levels of education among the nursing workforce have been linked to improved health outcomes for patients. For instance, health organizations with a higher proportion of university-prepared nurses benefit from decreases in (a) nosocomial infections (Covell, 2011), (b) failure-to-rescue (Aiken et al., 2003), and (c) mortality rates for both surgical (Aiken et al., 2003, 2014) and medical patients (Tourangeau et al., 2007). Besides, a recent review of research evidence concluded that in high-income countries, mortality rates for acute-care patients can be reduced if adequate numbers of well-educated nurses are available (Coster et al., 2018). In addition, environments in which advanced practice nurses function to their full scope-of-practice are associated with improved and efficient access to health care and health system sustainability in both public and private health systems (Browne et al., 2012; IOM, 2011, 2015; Maier and Aiken, 2016; WHO, 2016b), which, along with nurses' participation in health policy, contributes to advanced health equity (IOM, 2011; WHO, 2016b). Professionalization also strengthens the nursing workforce and enhances (a) nursing's visibility and recognition as an occupation requiring both advanced skills and knowledge and (b) its appeal as an attractive career choice (IOM, 2011; Trim, 2014). Moreover, the availability of graduate degrees in nursing contributes to the enhancement of institutional infrastructure for both nurses and women in general (IOM, 2015; Squires, 2007).

## 1.1. Study approach and rationale

This paper describes our study to investigate the relationship between nursing professionalization indicators and macro-level factors, such as gender regimes and gender equality policies. A limited understanding of macro-level (Pavolini and Kuhlmann, 2016; Squires et al., 2017) and gender (Kuhlmann et al., 2016; Kuhlmann and Bourgeault, 2008; Squires, 2007; Wall, 2010) factors influencing nursing professionalization and the nursing workforce, along with the numerous and significant benefits associated with this process, warrants efforts to explore this topic further.

With a few exceptions, across the world, most nurses are female (Hollup, 2014); for numerous and complex reasons, this status quo persists despite ongoing efforts to minimize the gender gap in nursing (Moore and Dienemann, 2014; Villeneuve, 1994). Currently, despite the multitude of perspectives adopted to examining gender and feminism in the context of nursing, the intricate ways in which gender influences the process of professionalization (Squires, 2007) and the imbedded power relations and ideologies entrenched in nursing knowledge, theories, and practice (Aranda, 2017) are not yet entirely understood. Yet, owing to assumptions that professionalization is gender-neutral, the influence of gender on professionalization is often overlooked (Kuhlmann et al., 2016; Kuhlmann and Bourgeault, 2008; Wall, 2010).

Given the political nature of both (a) health and health care (Bambra et al., 2005; Muntaner et al., 2002), and (b) *care work* and *care ethics* (Held, 2005; Tronto, 2013, 2015), all of which are dependent on the socioeconomic and political systems guiding the distribution of resources in a society, an in-depth exploration of influences affecting nursing and its evolution requires close examination of macro-level, structural factors. Such factors are situated outside of an individual's immediate control, and are referred to in the literature by different names, including environmental, societal, policy, and contextual factors (Sumartojo, 2000).

Consequently, unless we recognize that both health and health care work are political and plan accordingly, our chances of successfully impacting health policy will be limited (Bambra et al., 2005; Muntaner, 2002; Muntaner and Lynch, 1999; Muntaner et al., 2002; Navarro and Shi, 2001). The need to consider upstream elements has been also suggested by researchers who point out that by focusing mostly on typical elements of professionalization such as education level, knowledge base, and autonomy, the role of power in this process might be neglected (Johnson, 1972; Limoges, 2007; Yam, 2004).

Recent research and policy development on health human resources has also zoomed in on gender issues, in addition to other pressing topics such as the informal health care economy, dual practice (George et al., 2018), migration (Johnson et al., 2014), and capacity building (Ridge et al., 2018). For instance, a recent World Health Organization report, endorsed new approaches to research and policy-making, with emphasis on structural, high-level factors (George et al., 2017). The report suggests that intersectional research that considers issues of gender and class could enhance understanding of the intricate power relations affecting the health care workforce.

Our study builds on findings from a recent critical review of health and sociopolitical literature, which highlights that multi-faceted links exist between professionalization and gender inequality across various socioeconomic and political domains (Gunn et al., 2019a). We capitalize on the current scholarship preoccupied with the macro-determinants of nursing professionalization, including education and health policy initiatives (Aiken et al., 2009; Squires et al., 2016), adding a new perspective, that of macro-level gender policies.

## 2. Background

### 2.1. Gender, feminism, and nursing development

The topics of gender and feminism, in relation to nursing and its evolution, have been incorporated in numerous studies. For instance, researchers have investigated the effects of sociocultural norms/attitudes on the devaluing of women's work, including the underappreciation of nursing and that of other female-majority occupations (Choperena and Fairman, 2018; Davies, 1995; Meerabeau, 2005; Witz, 1992b; Yam, 2004). In turn, the failure to adequately appreciate the work performed by women has been linked to the insufficient social and financial recognition afforded to such occupations (Limoges, 2007; Mandel and Semyonov, 2005). Other studies have explored the gendering and devaluing of *caring/caring work*, which, instead of being recognized as requirements for all health organizations and health practitioners (Apeso-Varano, 2016; Caffrey and Caffrey, 1994; Goodman, 2016), have been linked to emotion and self-sacrifice, characteristics commonly attributed to women (Rafferty, 2018; Treiber and Jones, 2015). The exploration of the socially shaped *care/cure* binary, which compares and contrasts nurses' *caring work* with the *curing work* performed by physicians, has brought valuable insights to the understanding of the differential recognition experienced by various categories of health professionals (Sandelowski, 1997, 2000; Treiber and Jones, 2015).

Considerations of the influence of both religion and religious doctrines relating to gender roles on nursing's path to professionalization brought further understanding of the role of gender in nursing's evolution (Marshall and Wall, 1999; Nelson, 1997; Rafferty, 1996). Other researchers have suggested that nursing's professional status has been dually impacted by nurses' hierarchical positioning in a health system characterized by (a) male dominance/female subordination relationships that reproduce patriarchal social relations and (b) a partiality towards curative work (Davies, 1995). The issue of patriarchy is further emphasized by assertions that any clear understanding of power relations affecting professionalization relies on careful consideration of often neglected, patriarchal contexts (Witz, 1992b).

### 2.2. Arguments against nursing professionalization

Despite its numerous benefits, nursing professionalization has faced its share of criticism, including the concern that added health care costs, ensuing from a higher-educated, but also more expensive, workforce, will trigger the replacement of nurses with a cheaper, but also less-qualified, workforce (Chapman, 1998). In addition, it has been suggested that, given the multitude of resources involved (Squires and Beltrán-Sánchez, 2011) and the consequent increase in regulation, nursing professionalization could expand bureaucratization (Bail et al., 2009) and intensify occupational closure (Waters, 1989). This threat is further reflected in research examining nurses' engagement in their own *professional projects*. Thus, in response to exclusionary occupational closure tactics practiced by the medical profession, nurses have attempted to (a) push back against the medical profession's domination and, simultaneously, (b) advance their own position by creating their own professional organizations and licencing restrictions that could, in turn, exclude others from entering their occupation (Witz, 1990, 1992a).

Furthermore, gender ideologies contributing to the creation of labour and class divisions in professional nursing and, in the context of increased globalization, the additional stratification of nursing labour based on education, skill, and country of origin, along with a perceived disposable nature of the nursing workforce,

could increase the potential for exploitation of the nursing workforce (Wrede, 2012). Strong arguments against professionalization suggest that nurses should abandon their quest for professionalization since (a) there are significant barriers impeding it and (b) this pursuit is merely a self-advancement attempt (Porter, 1992).

This study is, nevertheless, based on the assumption that, overall, the benefits of professionalization surpass its potential shortcomings, and, for this reason, understanding more about the factors that impact it would be beneficial to both the nursing profession and the health system.

### 2.3. Ongoing challenges to comparative nursing workforce studies

The focus of this study is on regulated nurses, namely licenced practical nurses and registered nurses, including advanced practice nurses. Practical challenges to comparative nursing workforce research include country variation with regard to (a) nursing programs' pre-admission and graduation education requirements; (b) the type of institution providing the education (secondary/post-secondary level, hospital/education centre, university/technical colleges); (c) nomenclature and classes of nurses; and (d) categories of nurses that are regulated (Büscher et al., 2010; Currie and Carr-Hill, 2012; IOM, 2011; Nichols et al., 2010; WHO, 2006). For instance, given country differences regarding regulated nurses categories (OECD, 2018c), the numbers of regulated nurses by country, as captured in international databases, may be misestimated. Simultaneously, nursing role definitions/classifications may also vary over time within the same country (Currie and Carr-Hill, 2012). As a result, findings from comparative studies of the nursing workforce should be interpreted with caution, given the possibility that identified differences might be attributed to the lack of standardization of nursing role definitions and classifications, not the examined explanatory variables (Currie and Carr-Hill, 2012).

Educational requirements are especially relevant in professionalization studies, since higher level or university education is considered a key component of professionalization (Coburn, 1994). Currently, no consistent source of information about such educational requirements for nursing programs across the world exists, and information collected from multiple sources can be contradictory (Fleming and Holmes, 2005; Humar and Sansoni, 2017; ICN Workforce Forum, 2015; Koff, 2017; OECD, 2018c). According to education levels and institution type, two categories are commonly distinguished: (a) vocational education, which requires less than 12 years of education for pre-admission into nursing programs (Büscher et al., 2010), being offered at secondary or high-school level and (b) professional education, which requires more than 12 year of education for pre-admission, being offered at post-secondary level, either in a college or university and considered part of the higher education system (IOM, 2011). In some countries, the vocational and professional education categories co-exist as initial educational routes for regulated nurses, while in most countries, the vocational route has been gradually eliminated (Büscher et al., 2010). Despite in-depth searches, we found no consistent data across all 16 years and 22 countries examined about regulated nurses' educational requirements and categories.

An additional challenge to understanding the ways in which macro-level factors influence the nursing workforce across countries comes from differing funding structures for nursing education. For instance, while in many countries the funding comes from education budgets, in others, it is part of health sector funding, which, in light of ongoing health budget cuts and competing priorities for health spending, affects progress in increasing nurses' education levels (Francis and Humphreys, 1999).

#### 2.4. Gender equality in education, the labour market, and politics

Given professionalization's multifaceted nature, a number of macro-level factors could impact it; also, given nursing's female-majority composition, a lack of gender equality could impact various aspects of professionalization. Gender inequality is defined as the unequal access to resources that enable men and women to make choices regarding alternative life and work opportunities and capabilities (Korpi et al., 2013). Undeniably, the range of gender inequalities is wide-ranging, fluctuating considerably among OECD countries, as well as among cultures, occupations, social classes, and age and ethnic groups.

Since equality between females and males is best accomplished through the implementation of policies (Blofield and Franconi, 2015), we used a policy perspective, examining gender in the context of country-level policies promoting equality between females and males. Such policies challenge patriarchy by targeting not only family and home environments, but also education, economic, and political contexts (Borrell et al., 2014; Palència et al., 2014). In this study, we focused on the areas of education, labour market, and politics, where a lack of gender equality could impact both nurses' career trajectories and nursing's development, selecting a number of indicators of gender equality in education, the labour market, and politics as explanatory variables.

Educational prospects could vary significantly between females and males (Newman et al., 2016), affecting not only the field of study, but also the length of educational programmes pursued. Such educational differences, in turn, influence females and males' subsequent labour market opportunities and trajectories (Bambra et al., 2009). In addition, horizontal gender segregation practices between professions practiced mostly by women, such as health and welfare occupations, or mostly by men, such as engineering, manufacturing, and construction could result in gender-specific occupational niches (Sikora and Pokropek, 2011), which, in turn have been linked to the socioeconomic underappreciation of women's jobs, roles, and responsibilities (Muench and Dietrich, 2017; OECD, 2011; Vuolanto and Laiho, 2017).

Additionally, limited access to education and employment opportunities, along with being responsible for larger shares of unpaid activities, related to caring for children, the sick, and the elderly (Pereira, 2015) has a compounding effect and may result in further gender inequalities between females and males (Borrell et al., 2014; Newman et al., 2016). For instance, females' labour participation rates have been historically lower; besides, gender inequality has been linked to female's decreased participation in management and political decision-making (George et al., 2017), which could limit their opportunities to advocate for improvements in their status.

#### 2.5. Theoretical location

We used gender policy regimes to group countries, which enabled us to make comparisons and identify similarities and differences between them. A gender policy regime considers gender ideology when assessing policies' roles and effects in a given country (Sainsbury, 1999). In response to a lack of gender focus in early welfare state analyses (Backhans et al., 2011; Sainsbury, 1994), a number of gender regime typologies have been developed, either as alternatives or as extensions of welfare state regimes; they focus on gender relevant policies and/or their consequences for females' labour force participation (Backhans et al., 2011). For this study, we used Korpi's gender policy model, which classifies countries into three categories: Traditional family, Market-oriented, and Carer-earner, according to each country's capacity to promote gender equality through family policies that facilitate an equitable division of paid/unpaid work among females

and males which, in turn, increases females' access to the labour market (Korpi et al., 2013).

In Korpi's model, countries in the Traditional family category displayed low levels of gender equality because their policies supported mostly part-time and temporary paid work for women, resulting in their relatively low labour force participation, especially for mothers of young children (2013). Market-oriented countries showed medium levels of gender equality; their policies offered (a) some support to encourage paid work and facilitate professional careers for women, (b) mostly privatized child/parent/sick care services, and (c) in some countries, anti-discrimination labour market legislation. Countries in the Earner-carer category reached higher levels of gender equality through family policies that (a) eased women's access into the labour market, (b) ensured that care work is transferred to the public sector so that women can commit time to their careers, and (c) facilitated a more equitable division of paid/unpaid work among females and males by stimulating the active involvement of fathers in care of their children. Key features of each category are included in Supplementary Table S2.

### 3. Study objectives

Our overall goal was to explore whether gender regimes and measures of gender equality in education, the labour market, and politics are related to indicators of nursing professionalization. We addressed the following research questions:

- Q1. What is the effect of gender regimes on nursing professionalization indicators in high-income countries?
- Q2. What is the effect of gender equality policies within education, the labour market, and politics on nursing professionalization indicators in high-income countries?

Based on nursing's largely female practitioner base, we believe that higher levels of gender equality, indicative of a more balanced distribution of resources and prospects among females and males, would be positively associated with nursing professionalization indicators, formulating the following hypotheses:

- H1. Average nursing professionalization indicators in high-income countries differ among gender regimes, being the highest in Earner-carer regimes and the lowest in Traditional family regimes.
- H2. Public policies that promote gender equality in education, the labour market, and politics, as illustrated by measures of gender equality in these fields, are expected to be positively associated with nursing professionalization indicators.

### 4. Methodology

#### 4.1. Design and sample

Similar to other comparative health and socio-political research (Bradley and Stephens, 2007; Ng, 2013), we used a time-series, cross-sectional study design to examine the effect of gender variables on nursing professionalization indicators. By adopting this design, we were able to multiply the number of time points by the number of cross-section units, thus, increasing the number of observations (Raffalovich and Chung, 2014). We specified variables in terms of annual ratios, a recommended approach to examine the long-term impact of sociopolitical variables (Huber and Stephens, 2001). Also similar to other comparative studies, we opted for a convenient purposive sample of high-income countries, members of the Organisation for Economic Co-operation and Development

(OECD). For the 2018 fiscal year, countries categorized by the World Bank as high-income had a gross national income per capita of \$12,056 (U.S. dollars) or more (The World Bank, 2019). OECD countries are commonly used in international studies because of their consistent and systematic use of data collection methods, enabled by improved access to resources, which facilitates comparative research. We focused on 22 countries previously included in gender regime research and grouped them into three categories, according to Korpi's model (2013), as follows: (a) Traditional family – Austria, Belgium, France, Germany, Greece, Italy, Netherlands, Portugal, and Spain; (b) Market-oriented – Australia, Canada, Ireland, Japan, New Zealand, South Korea, Switzerland, United Kingdom (U.K.), and the United States (U.S.); and (c) Earner-carer – Denmark, Finland, Norway, and Sweden. The analysis covered 16 years, from 2000 to 2015, providing us with a sample of 352 country-year cases.

## 4.2. Variables

### 4.2.1. Outcome variables

Several indicators are frequently used to study characteristics of the nursing profession; however, to date, no universally recognized indexes of nursing professionalization exist. For this study, we focused on two indicators, the *regulated nurse-to-population ratio* and the *nurse graduate-to-population ratio*, previously used in country-level and comparative research studying the development of nursing (Büscher et al., 2010; ICN Workforce Forum, 2015; IOM, 2011; Squires and Beltrán-Sánchez, 2009; WHO, 2010, 2016a). The first indicator refers to all nurses who are currently licenced to practice in a given country—including migrant nurses—and who deliver health services to patients (OECD, 2018a). We used the indicator *nurses*, collected by the OECD, as a proxy for the *regulated nurse-to-population ratio*. This indicator has two categories: a) professional nurses—including both general care/specialist nurses and advanced practice nurses—and b) associate professional nurses such as assistant/enrolled/practical nurses (OECD, 2018a). With the exception of countries where midwifery is a nursing subspecialty, midwives were excluded from the count. Given a lack of comparable data for some countries—including France, Ireland, Italy, Netherlands, Portugal, and the U.S.—the indicator *nurse* also included professional nurses who do not provide direct care but who are employed as managers, educators, or researchers. Further, in countries such as Austria, Greece, and Italy, the number of nurses was limited to those working in hospitals.

Our second outcome indicator, the ratio of graduate nurses, captures the number of students who have obtained the recognised qualification needed to become a licensed nurse, including graduates from all level nursing programmes and excluding graduate degrees, in order to prevent double-counting (OECD, 2018b).

The unavailability of relevant data across all 22 countries of interest and 16 years of analysis limited our choice of professionalization indicators for this study. Thus, we focused on only two aspects of nursing professionalization: (a) the extent of the nursing profession, especially the number of nurses bound by professional standards, and (b) the profession's capacity to prepare new regulated nurses.

Given its dynamic and non-linear character (Andrews and Wærness, 2011), the process of nursing professionalization is associated with a large number of goals and stages (Baumann and Blythe, 2008), necessary to achieve, maintain, and enhance professionalization. Closely related to these goals, we identified a number of relevant indicators of professionalization, as listed in Supplementary Table S1. However, these indicators' absence and/or inconsistent collection in international databases precluded us from using them in this study. Sustained efforts by nursing

organizations to standardize nurses' role definition/job description, create commonly recognized indicators, and collect them consistently across countries (ICN Workforce Forum, 2015; Intercultural Education of Nurses in Europe IENE, 2019; Montalvo, 2007; WHO, 2009) should assist the future replication of this study with different indicators of professionalization.

### 4.2.2. Explanatory and control variables

As listed in Table 1, we used eight explanatory variables in separate regression models. Thus, we used the *gender policy model* indicator as proxy for gender regimes to test our first hypothesis and the following seven variables to test the second hypothesis. To measure gender equality in education we looked at females' participation in higher-level education and their representation in health/welfare and technical fields. Second, to assess gender equality in the labour market, we focused on the *gender wage gap*, *female labour force participation rates*, and *female share of employment in managerial positions*. Finally, to evaluate gender equality in politics we focused on the *female share of seats in national parliaments*.

Given that a comprehensive literature review on this topic identified a number of macro-level welfare state factors that could influence indicators of nursing professionalization (Gunn et al., 2019a) and a subsequent study suggested the existence of associations between such factors and the regulated nurse and nurse-graduate ratios (Gunn et al., 2019b), in this analysis, we considered the following control factors indicators of such policies: health care spending (public/private), public coverage for health care, public education sector funding, length of maternity and paternity leaves, and trade union density rates. In addition, given that various measures of a country's economic development have been previously linked to the number of health professionals, including nurses (Squires, 2007; Wharrad and Robinson, 1999), although, in some studies, such findings did not apply to OECD countries (Currie and Carr-Hill, 2012), both *gross domestic product per capita* and *gross domestic product annual growth rate* were also considered as control variables. Although not commonly identified as macro-level factors, the ratios of doctors and medical graduates were also considered as control variables. Due to multicollinearity and non-statistical significance, only two control variables, *medical graduate-to-population ratio* and *length of paid maternity leave*, were used in this analysis.

Further details about all variables are presented in the Supplementary Table S1; in addition, the rationale, measurement method, and data sources for the variables used are found in Table 1.

## 4.3. Data collection

We obtained our data from open access secondary sources of information, including the OECD, the World Bank, and the International Labour Organization and, as a result, did not require ethical consent. Data collection took place from March to December 2017. Before completing the analysis, from August to September 2018, we updated all entries to ensure the most updated data were used.

## 4.4. Data analysis

We used a combination of statistical packages and software programmes, as listed here: (a) Stata 15 (StataCorp, 2017) for the descriptive and inferential analyses, (b) R 3.5.1 (R Core Team, 2018) and Amelia II 1.7.5 (Honaker et al., 2018) to devise and implement a data imputation strategy, and (c) Microsoft Excel (Microsoft, 2013) to calculate the standardized/semi-standardized coefficients.

Our initial step was to calculate the means and standard deviations (total/between/within) for the explanatory/outcome/control variables. Next, we used Amelia II, a predictive multiple

**Table 1**  
Outcome, explanatory, and control variables – rationale, measurement, and data source.

Indicator	Rationale/Measurement	Data source
<b>Outcome variables</b>		
Regulated nurse-to-population ratio	Provides a measure of the extent of the nursing profession, especially the number of practitioners bound by professional standards. Measured per 1000 inhabitants.	OECD Health Statistics
Nurse graduate-to-population ratio	Assesses the capacity of a given country to prepare regulated nurses and is particularly important given current and anticipated nursing shortages, as well as an ageing nursing workforce. Measured per 1000 inhabitants.	OECD Health Statistics
<b>Explanatory variables</b>		
Gender policy model as proxy for gender regime	Allows the classification of countries into clusters of countries based on the gender-inequality-reducing impact of family policies. Three categories: Traditional family (reference), Market-oriented, and Earner-carer. Traditional family model countries: Austria, Belgium, France, Germany, Greece, Italy, Netherlands, Portugal, and Spain. Market-oriented model countries: Australia, Canada, Ireland, Japan, New Zealand, South Korea, Switzerland, U.K., and U.S. Earner-carer model countries: Denmark, Finland, Norway, and Sweden.	Theory
Measures of gender equality policy in education Female share of tertiary education graduates	Provides a measure of the number of females who complete education programs at tertiary levels. Measures gender equality in higher-level educational achievement, which is linked to subsequent labour market opportunities and the representation of females within vertical occupational structures. Measured as the percentage of the total number of graduates, both female and male (%).	World Bank
Female share of tertiary education graduates in health and welfare programmes	Provides a measure of the number of female graduates in health and welfare fields, at the higher level of education. Assesses horizontal gender segregation by reviewing the concentration of females in health and welfare fields. Measured as a percentage of the total number of tertiary graduates in these fields of education (%).	World Bank
Female share of tertiary education graduates in engineering, manufacturing, and construction programmes	Provides a measure of the number of female graduates in engineering, manufacturing, and construction fields in higher level education. Assesses horizontal gender segregation by reviewing the concentration of females in technical educational fields. Measured as a percentage of the total number of tertiary graduates in these fields of education (%).	World Bank
Measures of gender equality policy in the labour market Gender wage gap	Provides a measure of the relative difference between the earnings of males and those of females, being closely related to the degree of gender equality in a given country. Measured as a proportion of the median earnings of males (%).	OECD iLibrary
Female labour force participation rate	Provides an overall measure of gender power imbalances, the status of women, and women's empowerment, with implications for educational and economic achievement. Measured as the proportion of the population aged 15 and older that is economically active (%).	World Bank
Female share of employment in managerial positions	Provides information on the proportion of women who are employed in decision-making and management roles in government, large enterprises, and institutions. It measures vertical gender segregation in the labour market with regard to leadership opportunities. Measured as the number of females in junior, middle, and senior management as a percentage of employment in management (%).	International Labour Organization
Measures of gender equality policy in politics Female share of seats in national parliaments	Offers a measure of gender equality with regard to leadership opportunities, specifically participation in decision-making at national political level. It measures vertical gender segregation in leadership roles within politics. Measured as a percentage of all occupied seats and calculated by dividing the total number of seats occupied by females by the total number of parliamentary seats (%).	World Bank
<b>Control variables</b>		
Medical graduate-to-population ratio	Provides a measure of the extent of the medical profession. Measured per 1000 inhabitants. Relevant since there is a certain degree of overlap between services provided by doctors and nurses and, over time, countries or regions affected by doctor shortages experienced increases in the number of nurses. Used as control variable for the regulated nurse-to-population ratio model	OECD Health Statistics
Length of paid maternity leave	Offers a measure of the supports available for females to facilitate their return to work after giving birth. Measures the length of time, in weeks, of paid maternity and parental leave. Used as control variable for the nurse graduate-to-population ratio model	OECD iLibrary

imputation program, and the R software, to address a number of missing observations (Honaker et al., 2018). The total percentage of missing observations across all countries, by indicator, was as follows: *regulated nurse-to-population ratio* 14.2%; *nurse graduate-to-population ratio* 11.93%; *female share of tertiary education graduates* 16.9%; *female share of tertiary education graduates in health and welfare programmes* 19.89%; *female share of tertiary education graduates in engineering, manufacturing, and construction programmes* 26.42%; *gender wage gap* 18.75%; *female share of employment in managerial positions* 5.11%; and *female share of seats in national parliaments* 1.42%. Employing the imputation approach, we created five complete datasets and, after conducting validity diagnostic tests on them, imported them into Stata. We used Stata's *mi* command for multiple-imputation analysis, which employs Rubin's combination rules to pool together the individual results of regressions performed separately for each dataset (StataCorp and Dorta, 2018). Although a number of other combination rules exist to address situations in which, for example, the estimates from each imputed data set do not fit assumptions of normality (Ratitch et al., 2013), in this case, the application of Rubin's rules was well-fitted. To further assess the reliability of our imputation approach, we ran each regression twice (with and without the imputed values), with no substantial differences. In addition, using the same imputation process, we also generated 10 new complete datasets and ran each regression again, with only insignificant changes.

To estimate the effects of gender policy indicators on the *regulated nurse-to-population* and the *nurse graduate-to-population ratios*, we used fixed-unit effects linear regression models. Fixed-unit effects, through the use of country dummy variables, adjust for unobserved heterogeneity in cross-sectional data and control for omitted variable bias, present when not all explanatory variables with a potential effect on the outcome variables are considered (Beck, 2008; Beck and Katz, 1996). We applied the Prais-Winsten regression technique, with panel-corrected standard errors and a first-order autocorrelation correction (Beck and Katz, 1995). This approach is recommended when serial (spatial) and contemporaneous (temporal) correlations of errors are suspected, in cases when observations across units and time frames are not independent from each other (Beck, 2008). Our regression technique is further justified given that it adjusts for panel heteroskedasticity, or the unequal distribution of variances across units, which is often linked to cross-sectional data (Beck, 2008). If

non-independence of errors and heteroskedasticity are not controlled for, estimates of the standard errors could be inaccurate, which could, in turn, lead to incorrect assumptions about the significance of regression coefficients, accompanied by an increase in type 1 or 2 error rates (Raffalovich and Chung, 2014).

In separate regression models, we tested the effect of each explanatory variable on each of the two outcome variables. The models estimating the effect of gender policy variables on the ratio of regulated nurses controlled for the *medical graduate-to-population ratio*, while the models focused on the nurse graduates ratio controlled for the *length of paid maternity leave*. Before opting for the final regression models, we considered other potentially relevant control variables, as mentioned in Section 4.2.2. Control variables that did not have a significant effect ( $p < 0.05$ ) on the outcome variables and those that indicated multicollinearity among variables, as shown by a variance inflation factor or condition number of over 10 (Chen et al., 2003; Nau, 2018), were excluded.

We conducted a number of diagnostic and post-estimation tests to assess the robustness of our results. First, for each country, we checked for outliers by visually inspecting the graphs of each outcome variable plotted against each explanatory variable (Chen et al., 2003). Second, for each regression model and each imputed set, we assessed the normal distribution of residuals by (a) reviewing histograms, normal probability plots (both q- and p-norm), and kernel density plots; and (b) conducting skewness and kurtosis tests (Chen et al., 2003), with only minor deviations from normality and without any indication of unusually large residuals.

To facilitate comparisons among the relative effect size of each explanatory variable, we also calculated and reported the semi-standardized and standardized coefficients.

## 5. Results

### 5.1. Descriptive summary

The means, standard deviations, and minimum/maximum values for the outcome, explanatory, and control variables across all 16 years and 22 countries are shown in Table 2. The minimum/maximum values for the outcome variables, by country and by gender policy model, across all 16 years, are shown in Table 3. From 2000 to 2015, across all countries in the analysis, the lowest and

**Table 2**

Means; total, between- and within-country standard deviations; and minimum and maximum values for the outcome, explanatory, and control variables 22 countries, 2000–2015<sup>†</sup>.

Variable	Mean	Total SD	Between-country SD	Within-country SD	Minimum value	Maximum value
<b>Outcome</b>						
Regulated nurse-to-population ratio (per thousand pop.)	9.58	3.48	3.36	0.82	2.75	17.33
Nurse graduate-to-population ratio (per thousand pop.)	0.47	0.22	0.21	0.07	0.04	1.12
<b>Explanatory</b>						
Measures of gender equality policy in education						
Female share of tertiary education graduates (%)	56.58	4.62	4.38	1.48	40.86	67.17
Female share of tertiary education graduates in health and welfare programmes (%)	76.75	5.63	5.40	1.85	61.37	87.27
Female share of tertiary education graduates in engineering, manufacturing, and construction programmes (%)	25.29	6.55	6.70	2.18	9.46	41.14
Measures of gender equality policy in the labour market						
Gender wage gap (%)	17.23	8.06	7.48	2.11	3.30	41.65
Female labour force participation rate (%)	54.72	7.82	7.75	1.91	35.68	76.24
Female share of employment in managerial positions (%)	30.06	7.02	7.42	2.46	5.00	40.40
Measures of gender equality policy in politics						
Female share of seats in national parliaments (%)	26.66	10.68	10.30	3.44	5.90	47.30
<b>Control</b>						
Medical graduate-to-population ratio (%)	0.11	0.04	0.04	0.02	0.05	0.24
Length of paid maternity leave (weeks)	43.00	35.13	34.97	7.97	0.00	161.00

<sup>†</sup> Values before multiple imputation; SD – standard deviation.

**Table 3**  
Minimum and maximum values for the outcome variables 22 countries, 2000–2015<sup>†</sup>.

Gender policy model	Country	Regulated nurse-to-population ratio (per thousand pop.)		Nurse graduate-to-population ratio (per thousand pop.)		
		Minimum	Maximum	Minimum	Maximum	
<b>Traditional family</b>	Austria	7.12	8.04	0.48	0.59	
	Belgium	8.79	10.83	0.32	0.50	
	France	6.66	9.92	0.23	0.40	
	Germany	9.99	12.65	0.40	0.55	
	Greece	<b>2.75</b>	3.47	0.20	0.26	
	Italy	6.11	6.48	0.06	0.22	
	Netherlands	10.29	12.23	0.29	0.43	
	Portugal	4.22	6.29	<b>0.04</b>	0.36	
	Spain	3.54	5.29	0.18	0.25	
	<b>Market-oriented</b>	Australia	9.76	11.45	0.50	0.77
		Canada	8.51	9.87	0.25	0.59
Ireland		12.18	13.55	0.27	0.44	
Japan		8.43	10.96	0.45	0.57	
New Zealand		8.84	10.25	0.28	0.46	
South Korea		2.98	5.94	0.61	<b>1.12</b>	
Switzerland		11.59	16.58	0.57	0.98	
U.K.		7.91	9.15	0.25	0.32	
U.S.		10.10	11.29	0.36	0.66	
<b>Earnier-carer</b>		Denmark	12.37	16.90	0.80	1.06
		Finland	10.71	14.26	0.45	0.69
	Norway	12.13	<b>17.33</b>	0.67	0.79	
	Sweden	9.79	11.09	0.36	0.50	

<sup>†</sup> Values before multiple imputation.

highest values for the *regulated nurse-to-population ratio* were 2.75, belonging to the Traditional family gender regime, and 17.33, belonging to the Earnier-carer gender regime, while the average value was 9.58. Similarly, the lowest and highest values for the *nurse graduate-to-population ratios* were 0.04, belonging to the Traditional family regime, and 1.12 respectively, belonging to the Market-oriented regime, with an average of .47. A correlation matrix is shown in the online Supplementary Table S2.

In general, from 2000 to 2015, across all countries, both the regulated nurse and nurse graduate ratios had slightly upward trends, as displayed in Supplementary Figs. S1 and S2.

### 5.2. Regression models

The results for each outcome variable, regressed on gender regimes, are shown in Table 4. All coefficients were statistically significant ( $p < 0.001$ ) and positive, after accounting for the control variables. When compared to the Traditional family regime (the

reference group), the average *regulated nurse-to-population ratio* was 0.74 times higher among Market-oriented regimes, and 1.70 times higher among Earnier-carer regimes. Likewise, when compared to the Traditional family regime, the average *nurse graduate-to-population ratio* was 0.89 times higher in Market-oriented gender regimes and 1.56 times higher among Earnier-carer gender regimes.

The results of the regression of each of the outcome indicators on seven measures of gender equality in education, the labour market, and politics are displayed in Table 5. Separate regression models revealed that the following three variables were in a positive and significant relationship with the *regulated nurse-to-population ratio*: the *female share of tertiary education graduates* ( $b = 0.11$ ,  $t = 2.61$ ,  $p < 0.05$ ), the *female share of employment in managerial positions* ( $b = 0.12$ ,  $t = 2.81$ ,  $p < 0.01$ ), and the *female share of seats in national parliaments* ( $b = 0.21$ ,  $t = 4.53$ ,  $p < 0.001$ ), while the *gender wage gap* was in a negative and significant relationship with this rate ( $b = -0.24$ ,  $t = -5.07$ ,  $p < 0.001$ ). After

**Table 4**  
PW-PCSE models of gender regimes on regulated nurse-to-population and nurse graduate-to-population ratios in 22 high-income countries, 2000–2015<sup>†,‡,§,††</sup>.

Gender regimes	Regulated nurse-to-population ratio				Nurse graduate-to-population ratio			
	b	SE b	t	$\beta$	B	SE b	t	$\beta$
Traditional family (reference group)	0 (base)				0 (base)			
Market-oriented	2.48 <sup>***</sup>	0.26	9.56	0.74 <sup>***</sup>	0.19 <sup>***</sup>	0.04	4.36	0.89 <sup>***</sup>
Earnier-carer	5.72 <sup>***</sup>	0.50	11.35	1.70 <sup>***</sup>	0.33 <sup>***</sup>	0.09	3.71	1.56 <sup>***</sup>
Constant	6.78				.30			
R <sup>2</sup>	.63				.77			
Df	3				3			
Rho	.92				.62			

PW-PCSE, Prais-Winsten regression with correlated panels corrected standard errors and a first-order autocorrelation correction; b, unstandardized coefficient; SE b, unstandardized coefficient standard error; t, t-scores;  $\beta$ , semi-standardised coefficient; R<sup>2</sup>, coefficient of determination; rho, common autoregressive term; df, degrees of freedom.

<sup>\*\*\*</sup>  $p < 0.001$  (two-tailed tests).

<sup>†</sup> Each model includes first-order serial autocorrelation corrections and fixed-unit effects (country dummy variables). The controls for each model are described in the Data analysis Section (4.4) (results not shown here).

<sup>‡</sup> Number of observations = 352 (22 countries over 16 years).

<sup>§</sup> Missing data were imputed using Amelia II multiple imputation strategy. These results are based on 5 imputations.

<sup>††</sup> R<sup>2</sup> was calculated individually by Stata for each imputed dataset and then averaged across, using Rubin's combination rules.

**Table 5**Individual PW-PCSE models of measures of gender equality in education, the labour market, and politics on regulated nurse-to-population and nurse graduate-to-population ratios in 22 high-income countries, 2000–2015<sup>†,‡,§,¶,††,†††</sup>.

	Regulated nurse-to-population ratio (df = 17)				Nurse graduate-to-population ratio (df = 17)			
	b	SE b	t	β	B	SE b	t	β
Measures of gender equality policy in education								
Female share of tertiary education graduates (%)	0.082*	0.03	2.61	0.11*	0.001	0.00	0.40	0.03
Female share of tertiary education graduates in health and welfare programmes (%)	0.011	0.01	0.73	0.02	0.002	0.00	0.94	0.06
Female share of tertiary education graduates in engineering, manufacturing, and construction programmes (%)	0.015	0.02	0.82	0.03	−0.004	0.00	−1.93	−0.12
Measures of gender equality policy in the labour market								
Gender wage gap	−0.107***	0.02	−5.07	−0.24***	−0.005 <sup>†</sup>	0.00	−2.40	−0.17 <sup>†</sup>
Female labour force participation rate (%)	0.044	0.03	1.58	0.10	0.008**	0.00	3.02	0.30**
Female share of employment in managerial positions (%)	0.055**	0.02	2.81	0.12**	0.003 <sup>†</sup>	0.00	2.06	0.12 <sup>†</sup>
Measures of gender equality policy in politics								
Female share of seats in national parliaments (%)	0.068***	0.01	4.53	0.21***	0.006***	0.00	4.36	0.29***

PW-PCSEs, Prais-Winsten regression with correlated panels corrected standard errors and a first-order autocorrelation correction; b, unstandardized coefficient; SE b, unstandardized coefficient standard error; t, t-scores; β, standardized coefficient; R<sup>2</sup>, coefficient of determination.

\*\*\* p < 0.001.

\*\* p < 0.01.

\* p < 0.05 (two-tailed tests).

<sup>†</sup> Each welfare state policy measure represents a separate Prais-Winsten regression model with correlated panels corrected standard errors.

<sup>‡</sup> Each model includes first-order serial autocorrelation corrections and fixed-unit effects (country dummy variables). The controls for each model are mentioned in the Data analysis Section (4.4) (results not shown here).

<sup>§</sup> Number of observations = 352 (22 countries over 16 years).

<sup>¶</sup> Missing data were imputed using Amelia II multiple imputation strategy. These results are based on 5 imputations.

<sup>††</sup> R<sup>2</sup> for the RNPR models ranged between 0.90 and 0.93 & R<sup>2</sup> for NGPR models ranged between 0.76 and 0.78. For both models, R<sup>2</sup> was calculated individually by Stata for each imputed dataset and then averaged across, using Rubin's combination rules.

studying the standardized coefficients, we estimated that, when compared with other measures, the *gender wage gap* had the largest effect on the *regulated nurse-to-population ratio*. If this gap is decreased by one standard deviation, the ratio of regulated nurses should increase by about 0.24, when the other variables are held constant.

Two of these indicators were also in a positive and significant relationship with the nurse graduate-to-population ratio: the female share of employment in managerial positions (b = 0.12, t = 2.06, p < 0.05), and the female share of seats in national parliaments (b = 0.29, t = 4.36, p < 0.001), in addition to the female labour force participation rate (b = 0.30, t = 3.02, p < 0.01). We also found that the gender wage gap (b = −0.17, t = −2.40, p < 0.05) had a negative and significant effect on the nurse graduate-to-population ratio. We found that, when compared with other measures, the female labour force participation rate had the largest effect in raising the nurse graduate-to-population ratio. More exactly, for each one standard deviation increase in this measure, the nurse graduates' ratio should rise by about 0.30, when other variables are held constant. None of the coefficients for the other gender equality measures considered were found to be statistically significant.

## 6. Discussion

### 6.1. Summary of findings

The finding that the average regulated nurse and nurse graduate ratios differ across gender regimes, being the highest in Earner-carer regimes and the lowest in Traditional family ones, supports our first hypothesis.

Our second hypothesis was also supported given that a number of measures of gender equality in education, the labour market, and politics were found to be predictive of (a) the regulated nurse ratio: *female share of tertiary education graduates*, *female share of employment in managerial positions*, *gender wage gap*, and *female share of seats in national parliaments*; and (b) the nurse graduate ratio: *female share of employment in managerial positions*, *gender*

*wage gap*, *female share of seats in national parliaments*, and *female labour force participation rate*.

Our findings are consistent with those of previous studies, which, although using different approaches and indicators, found positive associations between (a) gender in(equality) factors and the availability of nursing human resources (Squires et al., 2017, 2016), (b) the presence of institutional supports for women to access higher education and nursing professionalization (Squires, 2007), and (c) gender imbalances in the labour market and health human resource shortages (Newman, 2014).

### 6.2. Potential explanatory mechanisms

#### 6.2.1. Gender regimes

The finding that countries in Earner-carer regimes had the highest average of regulated nurses and nurse graduates and those in Traditional family ones the lowest one supports our first hypothesis. Higher gender equality levels in Earner-carer regimes seemed to have benefited nursing, a female majority occupation by enabling a higher number of nurse graduates and regulated nurses, possibly because more candidates had sufficient time and financial resources to pursue, obtain, and maintain regulated nurse status. Traditional family regimes, on the other hand, had the lowest average of both regulated nurses and nurse graduates, possibly due to less resources available to interested applicants to attend the necessary schooling to obtain/maintain regulated nurse status. The descriptive statistic indicating that the highest value for the nurse graduate ratio belonged to a country within the Market-oriented regime cluster, South Korea, instead of to a country within the Earner-carer regime cluster, could be linked to a large hospital sector and a relatively recent remarkable expansion in health coverage in South Korea (OECD, 2012), leading to an increased demand for health graduates, including nurse graduates.

#### 6.2.2. Gender equality policy in education

The finding that the *female share of tertiary education graduates*, an indicator of gender equality policy in education, is positively associated with the regulated nurse ratio is not surprising, given

that countries with a higher proportion of female graduates from tertiary education could benefit from an advanced educational infrastructure and, thus, be more receptive to increasing minimum educational requirements for a majority-female occupation. On the contrary, low female shares of tertiary education graduates could indicate the presence of institutional barriers limiting women's access to higher-level education.

### 6.2.3. Gender equality policy in the labour market

The finding that the wage gap between females and males, reflective of patriarchy levels, is inversely related to the regulated nurse and nurse graduate ratios could have two explanations. First, wage gaps could result in insufficient economic power available to women to pursue higher-level education, including nursing programs. Second, since economic capital is vital in advocating for one's profession, in countries with higher gender wage gaps, females might accumulate significantly less capital, leaving majority-female professions at a disadvantage. Given that having a large number of females in an occupation has been associated with lower wages for its members (Tijdens et al., 2013), a country's gender wage gap could also be reflective of pay gaps between nursing and other occupations. Although data on nurses' wages are inconsistently collected across countries/years, available OECD data show that while, in most countries, nurses' wages are larger than country averages, in some countries they are smaller (OECD, 2015, 2017). This finding confirms that gender inequalities among OECD countries differ, but it also reinforces the need to compare nurses' wages to those of other professionals with similar levels of education.

The *female share of employment in managerial positions'* positive association with the regulated nurse and nurse graduate ratios is significant, given that, if females hold a small proportion of employment in managerial positions, nurses, who are majority female, would also probably hold a small proportion of such employment. This underrepresentation could mean less involvement in decision-making for nurses both within and outside the health care system and, as a result, fewer opportunities to advocate for higher nurse/patient ratios and better working environments; in turn, this could decrease the number of nursing jobs—possibly attracting less applicants to the profession—and discourage investments in the production of new nurses.

The *female labour force participation rate's* positive association with the *nurse graduate-to-population* ratio could be explained given that a larger female workforce would also require a larger pool of female graduates in most professions.

### 6.2.4. Gender equality policy in politics

Last, but not least, the *female share of seats in national parliaments*, a measure of gender equality in politics, was also positively associated with both outcome indicators. Similar to the female share of managerial jobs, this indicator could be predictive of the regulated nurse and nurse graduate ratios, since if females hold a small proportion of seats in national parliaments, nurses, with a large majority of female practitioners, would probably also hold a small proportion of such seats. Consequently, nurses would have limited formal power over political decisions involving, for example, resources allocated to nursing schools and health institutions, which, in turn, could negatively impact the number of nursing graduates and nursing jobs.

## 7. Strengths and limitations

Our research makes a few additions to the nursing literature that studies the influence of macro-level factors on nursing professionalization. First, it employs a macro-level gender policy approach by using a gender regime framework and by examining

country-level measures of gender equality policy. This study shows the usefulness of a gender equality policy lens for the study of nursing professionalization and identifies a few gender policy indicators that have a significant effect on the regulated nurse and nurse graduate ratios. Second, it makes a methodological contribution, using fixed-unit effects linear regression models and time-series, cross-sectional data to perform a comparative analysis of nursing professionalization indicators across 22 countries and 16 years, employing the Prais-Winsten regression technique. In addition, given that incomplete observations are intrinsic to time-series, cross-sectional data, it employs a multiple imputation strategy, using the Amelia II program, to address missing data.

We do, however, recognise the study's limitations. Foremost, in the absence of a formal nursing professionalization index, by selecting only two outcome variables, we focused on only two aspects of nursing professionalization: the number of members bound by professional standards and the capacity to prepare new practitioners. Although numerous other indicators of professionalization exist, we did not include them due to their inconsistent inclusion in international databases. Another drawback relates to the existing discrepancies among countries with regard to the defining, measuring, and collecting of nursing (Tomblin Murphy et al., 2016) and other indicators, which potentially impacts the accuracy of comparative research. To address this issue, we included only high-income countries that have access to more resources and standardized methods of data collection. Also, despite indicator variation, intrinsic to comparative research, we hope that our study will help create a range of established indicators for future research to replicate.

Next, since we used a convenience sample, our findings can be generalized only to the 22 countries in our study. Yet, since the overall implications are of importance to all countries practicing nursing, we hope that this research will trigger interest among researchers, who will replicate it for other countries. In addition, since the exact mechanisms by which gender equality impacts nursing professionalization are currently not well understood, another limitation could be variable omission bias, which we attempted to address through the use of fixed-effects regression models. As knowledge about the macro-determinants of nursing professionalization evolves, future studies will be able to examine additional factors potentially impacting this process.

## 8. Conclusion and recommendations

Our findings suggest that policies promoting gender equality have an effect on nursing professionalization indicators, in this case, the regulated nurse and nurse graduate ratios. Additional research is necessary to further test the impact of these gender equality indicators and identify additional macro-level determinants of nursing professionalization. This study could be replicated using different countries, years, gender equality measures, indicators of professionalization, statistical analysis methods, and gender regime typologies. In addition, given the medical profession's different gender profile and its exposure to similar macro-level factors, future studies could replicate this analysis with the number of doctors and number of medical graduates as outcome variables. Further, given the significant implications that education/health budget cuts have on the production and retention of health human resources, future studies could focus on indicator variation around economic crises.

Learning more about structural influences on nursing professionalization is justified, given the extent of beneficial effects associated with this process, not only for the nursing workforce, but also for patients and health systems in general. Additionally, increasing our understanding of the ways in which gender equality

policies influence the supply and demand of nursing human resources would increase the accuracy of nursing and health human resources forecasting tools, thus, facilitating an improvement in health workforce sustainability.

A focus on high-level factors impacting the development of nursing, such as gender equality policies, is necessary given that the distribution of education, health, labour market, and family resources in society is influenced by a combination of socio-economic and political factors guiding the creation of public policies. In addition, employing a wide-range of macro-level interventions would enrich our profession's current repertoire of advocacy strategies aimed at achieving, maintaining, and/or advancing professionalization levels. For example, policies that promote gender equality within the family should facilitate the equitable division of paid/unpaid work and, together with policies promoting gender equality in education, economic, and political arenas, could increase nurses' access to higher education, enhance their position in the labour market, and facilitate their engagement in political activism to advance their profession.

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