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Original Article

Analyzing economic feasibility for investing in nursing care: Evidence from panel data analysis in 35 OECD countries

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ABSTRACT

Objective: To analyze economic feasibility for investing in nursing care.
Method: The number of practicing nurses' density per 1000 population as a proxy for nursing staff and Gross Domestic Product (GDP) per capita (current US$) were collected in 35 member countries of Organization for Economic Co-operation and Development (OECD) over 2000–2016 period. The statistical technique of panel data analysis including unit root test, cointegration analysis, Granger causality test, dynamic long-run model analysis and error correction model were applied to measure economic impact of nursing-related services.
Results: There was a committed bilateral relationship between nurse-staffing level and GDP with long-run magnitudes of 1.39 and 0.41 for GDP-lead-nurse and nurse-lead-GDP directions in OECD countries, respectively. Moreover, the highest long-run magnitudes of the effect nursing staff has on increasing GDP per capita were calculated in Finland (2.07), Sweden (1.92), Estonia (1.68), Poland (1.52), Czech Republic (1.48), Norway (1.47) and Canada (1.24).
Conclusion: Our findings verify that although the dependency of nursing characteristics to GDP per capita is higher than the reliance of GDP to number of nurses' density per 1000 population, investing in nursing care is economically feasible in OECD countries i.e. nursing is not only a financial burden (or cost) on health care systems, but also an economic stimulus in OECD countries. Hence, we alert governments and policy makers about the risk of underestimating the economic impacts of nurses on economic systems of OECD countries.

What is known?

- To our knowledge, there is a lack of empirical studies to analyze economic feasibility for investing in nursing care.

What is new?

- This study is significant in nursing by measuring the effect of nursing characteristics on increasing Gross Domestic Product (GDP) per capita in 35 OECD countries over 2000–2016 period using the statistical technique of panel data analysis.
- Our findings verify that there was a bi-directional long-run relationship between the level of nursing staff and GDP per capita and a 1% increase in the number of practicing nurses per 1000 population would rise GDP per capita of OECD countries by 0.4%.
- Among OECD countries, the magnitudes of the effect nursing staff had on increasing GDP per capita were investigated at the highest level in Finland (2.07), Sweden (1.92), Estonia (1.68), Poland (1.52), Czech Republic (1.48), Norway (1.47) and Canada (1.24).
- Our results alert policy makers and governments about the risk of underestimating and ignoring the stimulus effect of nurses on GDP growth of OECD countries.

1. Introduction

Slowing down the rapid growth of health care expenditures is one of the biggest challenges in managing the health and social sector of Organization for Economic Co-operation and

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Development (OECD) countries and nurses are often considered as one of the costliest components of health care systems, because the number of nursing staff is substantially higher than other health care professionals. Across the OECD, nurses greatly outnumber physicians and there were about two and half times as many nurses employed as there were doctors i.e. 9 nurses compared to 3.4 doctors per 1000 population in 2015 [1,2]. According to larger levels of nursing staff, employed nurses have been targeted for cost cutting policies in different health care systems across OECD countries [3–6]. However, there is a doubt in net effect of cutting nurse numbers policy on reducing hospital costs as well as health care expenditures in terms of increasing adverse clinical outcomes, risk of complications, safety failures and patient mortality.

There is no doubt that nursing care add values beyond the effect on health care provision i.e. several studies have illustrated nursing impacts on improving quality of health care services in the national level including Aiken et al. [7], Estabrooks et al. [8], Rafferty et al. [9], Van den Heede et al. [10], Poghosyan et al. [11], Aiken et al. [12], Suhonen et al. [13], Aiken et al. [14], Cho et al. [15], Manojlovich [16], Aiken et al. [17], Amiri and Solankallio-Vahteri [18] and Amiri et al. [19]. However, there is a lack of empirical studies to estimate economic values of nurses in health and social sector. To our knowledge, all previous studies have focused on cost benefit analysis [3,4,20,21] and cost-effectiveness analysis [22–26] of nursing-related services using small samples of hospital data. Their results are inconclusive due to a limited number of research and mixed findings [6,27]. More recent research, such as Brownie et al. [28], Oliver et al. [29], Browall et al. [30], Fatoye and Baker [31] and Randal et al. [32] have verified financial impacts of improving nursing care resulting from enhancement in clinical practice and quality of care on clinical outcomes in cost-effectiveness which is considered as secondary-level outcomes to health care services.

Overall, the economic contribution of nursing and nursing services have not been well researched [27] which leads to underestimating the impacts of nursing characteristics by policy makers along with governments [33]. Hence, there is a huge need of empirical economic analyses such as economic impact studies as well as cost-effectiveness analysis to analyze the contribution of nurses within health care and economic systems in cross-national level.

The following study aims to estimate the economic value of nurses in macroeconomic perspective with adding the effect of nursing-related services in health-lead-GDP (Gross Domestic Product) theory – see Amiri [34]. According to health-lead-GDP or "Healthier Wealthier" theory, healthier people can work harder, longer and more efficiently and consequently, earn more income [35–38]. Thus, nurses as a key element on health care delivery would play a critical role in increasing the health level of different

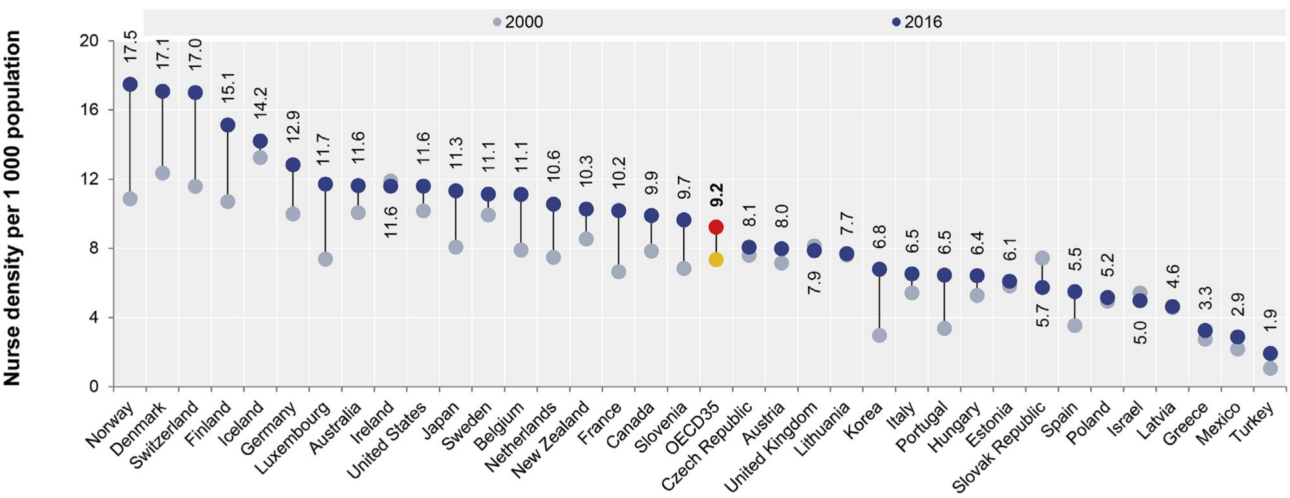

Fig. 1. Practicing nurses' density per 1,000 population in 35 OECD countries in 2016 and changes from 2000 to 2016.

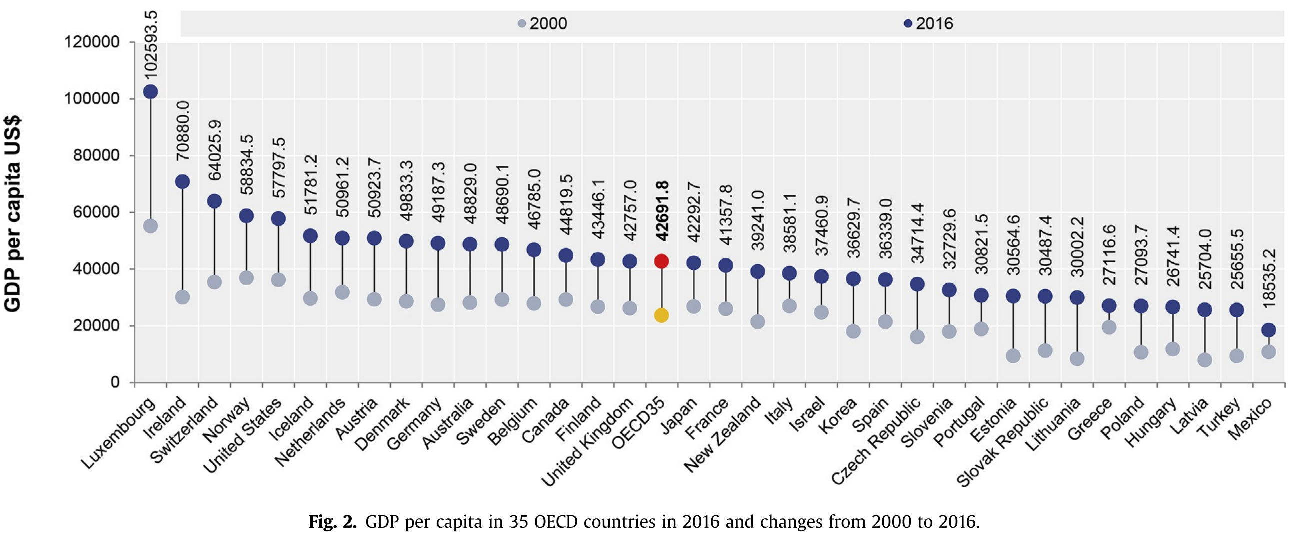

Fig. 2. GDP per capita in 35 OECD countries in 2016 and changes from 2000 to 2016.

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societies and subsequently rising GDP (Gross Domestic Product) and national income of different countries. To analyze the economic feasibility for investing in nursing care, statistical technique of panel data analysis is conducted to stimulate the possible relationship from the level of nursing staff to GDP per capita of 35 developed countries during 2000–2016 period collected from OECD Health Statistics.

2. Data and research method

The number of practicing professional nurses' density per 1000 population (head counts) including the population of nursing professionals who deliver clinical and hospital care services directly to patients – including general care nurses, specialist nurses, clinical nurses, district nurses, nurse anesthetists, nurse educators, nurse practitioners and public health nurses – were used as proxy for nursing characteristics. The observations of nursing staff and GDP per capita were collected from OECD Health Statistics in 35 OECD countries during 2000–2016 period available at OECD [39,40]. Artificial Neural Networks model (ANNs) were applied to generate missing observations of nursing staff series. According to the limited number of observations during time period (17 observations), we were not able to add other control variables in our analysis due to lack of meaningful degree of freedom in cross unit tests. However, we added some other variables like trend and lagged amounts of endogenous variable as control factors in our panel models. Figs. 1 and 2 depict the amounts of our variables in 2016 and changes from 2000. As the aim of this study is to measure the long-run elasticity of the relationship from nursing staff to GDP per capita growth, the logarithm of nurse-staffing level (*lnNURSE*) and GDP per capita (*lnGDPc*) were used in panel data analysis.

To provide a better data visualization, Fig. 3 depicts level and logarithm of nursing staff together with GDP per capita within orthogonal linear regression curve (red line). As can be seen, there existed a positive relationship between our series in both level and logarithm amounts, but this finding may be spurious considering the probability of stochastic trends in these series.

To assess the possibility of a generic relationship between our series, unit root test and co-integration analysis are essential statistical considerations that should be tested in panel data analysis. Unit root test clarifies whether the panel series have a stationary or non-stationary process. The null hypothesis of unit root test is the existence of stationary process or unit root. Here, we used the most common panel stationarity tests including Levin, Lin & Chu t-stat [41], Im, Pesaran and Shin W-stat [42], ADF - Choi Z-stat [43] and PP - Choi Z-stat [44]. If the null hypothesis of unit root tests is rejected, then there is a non-stationary process in our series and co-integration analysis is the efficient way of concluding the existence of relationship between our variables in long-run.

Pedroni [45,46] proposed a panel version of Engle-Granger co-integration test and this test is widely used in panel co-integration analysis. The null hypothesis of the Pedroni test is that series are not co-integrated and if it is rejected statistically, then there exists a co-integration relationship between the variables utilized in the test. Panel co-integration test opens the way to a causality test, dynamic long-run and panel error correction analyses. As the aim of this study is to measure the effect of nursing staff on GDP growth instead of its adverse effect, it is important to find the causal direction of these series in long-run. To detect the causality, the Pairwise Granger causality test [47] and Pairwise Dumitrescu Hurlin panel causality test [48] are applied to investigate the causal directions of our panel series.

Following by co-integration and causality tests, dynamic long-run analysis stimulates the long-run coefficients of co-integrated variables. Several factors and criteria such as direction of causal

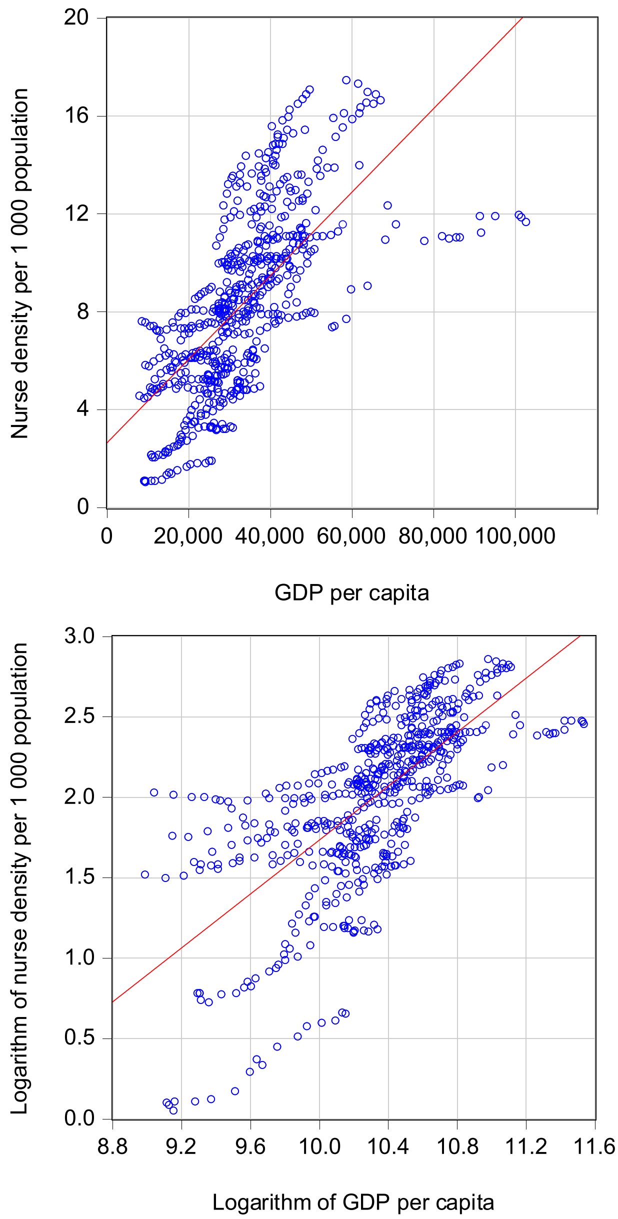

Fig. 3. Cross plot of level and logarithm of nursing staff together with GDP per capita in 35 OECD countries 2000–2016.

relationship between variables, the optimum lag lengths of independent variables, meaningfulness of coefficients of exogenous variables, R-squared, Durbin-Watson statistics and degree of freedom of the model would effect on the type of autoregressive models and control variables. In general, different types of the dynamic long-run model should be tested to calculate the long-run elasticities between the variables of interest in both panel series and cross unit estimations [49]. Finally, we are able to analyze the sensitivity of the co-integrated variables to an external shock in the panel error correction model using growth amounts of the main variables as well as the error terms of linear regression between panel series.

3. Empirical analysis and results

3.1. Unit root test

Results of different panel unit root tests are presented in Table 1 and argue that both series had a non-stationary process which

Table 1
Panel unit root test (35 OECD countries, 2000–2016).

Null hypothesis: Unit root	Level						1st Difference	
	Intercept		Intercept and trend		None		Intercept	
	Statistic	*P*	Statistic	*P*	Statistic	*P*	Statistic	*P*
LnNURSE								
Levin, Lin & Chu t-stat	−1.95	0.025	−2.40	0.008	10.80	1.000	−9.39	0.000
Im, Pesaran and Shin W-stat	1.97	0.975	0.66	0.747			−8.35	0.000
ADF - Choi Z-stat	72.66	0.390	65.98	0.614	18.51	1.000	195.59	0.000
PP - Choi Z-stat	144.96	0.000	84.02	0.121	15.40	1.000	203.84	0.000
LnGDPc								
Levin, Lin & Chu t-stat	−6.97	0.000	−1.20	0.115	24.57	1.000	−14.32	0.000
Im, Pesaran and Shin W-stat	0.87	0.808	2.67	0.996			−10.49	0.000
ADF - Choi Z-stat	58.11	0.843	39.55	0.998	0.75	1.000	230.21	0.000
PP - Choi Z-stat	124.88	0.000	34.47	0.999	0.28	1.000	240.61	0.000

Notes: The optimum lag lengths were determined based on Schwarz Information Criteria (SIC) from 0 to 3. Spectral estimations were based on automatic Newey-West for bandwidth selection and Bartlett for kernel. Levin et al. test assumed common *AR*(1) coefficient and trend, while other tests calculated based on country specific *AR*(1) coefficients and trend presentations.

Table 2
Pedroni co-integration residual test (35 OECD countries, 2000–2016).

Method	Individual intercept				Individual intercept and trend			
	Non-weighted		Weighted		Non-weighted		Weighted	
	Statistic	*P*	Statistic	*P*	Statistic	*P*	Statistic	*P*
Panel v-Statistic	4.20	0.000	3.77	0.000	4.95	0.000	3.65	0.000
Panel rho-Statistic	−0.83	0.201	−1.40	0.079	0.85	0.803	0.93	0.824
Panel PP-Statistic	−0.89	0.184	−1.97	0.024	−1.70	0.044	−2.63	0.004
Panel ADF-Statistic	−1.79	0.036	−3.08	0.001	−4.53	0.000	−5.61	0.000
Group rho-Statistic	1.47	0.929			3.10	0.999		
Group PP-Statistic	−0.30	0.381			−1.58	0.056		
Group ADF-Statistic	−2.88	0.002			−5.69	0.000		

Notes: Group-statistics were investigated by common *AR(1)* coefficients in within-dimension, and country specific *AR(1)* coefficients in between-dimension. The optimum lag lengths were determined based on SIC from 0 to 2. Spectral estimations were based on automatic Newey-West for bandwidth selection and Bartlett for kernel.

means that the stationarity of *lnNURSE* and *lnGDPc* were sensitive to trend presentation. Thus, results of common regression analyses may be biased and co-integration analysis is the efficient approach to explore the dependency of GDP growth to nursing staff in long-run.

3.2. Panel co-integration test

The aim of the co-integration test is to find whether *lnNURSE* and *lnGDPc* were co-integrated i.e. if there was a meaningful relationship between these series in long-run or not. The results of the Pedroni co-integration test are provided in Table 2 and significantly establish that our variables were co-integrated in long-run. This finding of co-integration analysis opens the way to Granger causality test, dynamic long-run analysis and error correction models.

3.3. Granger causality test

As the aim of this study is to scrutinize the plausible effect of nursing characteristics on GDP growth, we test the direction of the relationship between *lnNURSE* and *lnGDPc*. Results of the Pairwise Granger causality test and Pairwise Dumitrescu Hurlin panel causality test are reported in Table 3 and conclude that there was a bi-directional relationship between our series in long-run (*lnGDPc* ↔ *lnNURSE*). In another word, GDP per capita and nursing staff variables have a bilateral effect on each other and this finding argues that there is a significant relationship from the level of nursing staff

Table 3
Granger causality test between GDP per capita and nurse staffs (35 OECD countries, 2000–2016).

Pairwise Granger causality test					
	Null Hypothesis:	Obs.	*F*	*P*	Conclusion
With 2 lags	*lnGDPc* does not Granger cause *lnNURSE*	525	3.48	0.031	*lnGDPc*↔*lnNURSE*
	lnNURSE does not Granger cause *lnGDPc*		4.74	0.009	
With 3 lags	*lnGDPc* does not Granger cause *lnNURSE*	490	2.31	0.074	*lnGDPc*↔*lnNURSE*
	lnNURSE does not Granger cause *lnGDPc*		3.37	0.018	
Pairwise Dumitrescu Hurlin panel causality test					
	Null Hypothesis:	W-Stat.	Zbar-Stat.	*P*	Conclusion
With 2 lags	*lnGDPc* does not homogeneously cause *lnNURSE*	5.43	5.37	0.000	*lnGDPc*↔*lnNURSE*
	lnNURSE does not homogeneously cause *lnGDPc*	4.66	3.96	0.000	
With 3 lags	*lnGDPc* does not homogeneously cause *lnNURSE*	8.89	4.96	0.000	*lnGDPc*↔*lnNURSE*
	lnNURSE does not homogeneously cause *lnGDPc*	7.06	3.02	0.002	

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Table 4
Dynamic long-run model (35 OECD countries, 2000–2016).

Dependent variable	Variable	Coefficient	Std. Error	*t*	*P*	r^2	Durbin-Watson
lnNURSE	Constant	−0.2228	0.03	−5.71	0.000	0.99	1.39
	Trend	−0.0013	0.00	−4.67	0.000		
	lnNURSE(-1)	0.9799	0.00	313.17	0.000		
	lnGDPc	0.0927	0.02	3.10	0.002		
	lnGDPc(-1)	−0.0649	0.02	−2.25	0.024		
Long-run elasticity: (0.0927−0.0649)/(1−0.9799) = **1.3870**							
lnGDPc	Constant	0.4879	0.05	9.27	0.000	0.99	1.58
	Trend	−9.5E-05	0.00	−0.23	0.812		
	lnGDPc(-1)	0.9525	0.00	161.18	0.000		
	lnNURSE	0.1843	0.05	3.10	0.002		
	lnNURSE(-1)	−0.1647	0.05	−2.82	0.004		
Long-run elasticity: (0.1843−0.1647)/(1−0.9525) = **0.4113**							

Notes: The optimum lag lengths were estimated using SIC from 0 to 2.

to GDP per capita in OECD countries.

3.4. Dynamic long-run model

As *lnNURSE* and *lnGDPc* were bilaterally co-integrated, long-run magnitudes of this relationship can be measured in both directions using dynamic long-run analysis. Results of dynamic long-run panel models are available in Table 4 and confirm that long-run elasticity of GDP-lead-nurse relationship was 1.39, whereas long-run elasticity of adverse relationship (*lnNURSE*→*lnGDPc*) was 0.41 in OECD countries. In other words, 1% increase in GDP per capita would prepare the financial resource of employing 1.4% more nurse staffs' density per 1000 population and similarly, 1% increase in the number of practicing nurses per 1000 inhabitant would rise GDP per capita by 0.4% in OECD countries in long-run. These findings confirm that investing in nursing care is economically feasible in OECD countries as well as the dependency of nursing characteristics to GDP per capita is higher than the reliance of GDP to nursing staff which is logic with considering the impacts of other macroeconomic factors on economic growth.

To have a more precise conclusion about the effect of nursing characteristics on GDP growth in OECD countries, dynamic long-

Table 5
Dynamic long-run model in cross-sectional units using fixed effect method in nurse-lead-GDP direction (35 OECD countries, 2000–2016).

		Coefficient		Long-run elasticity of nurse-led-GDP relationship
Country	Constant	Trend	*lnNURSE* (-1)	1% increase in nursing staff may rise GDP per capita by
Australia	1.8082	0.0398	No meaningful	0.0%
Austria	2.3923	0.0467	No meaningful	0.0%
Belgium	0.1767	0.0320	0.0135	0.0%
Canada	−2.2739	0.0098	1.2386	1.2%
Czech Republic	−3.3568	0.0425	1.4809	1.5%
Denmark	−0.5892	0.0303	0.3186	0.3%
Estonia	−3.8292	0.0708	1.6810	1.7%
Finland	−4.7011	−0.0133	2.0665	2.1%
France	1.2548	0.0447	No meaningful	0.0%
Germany	1.6947	0.0488	No meaningful	0.0%
Greece	−0.8417	0.0053	0.8018	0.8%
Hungary	−2.3006	0.0334	1.0334	1.0%
Iceland	2.2228	0.0369	No meaningful	0.0%
Ireland	3.8787	0.0448	No meaningful	0.0%
Israel	−1.4029	0.0377	0.7926	0.8%
Italy	−0.7194	0.0149	0.5391	0.5%
Japan	7.7985	0.1097	No meaningful	0.0%
Korea	−0.4875	0.0293	0.2864	0.3%
Latvia	−2.5149	0.0635	1.0115	1.0%
Lithuania	4.8247	0.0797	No meaningful	0.0%
Luxembourg	−0.3700	0.0217	0.6147	0.6%
Mexico	−0.6040	0.0448	No meaningful	0.0%
Netherlands	3.3551	0.0642	No meaningful	0.0%
New Zealand	0.9311	0.0441	No meaningful	0.0%
Norway	−2.9861	−0.0063	1.4664	1.5%
Poland	−3.2267	0.0546	1.5235	1.5%
Portugal	−0.8106	0.0047	0.5500	0.6%
Slovak Republic	1.0155	0.0496	No meaningful	0.0%
Slovenia	−1.4144	0.0229	0.6587	0.7%
Spain	−0.6162	0.0138	0.5079	0.5%
Sweden	−4.2015	0.0194	1.9231	1.9%
Switzerland	3.4288	0.0719	No meaningful	0.0%
Turkey	−1.1155	0.0849	No meaningful	0.0%
United Kingdom	−0.9060	0.0297	0.4995	0.5%
United States	4.4866	0.0423	No meaningful	0.0%

Notes: Dynamic long-run model used to estimate long-run elasticities of nurse-lead-GDP was $lnGDPc = Constant + Trend + lnNURSE(-1)$. R-squared was 0.99 and Durbin-Watson statistics was 0.96.

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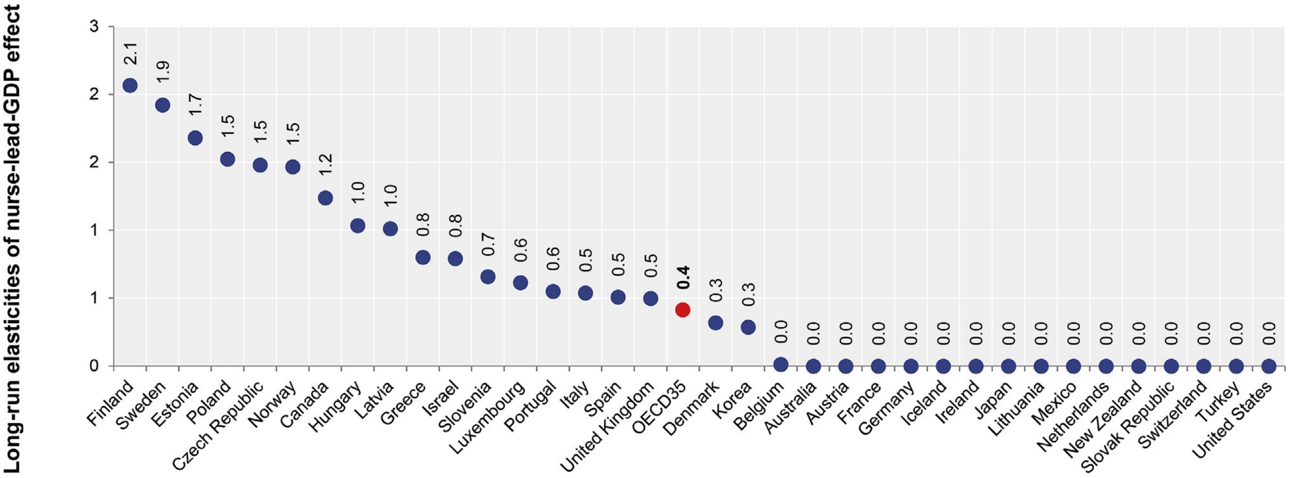

Fig. 4. Long-run elasticities of the effect nursing staff had on GDP per capita (2000–2016) based on the results of dynamic long-run model.

run model analysis in cross-sectional units is used here to investigate the coefficients of this relationship in individual countries. Results of dynamic long-run model using fixed effect method in nurse-lead-GDP direction are available in Table 5 and Fig. 4.

As can be seen, the highest magnitude of the effect nursing staff has on increasing GDP per capita in long-run was calculated in Finland with 2.07, followed by Sweden with 1.92, Estonia with 1.68, Poland with 1.52, Czech Republic with 1.48, Norway with 1.47 and Canada with 1.24. At the other end of the spectrum, there was no evidence for the existence of nursing staff→GDP relationship in Australia, Austria, France, Germany, Iceland, Ireland, Japan, Lithuania, Mexico, Netherlands, New Zealand, Slovak Republic, Switzerland, Turkey and United States. For the rest of OECD countries, the range of *lnNURSE*→*lnGDPc* coefficients was between 1.03 in Hungary and 0.01 in Belgium.

3.5. Panel error correction model

Lastly, results of panel error correction model between *lnNURSE* and *lnGDPc* are provided in Table 6 and prove that if the long-run relationship between *lnNURSE* and *lnGDPc* is disturbed, then it takes at least 31 years to restore it back for *lnNURSE*, and for *lnGDPc* the time span is about 12 years. Hence, if the long-run relationships between the level of nursing staff and GDP per capita are in disequilibrium because of some external factors, e.g. nursing shortage and health and/or fiscal policy shocks, the speed of correcting back to long-run steady state for GDP per capita is less prolonged compared to the number of nurses' density per 1000 population.

4. Discussion

There has been much interest in analyzing economic feasibility for investing in nursing care at a cross-national level. According to the lack of empirical research to measure economic impact of nursing-related services on health care and economic systems of OECD countries, the economic values of nurses and nursing care have been underestimated by health policy makers i.e. nursing staff are often the target for cost cutting policies regarding staffing decisions in hospitals. This study undertakes a new attempt to investigate the economic contribution of nursing and nursing services using a wide range of cross-national observations. The statistical technique of panel data analysis is used to measure long-run effect of the number of practicing nurses' density per 1000 population on increasing GDP per capita in 35 OECD countries during 2000–2016 period.

According to the result of unit root test, both series were nonstationary and this opened the way to co-integration and panel dynamic long-run analyses. Results of the Pedroni co-integration test and panel Granger test confirmed that there existed a significant bi-directional relationship between the level of nursing staff and GDP per capita in long-run. Results of the dynamic long-run model proved that the elasticities of GDP-lead-nurse and nurse-lead-GDP effects were 1.39 and 0.41 in OECD countries, respectively. As this study aimed to highlight nurse-lead-GDP effect, the coefficients of nursing staff→GDP direction were simulated in individual countries using dynamic long-run model with pooled data estimation. Results showed that the magnitudes of the effect of nursing staff has on increasing GDP per capita were estimated at

Table 6
Panel error correction model: fixed effects method (35 OECD countries, 2000–2016).

Dependent variable	Variable	Coefficient	Std. Error	*t*	*P*	Conclusion
dlnNURSE	Constant	0.0074	0.00	4.02	0.000	Length of restoring back to equilibrium: 31 years (1/0.0322) for *lnNURESE*
	dlnNURSE(-1)	0.1046	0.04	2.25	0.024	
	dlnGDPc	0.1114	0.02	3.81	0.000	
	dlnGDPc(-1)	0.0152	0.02	0.52	0.600	
	EC(-1)	−0.0322	0.01	−3.03	0.002	
dlnGDPc	Constant	0.0273	0.00	10.56	0.000	Length of restoring back to equilibrium: 12 years (1/0.0854) for *lnGDPc*
	dlnGDPc(-1)	0.2107	0.04	4.85	0.000	
	dlnNURSE	0.2605	0.06	3.81	0.000	
	dlnNURSE(-1)	−0.0032	0.07	−0.04	0.963	
	EC(-1)	0.0854	0.01	5.36	0.000	

Notes: The optimum lag lengths were estimated using SIC from 0 to 2.

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the highest level in Finland (2.07), Sweden (1.92), Estonia (1.68), Poland (1.52), Czech Republic (1.48), Norway (1.47) and Canada (1.24). By contrast, there was no evidence for such a relationship in Australia, Austria, France, Germany, Iceland, Ireland, Japan, Lithuania, Mexico, Netherlands, New Zealand, Slovak Republic, Switzerland, Turkey and United States and for the rest of OECD countries, the range of nurse-lead-GDP coefficients was between 1.03 in Hungary and 0.01 in Belgium. Interestingly, according to the results of panel error correction model, if the long-run equilibrium between nursing staff and GDP per capita is disturbed by external factors such as nursing shortage and health and/or fiscal policy shocks, the speed of correcting back to long-run steady state is at least 31 years.

Overall, our findings concluded that although the dependency of nursing characteristics to GDP per capita is higher than the reliance of GDP to the level of nursing staff, investing in nursing care is economically feasible in OECD countries. Thus, employing more nurses is not only a burden, but also an economic stimulus in OECD countries and would be a good policy for reducing the effects of financial crisis in OECD countries especially in Finland, Sweden, Estonia, Poland, Czech Republic, Norway and Canada. Indeed, we alert policy makers and governments about the risk of underestimating the economic impacts of nurses on economic systems of OECD countries.

Moreover, the limitation of this study was the small number of available observations during the time which was an obstacle for adding other control factors like education, the level of health care technology etc. in our analysis. Hence, adding other meaningful variables in the same kind of economic impact study would be our recommendation for future research.

5. Conclusion

Investing in nursing-related services by increasing the level of nursing staff is economically feasible i.e. the economic value of nurses is significantly positive in developed countries.

Conflicts of interest

The authors have declared that no conflicts of interest exist.

Authors' contributions

Both authors contributed to the study design and drafting of the paper. Amiri has done data analysis and both authors approved the final version of article.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijnss.2019.06.009.

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