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Forecasting Interest in Health Professions Education Based on Relative Search Volume Trends From the Philippines

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Abstract

Purpose: Health professions education (HPE), particularly dental education, nursing education, and medical education, had been standardized in the Philippines and the rest of the Southeast Asian nations. This study evaluated the interests of Filipinos in HPE through relative search volume (RSV) trends of search terms including dental degree (DMD), bachelor of science in nursing (BSN), and medical degree (MD).

Methods: A search query was done on Google Trends using the search terms DMD, BSN, and MD under the degree category. Restriction of data originating from the Philippines, from December 2009 to December 2019, under the health category, and the web search database were ensured to these parameters.

Results: ANOVA with post hoc Tukey's multiple comparison test further revealed significant differences $F(2, 30) = 59.12$ between DMD and MD ($p < 0.0001$), and BSN and MD ($p < 0.0001$), but not in DMD and BSN ($p = 0.481$) within the framework of Filipino search trends. Simple Seasonal Model for DMD, and the Winters' Multiplicative for BSN and MD were found to fit their individual trends. The series chart showed a slight increase for the DMD, a decline for the BSN, and a steady progression for the MD.

Conclusion: The interests of HPE in the Philippines will continue. Interests in MD showed the highest, while lower but comparable peak popularity in DMD and RN is reemerging.

Keywords: Forecasting; Health professions education; Data mining; Philippines

1. Introduction

In the Association of Southeast Asian Nations (ASEAN), general country-specific quality frameworks (QF) were fitted to the ASEAN QF (AQF) and used to develop mutual recognition agreements (MRA) per profession.[1–4] The ASEAN MRA for Healthcare Services comprises of the ASEAN MRA on Medical Practitioners, the ASEAN MRA on Dental Practitioners, and the ASEAN MRA on Nursing Services.[5]

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The world is growing and aging, and the Philippines is no exception. With a 103.5 million growth in population and an observed life expectancy, the nation needs more health professionals. Comparing the average rate of change in the Healthcare Access and Quality (HAQ) index will show modest growth of 0.9% from 1990 to 2000 and 1.1% from 200 to 2016. With a combined amount of USD 337 per person, the amount spent in health through prepaid private spending (USD 47), out-of-pocket spending (USD 173), government health spending (USD 117), and development assistance for health (USD 4) is projected to improve in 2050.[6]

The promotion of well-being across all ages and ensuring healthy lives are emphasized in the third sustainable development goal (SDG) under the 2030 Agenda for Sustainable Development.[12] Under the universal health care (UHC) provisions of most countries, the third SDG is a vital component.[13] In the attainment of UHC, ensuring that a considerable number of individuals undergo health professions education (HPE) efficiently is important. Interests in HPE can be promoted or maintained by systematically subsidizing the education of health care workers (HCW) and standardizing HCW jobs. According to the Global Burden of Disease Study, from 1990 until 2013, the years lived with disability (YLD) increased in 139 out of 188 countries.[14] Simple conditions are easily treated and controlled at the community level, but multimorbid conditions can confound the healthcare system. The phenomenon of multimorbidity can be described as diseases from multiple conditions suffered by increasing numbers of people. The treatment options for these conditions are expensive and require specialists with higher skill-sets. This adds to an already existing problem of HCW scarcity, for which a 27% shortage of primary care physicians is expected in the United States of America by 2025.[15] Australia, Brazil, China, New Zealand, Russia, and South Africa will be facing the same problem.[16,17] Despite having majority of governments all around the world acknowledging the health inequalities and health access discrepancies in

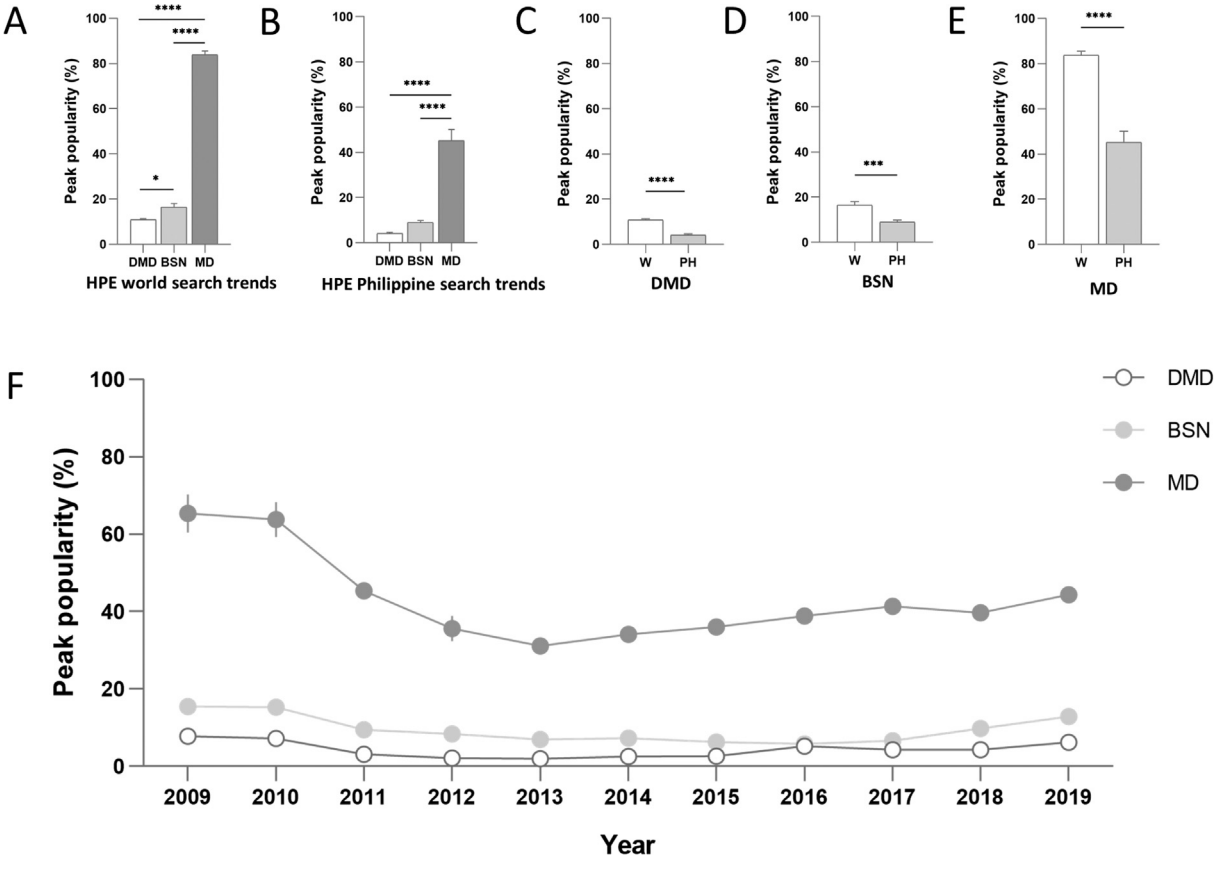

Fig. 1. Peak popularity percentage of HPE world search trends (A), Phillipine search trend (B), DMD (C), BSN (D), MD (E), and a 10-year trend line from 2009-2019 (F). HPE=health professions Education, DMD=dental degree, BSN=bachelor of science in nursing, MD=medical degree.

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both developed and developing countries, projected shortage of HCW is still foreseen to occur.[18] Countries with the lowest relative health care need have the most number of HCW, while those with the greatest burden of disease have the least. About 36 of 46 countries in Africa and 6 of 11 countries in Asia are having critical shortages in doctors, nurses, and midwives. While only 5 of 35 countries in the Americas, 0 of 52 countries in Europe, and 7 of 21 countries in the Eastern Mediterranean are suffering from the same deficiency.[19,20] The uneven distribution could be attributed to the typical allocation of only 42% of the total health expenditure for HCW salaries. Other reasons could be due to lack of HCW willing to serve in the rural and remote areas[21,22], oversaturation of specialists in developed countries, cultural reasons[23,24], job satisfaction[25], or unsatisfactory working conditions.[26] Nowadays the Google search engine has been widely used for searches concerning personal interests. These resulting aggregates of data are saved in a database where they provide insights and forecasting purposes that could be vital to determine the trends in the complex decisions people make pertaining to health professions education (HPE). These search pattern statistics can be analyzed by Google Trends (GT), a product of the American multinational technology company, Google LLC. The features that make this online portal useful include free, easy-to-use, able to segregate data per nation or region and at different time points.[27–32] Health-seeking behavior information from the internet has been previously reported and implicated to aid in actual healthcare treatments. To the knowledge of the researchers, there has been no year-long forecasting study done with the use of a 10-year data to gauge the interests of Filipinos in HPE. This information will be valuable in enlightening and describing the HPE preference or behavior of the Filipinos based on internet search trends. The current study aimed to evaluate the difference in the Filipinos' interests for HPE in the Philippines. Specifically, the objectives were to (1) assess the differences in the world's interest between Doctor of Medicine (MD), Doctor of Dental Medicine (DMD) and Bachelor of Science in Nursing (BSN) degrees; (2) know the differences in the Filipinos' interests for HPE programs; (3) compare the HPE interests between the world and the Philippines; (4) associate the temporal changes of the HPE interests in the Philippines; and (5) predict the interests of HPE interests for 2020 in the Philippines.

2. Methods

2.1. Source of data

The search terms dental degree (DMD), bachelor of science in nursing (BSN), and medical degree (MD) under the degree category were chosen to be included in the search query. A 10-year search parameter from December 2009 to December 2019, using the Philippines as the location, under all categories, and

Table 1
Comparison of relative search volume per search term across the years in the Philippines.

	Mean difference	95.00% CI of difference	p-value	
DMD				
2009 vs. 2010	0.6	−1.301 to 2.467	0.909	ns
2009 vs. 2011	4.7	1.404 to 7.929	0.005	**
2009 vs. 2012	5.7	2.931 to 8.402	0.000	***
2009 vs. 2013	5.8	2.349 to 9.318	0.002	**
2009 vs. 2014	5.3	2.219 to 8.281	0.001	**
2009 vs. 2015	5.2	1.844 to 8.489	0.003	**
2009 vs. 2016	2.6	−1.499 to 6.666	0.318	ns
2009 vs. 2017	3.5	−0.08908 to 7.089	0.057	ns
2009 vs. 2018	3.5	0.4853 to 6.515	0.021	*
2009 vs. 2019	1.6	−1.584 to 4.750	0.549	ns
BSN				
2009 vs. 2010	0.2	−0.3716 to 0.7050	0.909	ns
2009 vs. 2011	6.0	−0.4840 to 12.48	0.074	ns
2009 vs. 2012	7.1	1.772 to 12.39	0.009	**
2009 vs. 2013	8.5	2.718 to 14.28	0.004	**
2009 vs. 2014	8.2	1.721 to 14.61	0.012	*
2009 vs. 2015	9.2	3.061 to 15.27	0.004	**
2009 vs. 2016	9.7	3.203 to 16.13	0.004	**
2009 vs. 2017	8.8	2.413 to 15.25	0.007	**
2009 vs. 2018	5.7	−0.1537 to 11.49	0.058	ns
2009 vs. 2019	2.6	−3.399 to 8.566	0.689	ns
MD				
2009 vs. 2010	1.6	−3.531 to 6.697	0.909	ns
2009 vs. 2011	20.0	3.426 to 36.57	0.017	*
2009 vs. 2012	29.8	13.71 to 45.79	0.001	***
2009 vs. 2013	34.3	18.47 to 50.03	0.000	***
2009 vs. 2014	31.3	14.84 to 47.66	0.001	***
2009 vs. 2015	29.3	13.25 to 45.42	0.001	***
2009 vs. 2016	26.5	9.343 to 43.66	0.003	**
2009 vs. 2017	24.0	7.574 to 40.43	0.005	**
2009 vs. 2018	25.7	9.718 to 41.62	0.002	**
2009 vs. 2019	21.0	5.262 to 36.74	0.009	**

Two-way Repeated Measures ANOVA with post hoc Dunnett's multiple comparisons test at $p < 0.05$*, $p < 0.01$**, $p < 0.001$*** level of significance.
CI = confidence interval, DMD = dental degree, BSN = bachelor of science in nursing, MD = doctor of medicine

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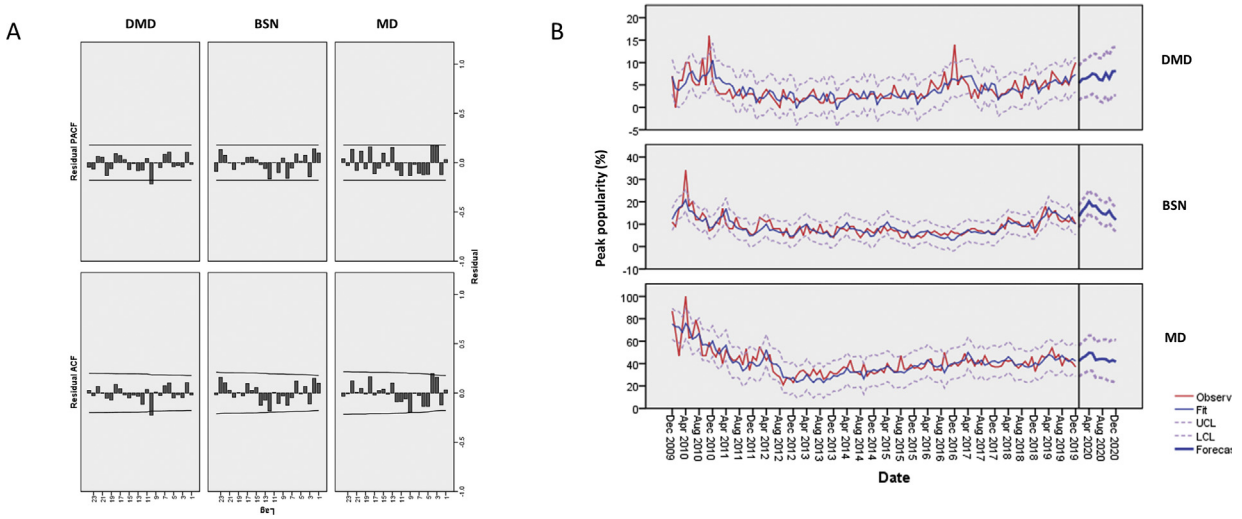

Fig. 2. Forecasting result showing the residual autocorrelation factor (ACF) and partial autocorrelation factor (PACF) used to fit the models (A) to provide a on-year forecast from December 2009−December 2019 (B). DMD=dental degree. BSN=bachelor of science in nursing, MD=medical degree.

web search as the database was done. Another search query was performed with the same parameters except for location, which was changed to worldwide. The graphic user interface of GT produced several charts and projected data. Although charts such as the interest over time chart, subregion comparison breakdown chart, interest by subregion per search term, and related queries per search term were readily available, data were re-analyzed from the raw figures. The comparison of total averages of the search terms in the specified search constraints was shown in the bar graph of the interest over time chart. The frequency and amplitude of bulk searches expressed in relative search volume (RSV) were conveyed by a line chart at the right side of the panel. The search interest in relation to the highest peak for the reference place and time were represented by the RSV expressed in units called peak popularity. The peak popularity ranges from 0 to 100 where 100 is the maximum percentage and 0 is the minimum. If data is absent or the data is inadequate to be plotted, a minimum entry is plotted. The data were downloaded in Comma Separated Values file (CSV). Considering the bilingual, or multilingual nature of the Philippines, related queries were checked for consistency.

2.2. Statistical analyses

Ordinary one-way ANOVA with post hoc Tukey's multiple comparison test was used to test the means of RSV of DMD, BSN, and MD separately within the cohorts of world searches and Philippine searches. Comparisons were also drawn between each search terms between world searches and Philippine searches through an unpaired t-test. Finally, a repeated measure two-way ANOVA with Geisser-Greenhouse correction, matched values stacked into a sub-column, Dunnett's multiple comparison test, and individual variances computed for each comparison was done. The reference point or year used was 2009. The time series module is the forecasting component of the IBM SPSS. By measuring a single variable regularly over time, a set of observations are obtained. This is the time series data which can be used to predict future events based on identified previous occurrences. In contrast with regression techniques, each of the cases are related to each other and the past data offers a model for the forthcoming events. In this study, a feature of the IBM SPSS called the Expert Modeler was used. This component allows the automatic identification and estimation of the best-fitting model for the variable series, but it is also capable of specifying custom models manually. The time series model identified may then be applied to the active dataset. The forecasts are then obtained.[33,34] The models or forecasting method may include exponential smoothing or univariate Autoregressive Integrated Moving Average (ARIMA). The ARIMA models provide added advantage of including predictor variables in the model and allow more complex methods for trend and seasonality modeling. Exponential smoothing predicts future values by using weighted values of previous series.

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When the series data exhibits trend, seasonality, or both, this technique becomes useful. As it adjusts its forecasts as new data are added and forecasts are done one point at a time. The models used in this study were of the exponential smoothing variety, particularly Simple seasonal and Winters' multiplicative. Simple seasonal model is applied to a dataset where there is no seasonal effect and trend that is continuous over time. Level and seasons are its relevant smoothing parameters. In contrast, the Winters' multiplicative model is used in a series where there is a seasonal effect and a linear trend. Level, trend, and season are its relevant smoothing parameters. The other possible models that can be used, but not in this study, are simple, Holt's linear trend, Brown's linear trend, Damped trend, and Winters' additive model.[34–38]

All statistical tests were done on GraphPad Prism 8 and IBM SPSS 21, where a p-value of less than 0.05 was considered significant.

3. Results

An analysis of variance (ANOVA) with post hoc Tukey's multiple comparison test showed that the world trend difference between DMD and BSN ($p = 0.020$), DMD and MD ($p < 0.0001$), and BSN and MD ($p < 0.0001$) search terms were significant, $F(2, 30) = 884.0$ (Fig. 1A).

ANOVA with post hoc Tukey's multiple comparison test further revealed significant differences $F(2, 30) = 59.12$ between DMD and MD ($p < 0.0001$), and BSN and MD ($p < 0.0001$), but not in DMD and BSN ($p = 0.481$) in the perspective of Filipino search trends (Fig. 1B).

Unpaired t-test found a significantly higher peak popularity percentage of the world ($M = 10.91$, $SD = 1.5$) in terms of the search term DMD compared to the Philippines ($M = 4.18$, $SD = 1.8$), $t(20) = 9.6$, $p < 0.0001$ (Fig. 1C). A higher trend was also seen in the world ($M = 16.45$, $SD = 5.4$) searches of BSN ($M = 9$, $SD = 2.97$) in contrast with the Philippines, $t(20) = 4.02$, $p < 0.001$ (Fig. 1D). The results for MD was comparable, as the search trend was higher for the world ($M = 83.91$, $SD = 5.52$) than the Philippines ($M = 45.18$, $SD = 16.38$), $t(20) = 7.43$, $p < 0.0001$ (Fig. 1E). The yearly search trends from 2009 to 2019 show similar interests for DMD and BSN, while MD showed higher frequencies. Despite this, a sharp decline was shown from 2010 to 2013.

A two-way analysis of variance was conducted on the difference in search trends from 2009 to 2019. The variations between interaction ($p < 0.0001$), years compared to 2009 as baseline ($p < 0.0001$), health professions search terms ($p < 0.0001$), and subjects ($p < 0.0001$) were found to be significant, $F(10, 74.37) = 41.69$, $p < 0.0001$. The DMD search term yielded differences during the years 2011, 2012, 2013, 2014, 2015, and 2018 compared to 2009. The BSN search term showed significant differences during 2012, 2013, 2014, 2015, 2016, and 2017 compared to 2009. While the MD search term showed an elevated difference from 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, and 2019 (Table 1).

Through the residual autocorrelation function and the partial autocorrelation function, the Simple Seasonal Model for DMD, and the Winters' Multiplicative for BSN and MD were found to fit their individual trends (Fig. 2A). These models were used to forecast the search trends of Filipinos from January 2020 to December 2020. The series chart shows a slight increase for the DMD, a decline for the BSN, and a steady progression for the MD (Fig. 2B).

4. Discussion

The Philippines and the rest of the world are aging.[6] There are currently only 1, 286 vacant positions for dentists, 6, 901 for physicians, and 12, 159 for nurses in the Department of Health in the Philippines. The 2030 expected workforce will reach 12, 802 dentists, 47, 151 physicians, and 263, 244 nurses. The cost of training will be 765.61 billion pesos for physicians, 35.02 billion pesos for nurses, only 5.65 billion pesos for dentists.[7] The escalation of chronic illness cases and intensification of YLD have been thought to be brought about by aging and decreasing death rates.[14] This causes multimorbidity which confounds the treatment processes involved in the health care system. Multimorbid conditions increases the required number of specialists that require more advanced training or HPE of HCW. This causes an induced scarcity or imbalance of HCW in both high-income and low- to middle-income countries. This are projected to be evident in 2025 in countries like the United States of America[15], Australia, South Africa, China, India, Russia, and Brazil.[16,17]

The Filipino interests in HPE, conveyed by the RSV and expressed through the peak popularity, showed similar trends with the world search. Although there were significantly lower searches in the Philippines, and the even lesser difference was found in the search term BSN. This can be explained by the Philippines producing more nurses as expressed by many nursing professionals migrating and seeking employment

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abroad. The results of this study showed the inverse of the report from the University of California that showed a growing trend in DMD, BSN, and MD from 2007 to 2012. Moreover, the same study also showed that there are more students enrolling in nursing programs than dentistry or medicine.[8] The great recession from 2008 to 2012 created global effects that decreased the supply and increased the demand for HCW. Despite this fact and varying number of health professionals, there are more nurses than physicians or dentists. For instance, the ratio of nurses to physician in Canada and the USA is 4:1, about 1.5:1 in the Western Pacific Region, and 8:1 in the African Region.[39]

The forecasting models show a slight increase for the DMD, a decline for the BSN, and a steady progression for the MD. Specifically, all three HPE program interests will rise during the first quarter of 2020. In April of 2020, interests for both BSN and MD will decline up until the last month. In contrast, DMD will recover from August, will erratically progress, but will rise at the end of the year 2020. This corresponds to a study on the projection of oncologists, although it was first postulated that from 2005 to 2020 the demand for physicians will rise.[9] The dentists in Saudi Arabia also experience the same problems of shortage and unemployment.[10] The rural and remote areas of a country is where shortage of dentists can usually be observed. Majority of dental students and dentists usually opt to start a practice in the urban areas for the apparent distinction and return of investments. This generates a shortage of dentists who choose to practice in remote and rural places.[21,22] This trend can be seen in both developing and developed countries.[16]

Exhibiting interests to a specific HPE program or degree by searching for it on the internet could demonstrate self-motivation. The intrinsic motivation is a source of persistence in pursuing a program and how prospective students succeed in these programs.[11] There are obvious limitations to this study as mining of data can be done from other various database sources like Facebook[40], Twitter[41–43], and other social media sites. As there is inadequate data collated and provided by the DOH and the government of the Philippines, timeline trend data from GT gives a unique insight into the interests and demand for HPE in the country.

There is an absence of actual data from another database in this study. An association test between figures derived from GT and enrollment data at the school and national level can provide another perspective on this issue. Tangible determinants in choosing an HPE program, retention rates, and reports on promotions or graduations are also concrete sources of information that could support or alter the findings of this study. The government and educational institutions should exhaust all resources in developing and reinforcing HPE in the country. There will be a surge in the demand of health professionals in 2020 in the Philippines and an exponentially increase in 2030.

5. Conclusion

This study showed high interest for MD compared to DMD and BSN based on the RSV in GT. The search trends for DMD, BSN, and MD are lower in the Philippines compared to the world. The timeline analysis and forecasting showed a growing interest for DMD but MD and BSN may decline after the first quarter of 2020.

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Other disclosure

None.

Declaration of competing interest

Ethical approval was sought from Southwestern University PHINMA but the study was found exempt as it did not involve human or animal subjects.

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