**Measuring inequalities in the distribution of health workers by bi-plot approach:
The case of Turkey**

*B. Baris Alkan[1], Cemal Atakan[2], Afsin Sahin[3]
[1]Sinop University, Turkey
[2]Ankara University, Ankara, Turkey
[3]Gazi University, Ankara, Turkey
*bbalkan@gmail.com

Abstract: Optimal planning of the health workers is of vital importance for a country. Distribution of health workers among provinces in emerging markets is an important development criterion. In this study, biplot graphical approach is used to determine the distribution of health workers. The results of biplot analysis point out that the distribution of the healthcare staff in Turkey is unbalanced. The number of health workers should be planned and considered according to the desire, need, population, target and workload criteria. The new employment opportunities should be created and the workers should be encouraged to serve in low income regions by providing better conditions.

Key Words: *Health care sector; health workers; income; biplot method.*

1. Introduction

The inequality between the regional differences among the residential suitable premises of any country is one of the frequent main stream subjects of the macroeconomics. There is plentiful empirical work on Turkey, analyzing this economic inequality in different perspectives. For instance, Turkkan and Aytekin (2009) on health inequality, Tomul (2009) on education inequality, and Gezici (2007), Tosun et al. (2006), Dayioglu and Baslevent (2006) for regional inequality. Kara (2006) analyzes the widespread wage inequality and sees Belek and Hamzaoglu (2002) for the gross inequality in health services. Anand (2010) claims that the overall inequality in the health-worker distributions is significantly higher in India than in China. In both countries the nurses are more unequally distributed than the other health worker categories. Wharrad and Robinson (1999) compare the international distribution of physicians and nurses by country and analyses the effects of national income on the distribution. They find that the Gross Domestic Product (GDP) per capita is an important variable in the distribution of physicians and nurses. As a macroeconomic variable inheriting aggregate information about the overall economy, we consider the GDP per person and investigate the relation with the number of nurses and physicians per population.

We prefer to analyze the Turkish data because it has a small-open economy and is a conspicuous candidate country for the European Union (EU) membership. It develops its health service sector besides, tries to reach to the main development goals of the World Bank. The tremendous diversity among the provinces in Turkey concerning the development indicators also creates an excellent laboratory for a distribution research.

The second part of the paper provides information about the health care personnel in Turkey. The third section introduces the data and the research methods. The fourth section presents the results. The fifth section discusses the findings of the paper. Concluding remarks appear in the last section.

2. An Overview on the Health Care Sector Personnel in Turkey

Team is a working group consisting of the people with the identical or the differentiated occupations. Also considering this, health economics deals with the distribution of the physical and human resources. These resources should be developed, provided, and activated by the individuals in the health care activities.

An overview of health spending is crucial for evaluating the health care personnel. Turkey is the 29th among OECD countries with 150 dollars concerning the health expenditure per person. On the other hand, we observe that the OECD countries allocate 55% of their GDP to the total health care spending and

Turkey has a rank of 32 (TUSIAD, 2004). In Turkey, nearly 78% of the Ministry of Health expenditures are allocated to the wage spending. This requires an optimum allocation necessity in the sector. As of 2009, June nearly 5% of the tax revenues is spent to the health sector in Turkey. Although 4% of the general budget is spent to the health sector in Turkey, this number increased to 5%. Nearly 22% of the tax revenues are spent to the interest payments. Comparing these two last ratios signals us an anomaly of an inefficient allocation of resources which disturbs the economic and social development. According to TEPAV (2008), during the years from 1999 to 2008, health spending increased by 50%, but education spending decreased from 30% to 22%. TEPAV (2009) also stress on the issue that the ratio of conservator and community health spending in the overall budget is not high as the medical health service spending. As of 2009 June, the ratio of medicine, conservator and community health and social health spending (green card) to the total health spending is 13%, 22% and 65% respectively. During the same period, the ratio of health spending to the total good and service spending and total central administration budget spending is 33% and 28% respectively. For the same period, ratio of personnel expenditures, good and service spending and capital expenditure to the total health services spending is 40%, 41%, and 12% respectively. Total health sector spending consists of 10% and 27% of the total personnel and good and service spending according to the database of Secretariat of Treasury of Turkey. During the last couple of decades, the health spending has increased, medical technology has been changed rapidly, and the population has got older than before. The discussion of the health care in Turkey should be focused on the distributional inequalities among the geographic areas concerning labor force.

In Turkey, there are four types of hospitals. These are government hospitals, military hospitals, private hospitals and university hospitals. 74% of the individuals benefit from the government hospitals. Others ratios are 11%, 4% and 4% for the private hospitals, private clinic and university hospitals according to Turk Stat. There is a serious competition among the government and private hospitals. The competition has been increased after subsidies given to the private hospitals and designing circulating capital legislations.

The wages and income generation process are not the same among regions. This fact promotes health care personnel to migrate to other cities. In private hospitals of the East of Turkey, the wages are higher than the West for the physicians. However for the nurses, the government hospitals pay higher than the private hospitals. In the countries where the unemployment level is above the expected, the demand for labor may exceed the wage level. This is consistent with the traditional adjustment model of labor market and wages.

According to the Turk Stat's Health Services Pleasure Research 2006 results, in Turkey nearly 66% of the population perceives nurses as responsible, 68% of them perceive them as responsible, 69% of them perceive them as experienced, 63% perceives them as cheery, and 65% of them perceive them as respectful. For physicians, these ratios are 66%, 69%, 71%, 65%, and 70% respectively. Concerning the other health personnel, these ratios are around 60%. Consequently, improving the education level increases the patient pleasure.

3. Data and Methodology

The data used in the study is gathered from the Turkish Statistical Institute (Turk Stat) Distribution of Health Personnel of Turkey by Provinces (for the year 2006), Healthcare Providers by years, (from 1951 to 2006), Healthcare Providers by establishment (for the year 2006, in Turkey's Statistical Yearbook), Gross Domestic Product (for the year 2001), and Population (for the year 2001).

In this study, we benefited from the correspondence analysis biplot and covariance biplot methods to investigate the relations from the data presented above. By the data, correspondence analysis biplot was used to analyze the relationship between health care labor in Turkey according to provinces, years and the establishment. Correspondence analysis is a method used for representing the similarities, differences, and relations among the variables in a single common graph by lower dimension. Especially, it is used for the categorical data in medicine, health sciences, economics, and social sciences.

By cross tables we analyze the departures from independence, that is to say, the deviation of observed frequency from the expected frequency is examined. While analyzing the cross tables, assumptions of the goodness of fit test violate, consequently the correspondence analysis is one of the methods used when the chi-square analysis is not feasible. One of the common methods used to evaluate the relation between

categorical variables is chi-square analysis. The deviation from the expected frequency contributes to the total chi-square value. Therefore we may see correspondence analysis as a tool for representing the deviations from expected frequency by a low-dimension graph. It is also possible to decompose the total chi-square by correspondence analysis (Clausen, 1998). Total variance in correspondence analysis is measured by the inertia, which is equal to usual Pearson chi-square statistic calculated on the cross tabulation, divided by the total sample size n (Greenacre, 2002). If the inertia value is not low, then the association between column and row is high. If it is near zero, there is no association between column and row. The cross tabulation (rxc) tables are analyzed with correspondence analysis and called simple correspondence analysis. Analyzing three or more dimensional (rxcxm…) contingency tables is called multiple correspondence analyses (Ozdamar, 2004). In this study, we use correspondence analysis biplot developed for two way cross tables.

The covariance biplot was employed to analyze the relationship between Gross Domestic Product (GDP) and nurses per population and physician per population for each province. Biplot is a technique showing the rows and columns of the data matrix on a single graph. The cosine of the angle between any two variable vectors approximates the correlation between those variables in the covariance biplot.

Full details about correspondence analysis biplot and covariance biplot may be found in Greenacre (1984), Gower and Hand (1996), Aitchison and Greenacre (2002), Park et al. (2008). For the graphics and analysis described in this study, we used SPSS and MATLAB.

4. Results

In this study, we used correspondence analysis biplot method for investigating the health care labor in Turkey according to provinces, years and the establishment. Besides, we benefited from the covariance biplot approach to analyze the relation between GDP and nurses per population and physician per population for each province.

Table 1: Results Of Correspondence Analysis For Distribution Data Of Health Personnel Of Turkey By Provinces

Dimension	Singular Value	Inertia	Proportion of Inertia	
			Accounted For	Cumulative
1	0.2419	0.0585	0.7070	0.7070
2	0.1073	0.0115	0.1390	0.8460
3	0.0775	0.0060	0.0724	0.9185
4	0.0566	0.0032	0.0390	0.9574
5	0.0480	0.0023	0.0275	0.9850
6	0.0346	0.0012	0.0150	1.0000
Total		0.0827	1.0000	

Correspondence analysis biplot result of contingency table obtained by crossing the health personnel working in each province is presented (Table 1). Whole total variance can be explained by six dimensions (Table 1). 70.7% of the total inertia (variance) is explained by the first dimension and the 13.9% of the total inertia is explained by the second dimension. 7.2% of the total inertia by the third dimension and the 3.9% of the total inertia is explained by the fourth dimension, 2.7% of the total inertia is explained by the fifth dimension, and 1.5% of the total inertia is explained by the sixth dimension. As a result, 84.6% of the total inertia is explained by the two dimensioned correspondence analysis biplot graph (Johnson and Wichern, 1998). The relation among the categories by correspondence analysis biplot is presented (Figure 1). The distribution of nurses is similar among Isparta, Duzce, Yalova, Tekirdag, Antalya, and Hatay. However, in Istanbul, Ankara, and Izmir provinces the distribution of pharmacists, dentists, practioners, and physician's exhibit more similar distribution compared with the nurses. The distribution of pharmacists, dentists, practioners, and physicians has a negative correlation with the distribution of midwife and sanitarians. Besides, the distribution of nurses is positively correlated with only the distribution of midwifes.

The results of correspondence analysis biplot for the distribution of health care personnel by years are presented (Table 2). The whole of the total variance can be explained by five dimensions. 55.98% of the total inertia (variance) is explained by the first dimension and the 24.12% of the total variance is

explained by the second dimension. 14.75% of the total variance by the third dimension and the 3.93% of the total variance is explained by the fourth dimension and the 1.22% of the total variance is explained by the fifth dimension. As a result, 80.1% of the total variance is explained by the two dimensioned biplot graph.
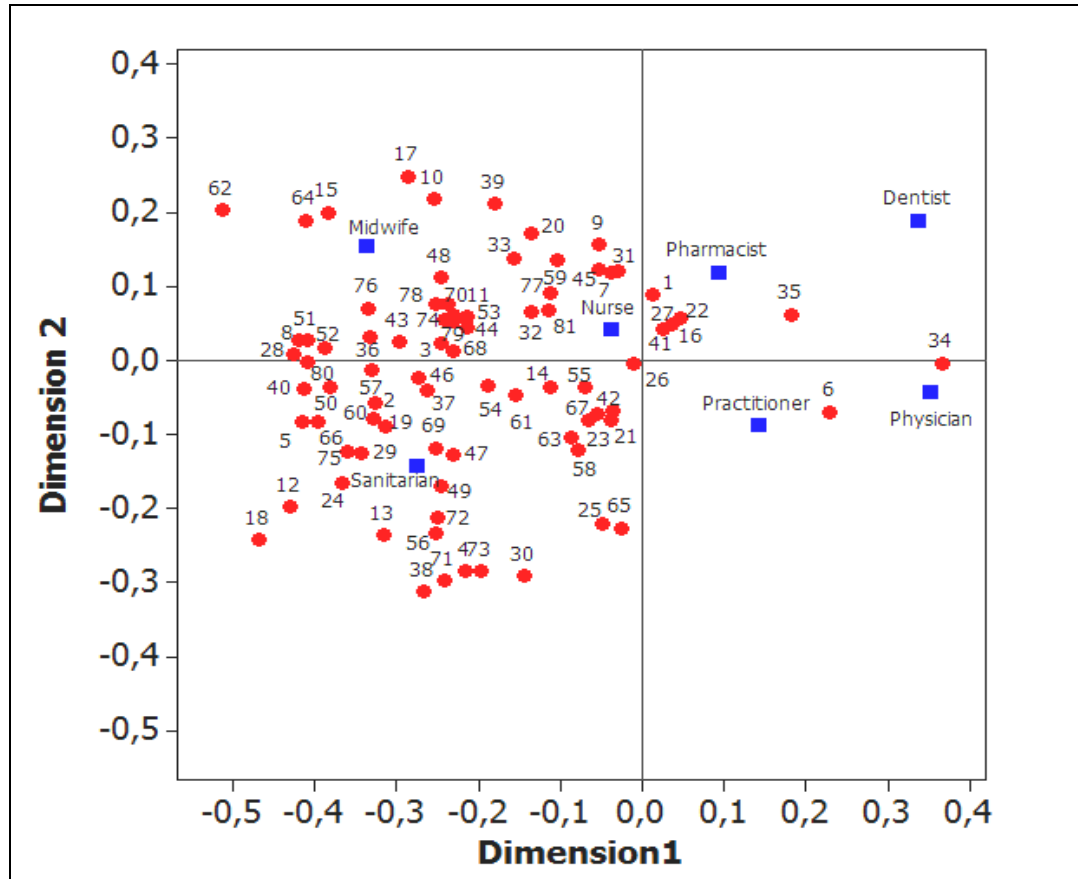

Figure 1: Correspondence analysis Biplot for distribution data of health personnel of Turkey by provinces

Table 2: Results Of Correspondence Analysis For Distribution Data Of Health Personnel Of Turkey By Years

Dimension	Singular Value	Inertia	Proportion of Inertia	
			Accounted For	Cumulative
1	0.1082	0.0117	0.5598	0.5598
2	0.0707	0.0050	0.2412	0.8010
3	0.0557	0.0031	0.1475	0.9485
4	0.0283	0.0008	0.0393	0.9878
5	0.0173	0.0003	0.0122	1.0000
Total		0.0209	1.0000	

The relations among the categories by correspondence analysis Biplot are presented (FIGURE 2). There is not a distinct change among the nurses according to years. Besides we did not observe an important difference between the distribution of health care personnel between the years 1951 and 1970. The number of midwifes, dentists and practitioners increases from 1970 to 1980 and at the beginning of 1990s. During the post-1990s, there is a tremendous increase in physicians and sanitations.
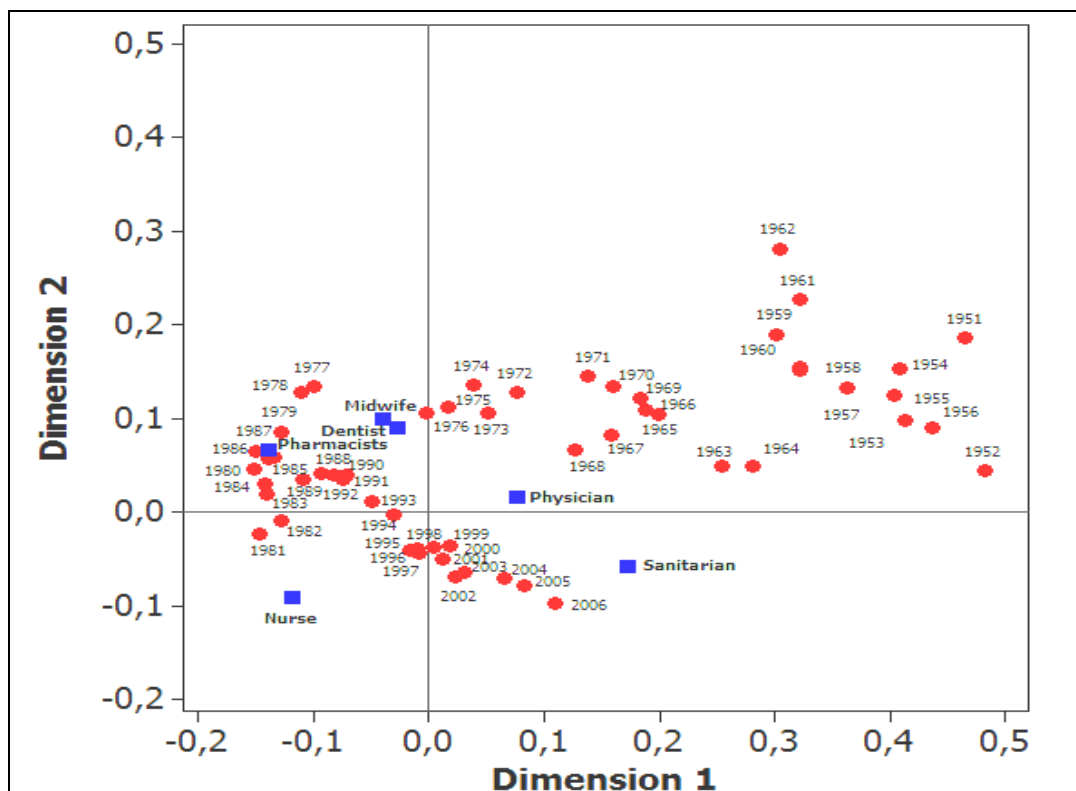
Figure 2: Correspondence analysis biplot for distribution data of health personnel of Turkey by years

Table 3: Results of correspondence analysis for distribution data of health personnel of Turkey by establishments

| Dimension | Singular Value | Inertia | Proportion of Inertia | |
			Accounted For	Cumulative
1	0.5461	0.2983	0.7893	0.7893
2	0.2789	0.0778	0.2060	0.9952
3	0.0424	0.0018	0.0048	1.0000
Total	0.8675	0.3779	1.0000	

The contingency table obtained by crossing the establishments of the health care personnel is investigated by the correspondence analysis biplot and results are presented (TABLE 3). The whole of the total variance is explained in three dimensions. 78.93% of the total inertia (variance) is explained by the first dimension and the 20.60% of the total variance is explained by the second dimension and 0.48% of the total variance is explained by the third dimension. As a result, 99.52% of the total variance is explained by the two dimensioned correspondence analysis biplot graph. The relations among the categories are presented (FIGURE 3). The correspondence analysis biplot graph indicates that most of the nurses, midwifes, practitioners, sanitarians work in the Ministry of Health. The dentists and pharmacists work mostly privately. A high proportion of the physicians work in the other governmental institutions. It is interesting to observe that in universities the number of nurses, practioners, and physicians are more than the other health care personnel.

Besides, according to the establishments; the distribution of nurses is similar with practitioners and the distribution of midwives is similar with sanitarians. It is also interesting to observe that the distribution of pharmacists and dentists exhibit identical structure according to the establishments.

Table 4: Singular Values And Proportions Explained Variability

Dimension	Singular Values	Squares of Singular Values (Eigenvalues)	Proportion Explained	Cumulative Proportion
1	13.0701	170.8275	0.7200	0.7200
2	6.3759	40.6521	0.1700	0.8900
3	5.3405	28.5209	0.1100	1.0000
Total		240.0005	1.0000	

The results of covariance biplot analysis of the relation between nurses and physicians per population and GDP per population for each province are presented (Table 4). The singular values and the explanation ratios of the total variance of each singular values are presented (Table 4). Seventy-two percent of the total variance is explained by the first dimension, and 17% of the total variance is explained by the second dimension. Eleven percent of the total variance is explained by the third dimension. As a result, 89% of the total variance is explained by the two-dimensioned biplot graph (Johnson and Wichern, 1998).

When the (FIGURE 4) and (TABLE 5) are analyzed, it is seen that the physician and the nurse vectors have a high correlation by $r = 0.9694$, $\theta = 14.21$ and ranged in a similar direction. At the same time, there is a positive correlation between physician and GDP by $r = 0.6965$, $\theta = 45.85$ and between nurse and GDP by $r = 0.4991$, $\theta = 60.05$.

Figure 4 indicates that the highest GDP per person provinces are Kocaeli, Ankara, Bolu, Izmir, Istanbul, Mugla, Zonguldak, Edirne, and Eskisehir. The lowest GDP per population provinces are Sirnak, Agri, Mus, Bitlis, and Hakkari.
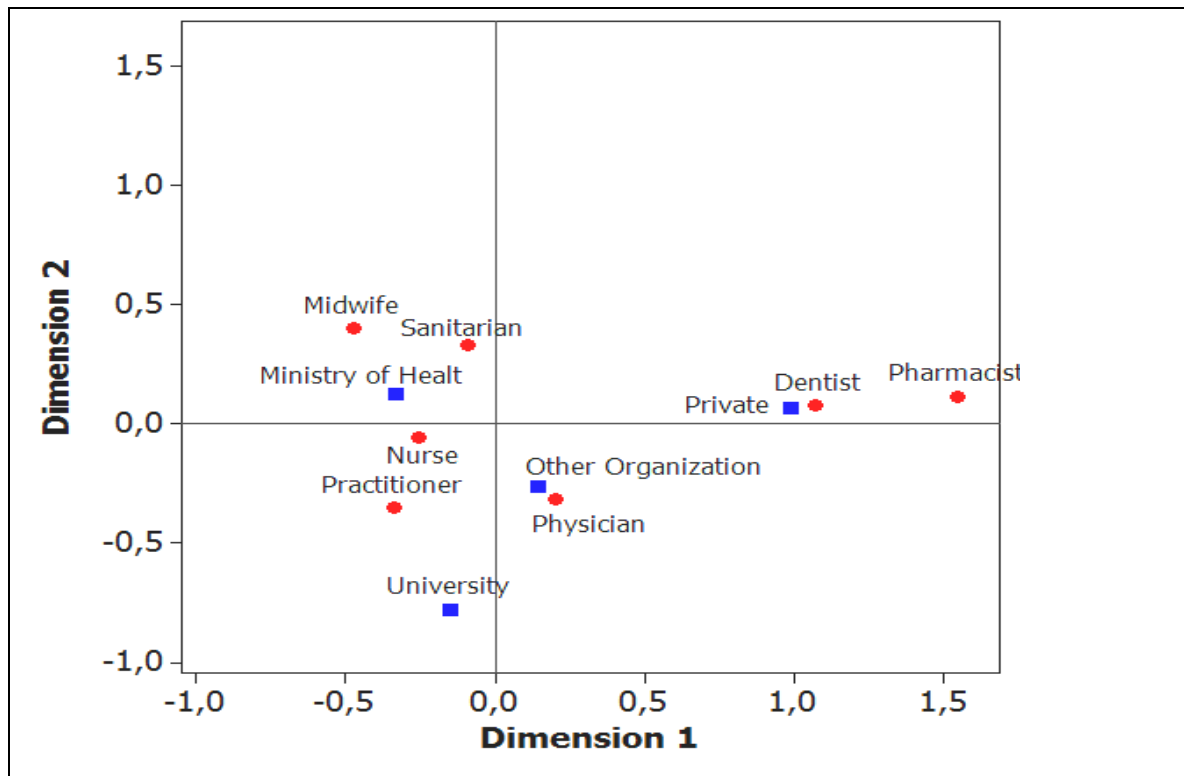

Figure 3: Correspondence analysis biplot for distribution data of health personnel of Turkey by establishments
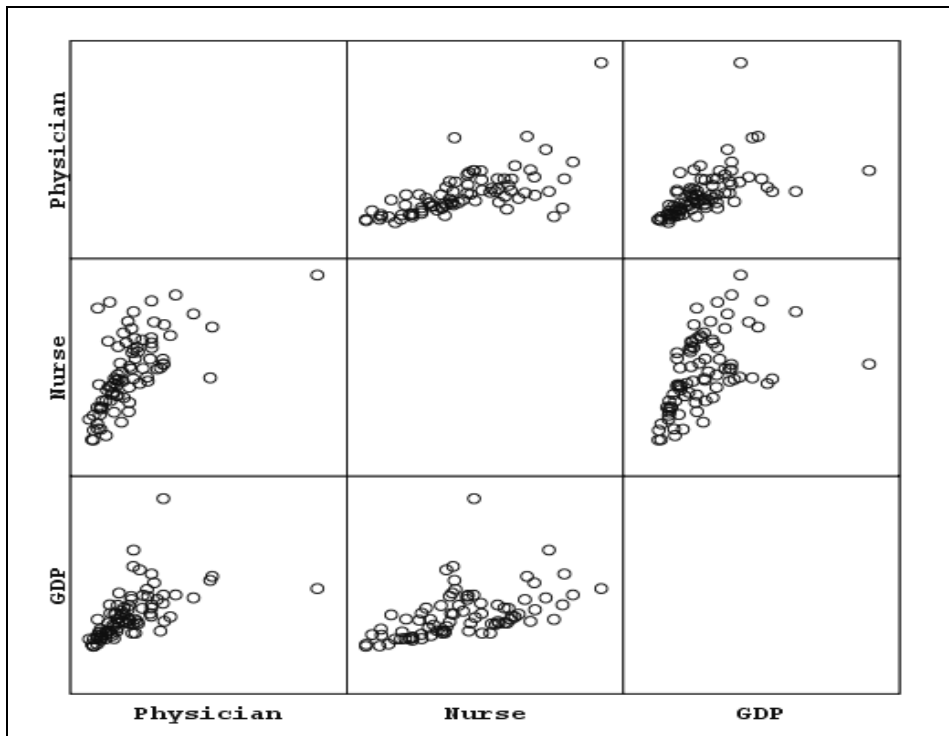
Table 5: Correlation values

Variables	Correlation	Angle(θ)
Physician - Nurse	0.9694	14.2100
Physician - GDP	0.6965	45.8500
Nurse - GDP	0.4991	60.0500

The East of Turkey has the lowest GDP per population which indicates an inefficient distribution of income and regional imbalances. Another result emerged by the publication of Turk Stat Main Labor Force Indicators by Province, 2008. The low GDP per population provinces accept Agri has an unemployment rate over 13% and the employment rate is lower than 35% accept Agri. This is also meaningful because, animal husbandry is creating most of the employment in Agri. We observed that in the provinces owning highest (lowest) GDP per population has a highest (lowest) nurses and physicians per population. This positive symmetric correlation also verified by the scatter plot analysis.

Figure 4: Covariance Biplot

According to the scatter plot results in (FIGURE 5), it is observed that the results of the scatter plots and covariance biplot give an identical correlation structures among the variables. According to the scatter plot results, GDP per population rate has a positive correlation by physician & nurse per population. High positive bivariate correlations are observed between physician & nurse per population. There is a positive bivariate correlation between physician per population & GDP per population and nurse per population & GDP per population. This case also strengthens the results of covariance biplot.

Figure 5: Scatter Plots of the Variables

5. Discussion

Education, employment opportunities, income equality, gender, nutrition, access to clean water and sanitation are the main determinants of public health in developing countries. Turkey as a developing country increases its potential and tries to reach to the high level standards. Turkey also increases its potential on the healthcare sector issues and increases its current situation of healthcare staff. However when we compare its healthcare sector structure by India, Cuba, China, Thailand, Jordan, The Philippines, we may observe some deficiencies (Mashayekhi et al.,2006). Being an important supplier of the healthcare services needs a high standard planning and re-organization. Turkey may also catch-up those standards and converge its healthcare sector by these countries.

The world changes with a high speed. The domestic problems may be a global phenomenon after a while. The needs, regionalism, the density in the centers of the cities bring new problems. These area and region based problems force healthcare sector to be more effective and efficient. High qualified and RAMBO (Researcher, Administrator, Manager, Business, Operator) staff are necessary to solve the problems. Within the restricted resources, the optimal number and ratio of health workers should meet the population's healthcare needs. Optimization should be developed to solve the technical and strategic issues. The health workforce and the health care services should be organized within this rationality perspective. This rationality may also sustain the balances in the distribution of the density of health workforce among areas.

Following major developed countries, Turkey also adopted several reforms on healthcare sector. The health reforms held in Turkey are prepared in 1954, 1960, 1961, 1987, 1992 and 2002 as enactment of the legislations and laws to increase the quality of the health care services. The main motive behind these reforms is to diminish of budget deficits. However health sector has its own dynamics. Health is simultaneous physical and mental goodness as usually mentioned by World Health Organization. Health service has its own dynamics. The demand for health care services is random. It has no substitution, cannot be postponed. The dimension and scope of it are determined by the physician and not by the beneficiary. The consumers of the health services are not rational and the consumer information is restricted, the patient may not demand to be treated. For the services, sustaining the satisfaction and quality is not an easy task and the output of it cannot be turned to money.

The demand for health is not certain. The cost of the disease is uncertain and its dimension is high. Health services cannot be postponed and substituted. Health sector is technology and labor intensive; consequently its costs are high. The conservative health services are totally public goods. The monetary solutions therefore solve the quantitative issues than the qualitative ones. Countries try to solve these problems for being more developed. The distribution of healthcare staff is one of the developing criteria of the countries. In this paper we present the situation of this abnormal unequal plus inefficient allocation of healthcare staff by the biplot approach.

The investment and optimization on healthcare sector are one of the solutions of giving high quality services. The sector has its own dynamics. For instance the price elasticity of the demand for health care services is not high. Although the price increases, the demand decreases very little. When the income elasticity decreases, price elasticity of demand increases. Consequently, government investment is necessary in the sector especially to the East Anatolia Region of Turkey. Because by the increasing development, the demand of the citizens for the healthcare services will increase in the future. The aging phenomenon of the recent decade will also increase the need for the healthcare services.

Optimal planning of the healthcare staff is one of the solutions for the demand side of the sector. There is also a fact that the nurses migrate from low income provinces to high income provinces. Although this is not a national problem and has also international examples, the solution may be solved by its own conditions and dynamics (See Mejia and Pizurki ,1979) for the migration of healthcare staff for individual country level). One of the reasons of this migration fact of healthcare staff may be the life standards in lower cities. In some cases there is a mandatory service for three years but this is not sufficient. When the mandatory service finishes, West and South of Turkey is preferred. In the East of Turkey the conditions are restricted; overall income per person is lower. The cost of living is as similar as the West in the East. Social opportunities are not much. The training opportunities are not good. The hospital conditions are very restricted and this decreases the job satisfaction and satisfaction. The hospitals are small and patient number is low so the circulating capital is low. The low circulating capital lets personnel to migrate. There is a security problem, infrastructure is no sufficient, there are transportation problems, there is a holiday problem. For instance, if married, the school opportunities are very restricted for her child. There is a deficiency in qualified healthcare staff. The distribution and re-organization may also consider these issues to solve problems and create optimal solutions.

6. Conclusion

The health service delivery in the WHO European Region data indicates that the number of nurses, physicians, pharmacists, and dentist per person is low compared with EU member states (World Health Organization, 2009). Turkey as an accession country to the EU should arrange its healthcare employment. New projects should also be produced for increasing the healthcare staff employment. Because the allocation and the number of the healthcare staff are one of the development criteria of the countries.

The staff aimed at enchasing health should be educated according to the country conditions and health system. The existing workforce should be distributed efficiently and balanced throughout the country. The team work should be developed and the career incentives should be created in health sector. Strategic management skills should be used and the sources should be distributed efficiently. These will create value and happiness in the healthcare sector.

The quantity of the health labor force should be planned according to the desire, need, population, target and workload methods. The midwives and nurses have limited opportunities to work other than the government, so new employment opportunities should be created. The health reforms should be adequate to increase the life standards of the healthcare sector staff. The overall GDP per population is an important determinant for the distribution of physicians and nurses. So by the overall increase in growth rates, the healthcare sector will also get more opportunities to be in a better position.

Giving high importance to the health of its citizens is an essential criterion for being a developed country. For this purpose, the healthcare staff of the country should be well-trained to give good services to the citizens. The optimality condition is also critical to obtain maximum benefit from the services. However in Turkey, there is a high dispersion among the cities concerning the quality, quantity of the healthcare workforce and the equipments used in the services. In this sense, it is important to ensure the optimal

distribution of health personnel among the provinces. Therefore, it is required to prepare and implement an action and strategy plan by decision-makers on the subject.

For the future research, the distribution of health care personnel may be compared with the other developed and developing countries. The main structural differences may be introduced by the biplot approach. Besides, the effects of the system of new family medicine started to be applied in Turkey on the distribution of the health care personnel can be analyzed and discussed.

References

Anand S. (2010): Measuring health workforce inequalities: Methods and application to China and India, Human Resources for Health Observer, 5, World Health Organization, Geneva, Switzerland.

Aitchison J. and Greenacre M. J. (2002): Biplots of compositional data. *Applied statistics*, 51:375-392.

Belek I. and Hamzaoglu O., (2002): Changes in health in the last two decades in Turkey: Negative impacts of export-oriented development strategy on health, *International Medical Journal*, 9(3):177-84.

Clausen S. E. (1998): Applied correspondence analysis: an introduction. Sage Publication, USA

Dayioglu M. and Baslevent C. (2006): Imputed rents and regional income inequality in Turkey: a subgroup decomposition of the Atkinson index *Regional Studies*, 40(8):889-905.

Gezici F. (2007): Spatial analysis of regional inequalities in Turkey. European Planning Studies, 15(3):383-403.

Gower J. C. and Hand D. J. (1996): Biplots. Chapman and Hall, 277 p., London

Greenacre M. J. (1984): Theory and applications of correspondence analysis. Academic Press. Inc. p. 223, London.

Greenacre M. J. (2002): Correspondence analysis of the Spanish national health survey. Gaceta Sanitaria, 16, 160-170.

Kara, O. (2006): Occupational gender wage discrimination in Turkey, *Journal of Economic Studies*, 33(2):130-43.

Johnson R. A. and Wichern D. W. (1998): Applied multivariate statistical analysis. Prentice & Hall, USA.

Mashayekhi M., Julsaint M. and Tuerk E. (2006): Strategic considerations for developing countries: the case of GATS and health services. In: Blouin, C., Drager, N., Smith, R. (Eds.), International Trade in Health Services and the GATS, The World Bank, Washington, DC; p. 2.

Mejia A. and Pizurki H. (1979): Physician and nurse migration analysis and policy implications, World Health Organization, p. 43.

Ozdamar K. (2004): Statistical data analysis with package programming. Kaan Kitabevi, Eskisehir

Park M., Lee W. L., Lee J. B. and Song, S. H. (2008): Several biplot methods applied to gene expression data, *Journal of Statistical Planning and* Inference, 138(2), 500-515.

TEPAV. (2009): Fiscal monitoring report, *Turkish Economic Policy Research Trust*, Istanbul.

TEPAV. (2008): Fiscal monitoring report, *Turkish Economic Policy Research Trust*, Istanbul.

Tomul, E. (2009): Measuring regional inequality of education in Turkey: an evaluation by Gini index. Procedia, *Social, and Behavior Sciences*, 1(1):949-52.

Tosun C., Timothy D.J. and Ozturk Y. (2006): Tourism growth, national development, and regional inequality in Turkey, *Journal of Sustainable Tourism*, 11(2):133-61.

Turkkan A. and Aytekin H. (2009): Socioeconomic and health inequality in two regions of Turkey, *Journal of Community Health*, 34(4):346-52.

TUSIAD. (2004): A healthy future: Applicable solutions on the health reform. September, 09(380), p. 168.

Wharrad, H. and Robinson, J., (1999): The global distribution of physicians and nurses. *Journal of Advanced Nursing*, 30(1), 109-120.

World Health Organization. (2009): The European health report. WHO Regional Office for Europe, Copenhagen: 191.