AN EMPIRICAL STUDY ON THE CURRENT STATUS OF RESEARCH WORKERS IN THE KOREAN MARKET: FOCUSING ON BIOPHARMACEUTICALS AND MEDICAL EQUIPMENT

[1]SHIM JUNG-MIN, [2]RYUJU-HYE

Research Fellow and Researcher, KISTEP(Korea Institute of S&T Evaluation and Planning)
E-mail: sjmin1@kistep.re.kr, jhryu@kistep.re.kr

Abstract- South Korean society is currently aging at an unprecedented rate while the "catch-up" economic development strategy that the nation has been pursuing over the last four decades has been revealing increasing limits on the sustainability of the Korean economy. For the last three decades, the Korean government has been fostering biotechnology and the development of research human resources in an effort to counter the grim prospects of population aging and unsustainable economic growth. The Korean labor market, however, is still in need of researchers. This study provides an empirical analysis of the current status of biotechnology research workers, particularly those working in the fields of biopharmaceuticals and medical equipment, and delineates implications for future policy on how to develop and encourage biotechnology human resource.

Index Terms- Biopharmaceutical, Medical Equipment, Research Workers, Labor Market.

I. INTRODUCTION

South Korea is fast becoming a post-aged society while the "catch-up" economic development strategy the nation has been pursuing over the last four decades has been revealing increasing limits on the sustainability of the Korean economy. In an effort to counter these grim prospects, the Korean government has been fostering biotechnology and related industries for the last three decades, and thanks to government investment, biotechnology has been growing dramatically. Yet there is still increasing demand for competent biotechnology researchers, with some even claiming that the absence of such researchers compromises the competitiveness of Korea's biotechnology industries. However, there is a lack of official statistics to which policymakers may refer in order to find effective measures to foster and make use of biotechnology researchers. No effort has been made so far to identify the problems that biotechnology researchers face upon entering their respective fields.

This study was conducted in an effort to establish an official statistical basis to support policymaking aimed at fostering and making use of biotechnology researchers in Korea. In particular, this study provides an empirical analysis of the current status of research workers in biopharmaceutical and medical equipment industries and delineates policy implications based upon that analysis.

Biopharmaceuticals form the largest biotechnology industry in Korea today and, therefore, is where representative examples of Korean biotechnology researchers can be found. Having recently developed biosimilar technology, the industry has shown great potential and is capable of leading the future of the food industry. The advancement of information and communications technology and the growing interest in personal wellbeing and health have also dramatically raised the demand for healthcare products and medical devices. The medical equipment industry therefore provides a new niche market for globalizing businesses.

II. BIOPHARMACEUTICAL AND MEDICAL EQUIPMENT INDUSTRIES: DEFINITIONS AND CURRENT STATUS

A. Biopharmaceutical industry

The biopharmaceutical industry encompasses all industrial activities that apply biotechnology to research and development and/or production in order to produce and manufacture the drugs and medical products needed to diagnose, treat, or prevent diseases in humans and animals. [1] In 2010, the global pharmaceutical market was valued at USD 874.6 billion, having grown at an average rate of 6.2 percent annually since 2006. And its market value is expected to reach USD 1.1 trillion by 2020. Whereas the existing chemical and synthetic pharmaceutical market is becoming saturated and is anticipated to shrink in size, the biopharmaceutical industry is expected to expand, finding new treatments for diseases that synthetic drugs have failed to combat, such as amyotrophic lateral sclerosis (ALS), various neurological disorders, and other rare diseases.[2]

As of 2013, the biopharmaceutical industry in Korea was valued at USD 2.34 billion, about 0.2 percent of the global total, and a total investment of USD 730

[1] This industry, however, does not include the industry of manufacturing medical and diagnostic equipment and devices (Ministry of Trade, Industry, and Energy (2014),*Korean Biotechnology Industries as of 2013*).

[2] Biotech Policy Research Center (2012), *Current Status andDevelopment Trends of Biopharmaceuticals.*

million had been made in biopharmaceutical research and development. The average amount of investment in R&D in this industry is USD 2.3 million, which is higher than the average amount of investment for all other Korean industries.

B. Medical equipment industry

The medical equipment industry is a healthcare industry that seeks to improve the quality of life through the use of advanced medical devices and equipment. It is an interdisciplinary field, requiring input from multiple disciplines, including clinical medicine, electrical engineering, electronics engineering, mechanical and materials engineering, and optics, to achieve the design and manufacturing of related products. As of 2013, the medical equipment market worldwide was valued at USD 323.8 billion, and according to BMI Espicom, a research agency, its value is expected to reach USD 340.3 billion by 2014, growing at an average rate of 6.5 percent annually from 2009 onward.

The Korean medical equipment industry was valued at USD 3.95 billion as of 2013, about 1.2 percent of the global total, and its share of the world market is rising rapidly. Leading exports in the industry are diagnostic ultrasound devices, soft contact lenses, and dental implants. The Korean government has been striving to foster the industry through diverse measures, including continued investment, more efficient regulations, support for improving product reliability, and support for entering both domestic and overseas markets. These efforts, however, have yet to bear any tangible outcomes.

III. RESEARCH METHOD

The objective of this study is to survey and ascertain the current status of the labor market for the Korean biopharmaceutical and medical equipment industries with a view to finding policy implications.

Biopharmaceutical and medical equipment personnel can be defined as those working in the biopharmaceutical and medical equipment industries and related fields, using specialized knowledge and techniques related to the respective subject matter. For the purpose of this study, therefore, general administrative workers (those working in human resources management, purchasing, general accounting, etc.) were excluded. The personnel included in the scope of this study can be divided into three categories: researchers (including R&D workers and clinical trial workers); manufacturers (including facility maintenance workers and quality assurance agents); and sales and management workers. The findings of a poll conducted on businesses in the two industries for this study are summarized in the following table.

Fugur1. Poll findings

Poll targets	-Biopharmaceutical and medical equipment businesses with main offices in Korea -100 biopharmaceutical businesses -326 medical equipment industries
Polling period	-March 9 to April 30, 2015 (approximately two months)
Populations	-Biopharmaceuticals: 299 member companies of pharmaceutical and biotechnological associations (response rate of 33.4 percent) -Medical equipment: 2,607 of the 5,366 businesses listed in the *Handbook of Medical Equipment Manufacturers, Importers, and Exporters 2014* (response rate of 12.5 percent)
Polling method	-Biopharmaceuticals: total inspection of all 299 businesses with main offices located in Korea -Medical equipment: quota sampling of medical equipment in different regions
Poll content	-Basic business information, personnel and employment information and policies, education and training policies and records, etc.

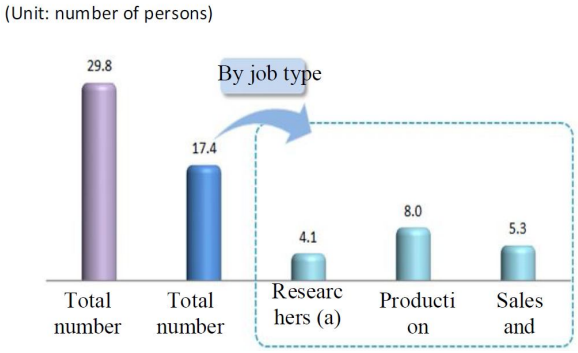
IV. RESULTS

A. Business and workforce sizes

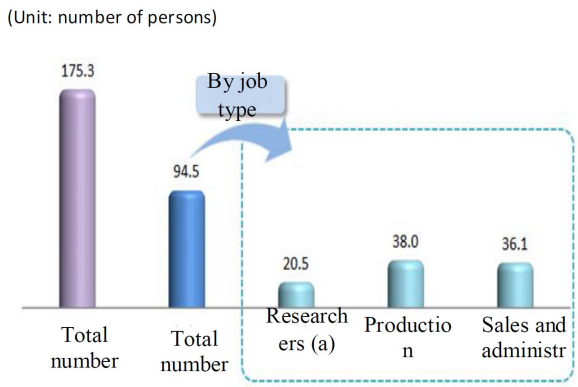
Small- and medium-sized enterprises make up 36 and 39 percent of the biopharmaceutical industry in Korea, respectively, and the majority of businesses in this industry are independent, unlisted companies. They also tend to hire relatively small numbers of employees, with 36 percent of the total hiring between 10 and 50 employees and another 23 percent, between 50 and 100. The average number of employees per company in this industry is 175, 94.5 (or 53 percent) of which are biotechnology researchers. Production workers (40.2 percent) and sales and administration workers (38.2 percent) make up a greater portion of the workforces of these businesses than researchers. Of the average number of researchers per business (94.5), 10.8 hold masters' degrees or equivalent qualifications, whereas 27.1 production workers have earned vocational college diplomas or less and 29.7 sales and administrative workers possess bachelors' degrees. Although the biopharmaceutical industry hires more women than other industries, the majority of these women, who hold vocational college diplomas or less, are engaged in production.

In comparison to the biopharmaceutical industry, the medical equipment industry is made up of more small- and medium-sized businesses. The average size of a business in the medical equipment industry is even smaller, with 49.7 percent of all businesses in the industry being small businesses and 28.0 percent small venders. The average number of employees per business is 29.8, 46.4 percent of which work in production and 30.3 percent in sales and administration. The average number of researchers per business is four. Most researchers have bachelors' degrees, while production workers possess vocational

college diplomas or less and sales and administrative workers hold bachelors' degrees. The state of research and development in the medical equipment is therefore worse than that in the biopharmaceutical industry.



Fugur2. Personnel distribution in biopharmaceutical industry



Fugur3. Personnel distribution in medical equipment industry

B. Employment status and prospects

The biopharmaceutical industry generally favors young males with bachelors' degrees who are capable of working in sales and/or administration. Although biosciences, including biology, are the preferred majors or specialties of researchers that the industry hires, university majors or degrees had relatively less influence on employment in either production or sales/administration. However, the industry tends to put more emphasis on degrees and university majors when hiring new employees, but prioritizes work experience, skills, and expertise when hiring experienced employees. People holding either vocational college diplomas or bachelors' degrees can enter this industry relatively easily, while people with masters' degrees find entering the industry "neither easy nor difficult" (48.0 percent) or "somewhat difficult" (28.0 percent). People with doctorates find the industry even more difficult to enter than do people with masters' degrees. In other words, the more educated one is, the more difficult it is to find employment in the biopharmaceutical industry.

Human resources managers responsible for hiring in the biopharmaceutical industry point to two reasons behind the difficulty they face finding and hiring new employees with the right qualifications. First, it is difficult to find candidates with suitable qualifications as well as the potential, aptitude, and attitude that the companies desire. Second, given the relatively poor salary and working conditions in the industry, not many qualified and desirable job candidates apply for jobs. This situation indicates that there is a need for businesses in the industry to develop programs to enhance the competency of new employees as well as to offer better working environments and conditions. As for hiring experienced employees, human resources managers also expressed the difficulty of finding personnel with the desired levels of expertise and practical experience, most likely because employees moving from one workplace to another in the industry have not been given enough time and chances (e.g., retraining programs) to enhance their capabilities and competencies.

The medical equipment industry, on the other hand, tends to prefer young male employees holding either vocational college diplomas or less than postgraduate degrees. Whereas the medical equipment industry, like the biopharmaceutical industry, does have its preferences for certain university majors in the researchers it hires (such as electrical and electronics engineering), university majors or education in general bear relatively little relation to employees chances of landing jobs in production or sales/administration.

Attitudes, personality traits, potential, and capability are important criteria in hiring new employees, whereas relevant work experience and skills are more important when it comes to experienced employees. The reason for this is that the industry generally hires new employees for production and sales positions rather than research, and thus prefers candidates with relevant skill sets and adaptability rather than academic degrees or research experience.

People with masters' degrees or doctorates find the medical equipment industry very difficult to enter, while people with lesser degrees and qualifications do not perceive entry into the field to be difficult. In other words, the more education one has, the more difficult it is to find employment in the medical equipment industry as well. However, further in-depth research is needed to determine the exact cause for this perceived difficulty of finding people with higher degrees in the medical equipment industry—namely, whether it is because the industry prefers people with lesser degrees because it is costly to find and hire people with higher degrees or because the industry has little need for such high academic qualifications.

The reason it is difficult to hire new employees with the right qualifications in the medical equipment industry, irrespective of the academic degrees candidates hold, is that the poor salary and working

conditions deter competent biotechnology workers from applying for jobs in the industry. In other words, the poor working environment is a greater obstacle to increasing the number of researchers in the medical equipment industry than it is in the biopharmaceutical industry.

Among the efforts that have been made to overcome the shortage of human resources in the two industries, the most popular (56.4 percent) was the division of existing workloads and roles, followed by the re-training or additional training of existing personnel (17.8 percent) and outsourcing of jobs (15.3 percent). In order to narrow the human resources gap, the two industries need to make more active efforts to incentivize and attract individuals with the right qualifications as well as enhance their external relations networks.

C. Re-training

Ninety out of 100 businesses in either the biopharmaceutical or medical equipment industry provide training for their employees, with the most preferred sources of training being specialized external training agencies.

Regarding the effectiveness of employee training, 61.1 percent of biopharmaceutical businesses and 72.7 percent of medical equipment businesses answered that such training was effective, and businesses in both industries picked "lack of time" as the greatest obstacle to providing training and human resources development.

As for capability enhancement programs, these industries preferred on-the-job training (OJT) most. The biopharmaceutical industry, with its relatively greater percentage of researchers holding masters' degrees or doctorates, also showed a preference for academic conferences, inside and outside Korea, as means of re-training.

CONCLUSION

What do these findings imply for policymaking?

First, it is important to create more decent jobs in the biopharmaceutical and medical equipment industries by ensuring their growth. The biopharmaceutical industry, in particular, is a knowledge-based field of economic activity that promises high returns but requires great risk and considerable long-term investment. The medical equipment industry requires interdisciplinary collaboration among clinical medicine, electrical and electronics engineering, mechanical and materials engineering, and optics and other such disciplines. The industry produces a wide range of goods, including simple wearable devices as well as high-end electronic medical devices featuring the latest technology. Specialized small- and medium-sized businesses, which have an advantage in that they can produce small quantities of a wide range of goods, tend to lead the market. The production of state-of-the-art, high-value-added devices, nevertheless, still remains almost the exclusive purview of a few large corporations. Survival in both industries requires an ability to lead innovation in research and development in the long run.

There are, however, only a few businesses in either industry that offer competitive prospects for the future. The current structures of these industries make them less and less attractive to highly qualified and trained research personnel. The Korean government, therefore, needs to select and foster competitive businesses in the biopharmaceutical and medical equipment industries in order to encourage more researchers to work in these fields.

Second, it is crucial to improve the salary and working conditions in these industries in order to overcome the chronic shortage of researchers. These industries are in need of competent researchers, while the number of well-educated university and graduate school graduates without jobs continues to rise in Korea. The current situation indicates a persistent gap in the wages and working conditions demanded by job candidates and those offered by the job market. Despite their enormous potential and future prospects, the biopharmaceutical and medical equipment industries offer insufficient numbers of decent jobs to satisfy the demand. The relatively low salaries and poor working conditions in these industries also make it difficult for businesses to find and hire candidates with the desired qualifications. Therefore, it is important to improve the salary and working conditions at the small- and medium-sized businesses that make up these industries in order to attract more researchers.

Third, it is also important to increase the number of women working in these two industries and provide them adequate support. The majority of women working in these industries today are relatively less-educated production workers. Although biotechnology is a field that attracts a significant and increasing number of women, the two industries are not making full use of the women personnel available. In one survey, it was found that both industries favored male employees twice as much as female employees. The reason for this is that, being made up of mostly small- and medium-sized businesses, these industries cannot provide the working conditions and support that enable women to maintain a proper work-family balance. In the long run, however, the biopharmaceutical and medical equipment industries need to increase their support for women so as to improve their work-family balance, not only to encourage more women to work in these fields but also for the sustainable growth of the industries themselves. To that end, the government should help develop and spread a suitable model of human resources management.

Finally, the two industries also need to develop and improve their re-training programs. Systematic re-training is crucial to the development and enhancement of the capabilities and competencies of personnel in these industries. The small- and medium-sized businesses that make up these industries, however, lack the resources and expertise to develop and provide effective re-training programs on their own.

Therefore, the Korean government needs to conduct a thorough survey of the demand for the re-training of researchers and establish a re-training master plan that can help businesses develop and operate effective programs in partnership with local government organizations and agencies.

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