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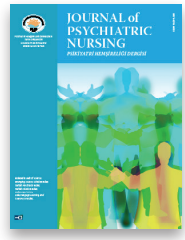

Original Article

The importance of mental health variables for life expectancy by entropy weighting method: a case of OECD countries

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Abstract

Objectives: This study aims to determine the weights (order of importance) of the mental health variables associated with life expectancy and rank them from the most important.

Methods: This is a retrospective study involving member countries of the Organization for Economic Co-operation and Development (OECD). Mental health variables were divided into two groups: (i) healthcare resources (psychiatric beds in mental hospitals or general hospitals, psychiatrists, and nurses working in the mental health sector); (ii) subjective well-being measures (perceived health status, life satisfaction, and quality of support network). Accordingly, the secondary data for the variables of mental health-related healthcare resources used in this study covers the years 2013–2017, and the data of subjective well-being measures covers 2017. The order of importance (weights) of the study variables was determined using the "entropy weighting method," which is one of the criteria weighting methods employed in multi-criteria decision-making.

Results: The most important variables associated with life expectancy were beds in mental hospitals and nurses working in the mental health sector. The quality of the support network was relatively less important.

Conclusion: The results obtained point to the necessity of strengthening mental health resources in order to increase life expectancy. These results can guide health professionals about the priority interventions and policies that should be planned to increase life expectancy and the management of life expectancy-related variables.

Keywords: Entropy; healthcare resources; life expectancy; mental health; well-being.

Life expectancy is a key indicator of health. It has increased globally over time with the impact of improved quality of healthcare.[1] In the member countries of the Organization for Economic Co-operation and Development (OECD), a person born today is expected to live an average of 81 years. However, the increase in life expectancy has slowed in most OECD countries recently (especially the United States, France, and the Netherlands). Indeed, in 2015, life expectancy was observed to decrease in 19 countries.[2]

Life expectancy is associated with an increase in individuals' educational and income status and healthier life patterns. Also, developments in healthcare services, more access to health services, and quality care directly affect life expectancy.[3,4] Another variable that affects life expectancy is mental health. Individuals with mental health problems tend to die earlier than the general population.[4–8] It has been reported that a diagnosis of a serious mental illness reduces life expectancy from 10 to 25 years.[7,8]

According to OECD data, almost 1 in 10 adults thinks that their health status is poor, and an estimated 1 of 2 people will have a mental health problem during their lifetime.[2,3] According to the World Health Organization (WHO), approximately one billion people have a mental illness.[9] Problems in the field of mental health may lead to poor educational outcomes, higher unemployment rates, worse physical health, and even self-mutilation, suicide-related deaths, and reduced

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What is presently known on this subject?

- The rate of increase in life expectancy has slowed in most member countries of the Organization for Economic Co-operation and Development (OECD) and even declined in some.

  It is known that there is a relationship between life expectancy and mental health resources and subjective well-being measures. However, the literature on this topic is limited.

What does this article add to the existing knowledge?

- Increasing the number of psychiatric beds in mental health hospitals and general hospitals as well as the number of mental health professionals may be among the priority initiatives in order to achieve positive outcomes related to life expectancy.

  Healthcare resources in the field of mental health are more important than subjective well-being variables in increasing life expectancy.

What are the implications for practice?

- Increasing the number of psychiatric beds and mental health professionals will contribute to increasing life expectancy and the management of related variables.

  The results of the study will guide health professionals in setting priorities for policies to be created and initiatives to be planned.

life expectancy.[4–8] Besides, individuals with mental health problems experience limited access to healthcare resources compared with the general population, which is also related to life expectancy.[8]

The life expectancy of individuals with mental health problems is closely related to the effectiveness of social policies and health care delivery.[4] However, these individuals have limited use of healthcare resources compared with the general population.[8] At this point, access to these resources is vital to improving health.[10]

The mental health and subjective well-being of individuals are also interrelated. Subjective well-being is basically evaluated in three areas: evaluative/cognitive well-being (or life satisfaction), hedonic/emotional well-being (feelings of happiness, sadness, anger, stress, and pain), and eudemonic well-being (sense of purpose and meaning in life).[11,12] In the literature, it is stated that there is a strong relationship between subjective well-being, sources of social support, their quality,[13] and life satisfaction.[14,15] It can be said that these variables affect life expectancy.

In the light of this information, health professionals have important responsibilities to increase the life expectancy of individuals. However, there is a need for effective health policies to support health professionals in this area. In addition, it is necessary to know and understand the "predictive value" of relevant factors for these policy measures.[16] A review of the literature has shown that there is no information showing the priority of interventions that should be planned in the field of mental health to increase life expectancy. In fact, this information is a guide for health professionals and policymakers in the field of mental health. Besides, the literature also emphasizes the limitations of studies examining the relationship between life expectancy and mental health.[5,17–19]

Aim and Research Question

This study was conducted to determine the weights (order of importance) of the mental health variables associated with life expectancy and rank the variables in order of importance, beginning with the most important. For this purpose, we sought an answer to the question, "What is the ranking of mental health variables related to life expectancy in order of importance?".

Materials and Method

Design

This is a retrospective study.

Place and Time of Research

This study was carried out using secondary data obtained from the "WHO Global Health Observatory" database[20] and the "Better Life Index" included in the "Social Protection and Well-Being" theme in the OECD database.[21] The databases used during the study were scanned in January 2021.

Participants

Assessments made following the aim of the research include OECD member countries, which consist of 37 countries. However, the data for some countries were not available. In this context, the inclusion criterion of the study was determined as "the country with data within the scope of the relevant variable." Of the 37 member countries, only 16 were included, as the others had missing data regarding the relevant variables.

Variables

Mental health variables thought to be associated with life expectancy were grouped under two headings: (a) healthcare resources and (b) subjective well-being measures. Descriptive information about the variables is given in Table 1.

The variables under healthcare resources were as follows: (i) beds in mental hospitals (per 100,000 people); (ii) beds for mental health in general hospitals (per 100,000 people); (iii) psychiatrists (per 100,000 people); and (iv) nurses working in the mental health sector (per 100,000 people).

The variables under subjective well-being measures were as follows: (i) quality of support network (percentage of people who have friends or relatives that they can count on in times of trouble); (ii) perceived health status (percentage of adults reporting "good" or "very good" health); (iii) life satisfaction (mean values on an 11-point scale, with responses ranging from "0-not at all satisfied" to "10-completely satisfied").

Data Collection

The data for the variables of healthcare resources related to mental health in the OECD member countries included in the study differ on a yearly basis. Retzlaff-Roberts et al.[22] stated that when the values of the variables for a single year could not be obtained, the old values of the countries could be used.

Table 1. Descriptive features of the variables (n=16)

Variables	Mean	Median	Min.	Max.
Healthcare resources				
Beds for mental health in general hospitals	19.34	14.06	4.67 (Türkiye)	66.15 (Japan)
Beds in mental hospitals	45.85	23.40	3.12 (Chile)	196.63 (Japan)
Nurses	54.16	33.82	1.88 (Chile)	150.25 (Türkiye)
Psychiatrists	14.38	12.19	1.64 (Türkiye)	43.96 (Switzerland)
Subjective well-being measures				
Life satisfaction	6.37	6.40	5.20 (Greece)	7.50 (Switzerland)
Quality of support network	88.94	90.00	76.00 (Korea)	95.00 (Spain)
Perceived health status	8.98	9.00	2.60 (United States)	17.00 (Korea)

n: Number of countries included in the study.

Accordingly, the secondary data for the variables of mental health-related healthcare resources used in the study covered the years 2013–2017, and the data for the variables of subjective well-being measures covered 2017.

Ethical Considerations

Since the data were open-access, ethical approval was not required for this study.

Data Analysis

The weights of the study variables were determined using the "entropy weighting method," which is one of the criteria weighting methods employed in multi-criteria decision-making. This method is used to determine the weights of the evaluation criteria.[23] In the method, only the values derived from the data set are weighted, and the subjective preferences of the individuals are not included. Therefore, the method is one of the objective weighting methods.[24] The steps related to the method are given in Table 2.[23] The weights were calculated by applying the five steps in the table.

Results

In determining the weights of the variables with the entropy weighting method, the "entropy" and "dj" values were calcu-

Table 2. Steps of the entropy weighting method

Steps	
Step 1: **Creation of the decision matrix:** For each alternative, the "decision matrix X" that includes the values of the criteria is created. Where "m" indicates the number of alternatives and "n" indicates the number of criteria. "X_{ij}" is the "i^{th} alternative value in terms of the "j^{th}" evaluation criteria.	$\begin{bmatrix} x_{11} & x_{12} & \dots & x_{1n} \\ x_{21} & x_{22} & \dots & x_{2n} \\ \dots & \dots & \dots & \dots \\ x_{m1} & x_{m2} & \dots & x_{mn} \end{bmatrix}_{mxn}$ i= 1, 2, … m; j=1, 2, …, n
Step 2: **Normalization:** In this step, the values in the decision matrix are normalized and a "normalized decision matrix" is created. "P_{ij}" is the normalized value of each criterion.	$P_{ij} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}}$
Step 3: **Calculation of entropy value:** The resulting P_{ij} values are converted to the entropy value (E_j). "E_j" is the entropy of the criteria.	$Ej = \frac{-1}{ln\,(m)} \sum_{i=1}^{m} p_{ij} ln p_{ij}$
Step 4: **Calculation of the degree of divergence (d_j):** "d_j" is the degree of diversification of the criterion.	$d_j = 1 - \mathrm{E}j$
Step 5: The objective weights of the criteria	$w_j = \frac{d_j}{\sum_{j=1}^{n} d_j}$

Table 3. Entropy, weight values, and ranking mental health variables

Mental health variables (Criteria)	Entropy value	d_j	Weights	Ranking
Beds in mental hospitals	0.807482	0.192518	0.346	1
Nurses working in mental health sector	0.860663	0.139337	0.250	2
Beds for mental health in general hospitals	0.890487	0.109513	0.197	3
Psychiatrists working in mental health sector	0.929559	0.070441	0.126	4
Perceived health status	0.957354	0.042646	0.077	5
Life satisfaction	0.997953	0.002047	0.004	6
Quality of support network	0.999459	0.000541	0.001	7

lated after the normalized decision matrix was created. Then, the weight of each variable was determined. The related values and the ranking of variables in order of importance are given in Table 3. Accordingly, "beds in mental hospitals" was the most important of the mental health variables associated with life expectancy. This was followed by the variables "nurses working in the mental health sector" and "beds for mental health in general hospitals," respectively. On the other hand, it was found that the variable with relatively less importance among others was "quality of support network."

Discussion

The rate of increase in life expectancy has slowed in OECD member countries and even fallen in some.[2] This indicates the necessity of better mental health. However, there are three main barriers to achieving better mental health: the inadequacy of available mental health resources, inequality in their distribution, and inefficiency in their use.[25] In line with this information, we sought an answer to the following question in the present study: "What is the ranking of mental health variables related to life expectancy in order of importance?" Some mental health variables (healthcare resources and subjective well-being measures) associated with life expectancy were examined, and their weights were determined using the entropy weighting method.

In the current study, one of the variables evaluated within the scope of healthcare resources was the number of psychiatric beds. Beds reserved for the continuous use of patients with mental disorders are called "psychiatric beds." These beds are available in public and private psychiatric hospitals, general hospitals, and hospitals for the elderly and children.[26] The average number of psychiatric beds per 100,000 people in the world is <7 in low- and middle-income countries and over 50 in high-income countries.[27] This value is 45.85 in mental hospitals and 19.34 in general hospitals in OECD member countries included in the study. Therefore, >75% of individuals with mental health problems in low- and middle-income countries receive no treatment,[9] they become disadvantaged, and their life expectancy decreases.[8] This big difference between the numbers of psychiatric beds in countries is related to the budget allocated to mental health, and it gives an idea about the adequacy of the service provided to individuals.[26] Lack of access to enough psychiatric beds can lead to inappropriate denial of the right to treatment for individuals in need of mental health care,[28,29] prolonged waiting times in the emergency department, the requirement of more severe symptom levels for admission to the service,[28] and an accelerated discharge process to meet the need for beds.[28,29] All of these conditions increase the risk of homelessness, violent crimes, imprisonment,[28,29] increased suicidal thoughts, and premature death.[28] This may result in a decrease in life expectancy. Based on all this information, the "number of psychiatric beds" of OECD member countries was associated with life expectancy, and the rank order in importance was evaluated. Accordingly, "beds in mental hospitals" was determined as the most important variable associated with life expectancy, and "beds for mental health in general hospitals" was determined as the third most important variable. This result shows that priority should be given to the number of psychiatric beds in the planning process to achieve positive outcomes related to life expectancy. However, because there are very few studies to guide policymakers on the necessity of increasing the number of psychiatric beds,[28] it is thought that this result, which reveals the relationship between the number of psychiatric beds and life expectancy, will contribute to the literature.

Another variable evaluated within the scope of healthcare resources in this study is manpower. Manpower is directly related to the delivery of mental health services.[25–27] The median number of mental health workers in the world is 9 per 100,000 people. However, the differences between countries are noticeably large. This number ranges from <1 in low-income countries to 72 in high-income countries.[27] This value is 12.19 for the number of psychiatrists and 33.82 for the number of nurses in OECD member countries included in the study. This condition negatively affects the care process that is effective and necessary for increasing life expectancy in individuals with mental health problems. It can make it difficult for individuals to receive optimal care services; manage lifestyle, diet, and medication;[30] and improve their physical health.[28] In the light of this information, the "size of manpower" working in the mental health field of OECD member countries was associated with life expectancy, and the rank order in importance was evaluated. Accordingly, the number of "nurses working in the mental health sector" ranked second in order of importance, and the number of "psychiatrists" ranked fourth. Con-

sidering the risks related to the insufficient manpower in the field of mental health and the findings specific to this study, it is thought that it is important to increase the number of health professionals working in the field of mental health.

Several demographic and economic factors are effective in explaining life expectancy, including family traditions, level of education, housing, lifestyle, health behavior, and environmental risk factors.[16] The balance between aging and health is related to well-being. Well-being has a protective role in promoting health.[12] Social support networks,[12] perceived health status, and life satisfaction make up important components of subjective well-being.[12,15] The data in the Mental Health Atlas 2017 support the literature and emphasize the importance of efforts to increase subjective well-being. According to this report, 63% of countries in the world have a mental health promotion and prevention program. Forty percent of these programs cover improving mental health literacy or combating stigma.[27] In line with this information, in the study, we analyzed the variables "quality of support network," "perceived health status," and "life satisfaction," which are thought to be related to life expectancy. Accordingly, the ranking of these variables in order of importance was "perceived health status, life satisfaction, and quality of support network," respectively. Subjective well-being variables were relatively less important than the variables of healthcare resources in promoting life expectancy. These results point out that the priority for planned interventions related to life expectancy should be strengthening healthcare resources. It should be taken into account that strengthening mental health resources may also positively affect the variables of subjective well-being. As a result, it is necessary to develop policies, make investments in social protection, improve the quality of care, and support a healthy lifestyle to promote life expectancy.[16]

Reflections on Nursing

According to the 2019 report of the OECD, approximately three million premature deaths can be prevented with a qualified health care service.[2] In line with this information, health promotion practices, and qualified nursing care services have become a basic need to increase life expectancy.[31] It is also stated that the increase in the number of nurses, who are an important source of mental health, will also increase life expectancy. Increasing life expectancy will increase the need for nursing care in response.[1] In this vicious circle, nurses, who occupy a large place in health service delivery, play a key role in improving health outcomes and meeting rapidly increasing health service demands.[32] Increasing the number of qualified nurses and ensuring their equal distribution is necessary and important for the management of life expectancy-related variables. However, studies examining the role of nurses in increasing life expectancy, which is a basic indicator of health level, are limited.[1] In this context, it is believed that the results obtained from this study will guide nurses on the priority interventions and policies that should be planned to increase life expectancy and the management of the variables associated with life expectancy.

Limitations and Recommendations for Future Studies

This study has some limitations; for example, the year of the data differed from country to country. For this reason, the most up-to-date data for each country were used in the study. Another limitation was the lack of data for some countries. Therefore, the results of this study should be evaluated in the context of the countries included in it. However, we recommend that new studies be planned when the datasets are updated in the following years. Lastly, the selected variables are limited to the assumptions of the researchers. For this reason, it is recommended to plan studies that include more and different variables in the field of mental health related to the subject. In addition, the increase in the diversity of mental health-specific data in official databases will allow researchers to conduct more comprehensive evaluations.

Conclusion

In this study, mental health variables that might be associated with life expectancy were ranked in order of importance. Accordingly, "healthcare resources" grouped as the number of psychiatric beds and mental health professionals ranked first. It was determined that subjective well-being, another variable that might be related to life expectancy, had relatively less importance. The results obtained point to the importance of strengthening mental health resources in order to increase life expectancy. It should not be overlooked that studies on strengthening resources may have positive effects on subjective well-being. Achieved results; it can guide mental health professionals, health policy makers, and researchers in solving problems that affect life expectancy.

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