APPLICATION OF THE ANALYTIC HIERARCHY PROCESS FOR THE SELECTION OF BENEFICIARIES AND PROVIDERS OF OCCUPATIONAL REHABILITATION SERVICE

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ABSTRACT

Purpose: The aim of this study is to select the beneficiaries and providers of Occupational Rehabilitation Service for Turkey.

Material and Methods: This research conducted to select the beneficiaries and providers for occupational rehabilitation used the Analytical Hierarchy Process (AHP), which is a multi-criteria decision making technique. This research conducted based on expert opinion, the results of 4 components were evaluated according to criteria of relevance, human orientation and cost.

Results: It was determined that the highest weight was "workers who have had a occupational disease" with 0.444 and the lowest weight is "workers who have had a accidents/disease for non-work reasons" with 0,232. "Ministry of Health" is selected as the highest weighted alternatives with 1.21. 'With the commission decision that can give fitness of the work' is also the highest weighted alternatives with 0.51. 'Case Manager' is the alternative with the highest level of importance with 0,29.

Conclusion: Occupational rehabilitation isn't a service defined and implemented by the Health Implemetation Comminique (HIC) or any other legislation. It can be implemented with in the existing health system in Turkey. This servise may help to reduce lost of work and economic and social cost caused by occupational accident and disease.

Keywords: Occupational rehabilitation, return to work, occupational health, occupational safety, AHP.

INTRODUCTION

Work related injures and diseases are the major public health problem in the world. The Labour Organisation (ILO) reports that 2.3 million work-related accidents or illnesses occur worldwide every year, and that 6,000 workers die every day as a result of these occupational accidents and diseases (1). The impact of accidents and injuries on the global economy is also very high. The European Agency for Health and Safety at Work reported that occupational accidents and diseases caused 2.8 million deaths worldwide, resulting in a total loss of 67.8 million years of life, while injuries and diseases caused a total of 55.5 million years of disability (2). When all these are evaluated on the basis of the average production of an employee, it is estimated that the total cost of fatal and non-fatal work-related incidents accounts for 3.9% of global Gross Domestic Product. Occupational rehabilitation is defined as a multidisciplinary field of study that removes health-

related physical or Metal limitetin and / or limitations related to the working life of individuals from working age, thus supporting effective participation in working life by increasing work-worker fitting (3–5). This service accelerates work adaptation and return to work, reduces lost working days and ensures sustainable employment. In this way, economic and social costs arising from occupational accidents and occupational diseases are minimised (7,8).

According to the Social Security Institution statistics for 2022, 588,823 people had work accidents and 1,517 of these people died after work accidents. 953 people were diagnosed with occupational diseases and 8 of them died. As a result of non-fatal work-related accidents and diseases, some of workers are separated from employment with temporary incapacity for work and some with permanent incapacity for work and disability. Not only very high economic cost of lost working days and loss of working capacity, but also it hinders sustainable employment and causes social exclusion. For this reason, a occupational rehabilitation-return-to-work service that reduces the loss of working days as a result of work-related accidents and diseases, supports the sustainable employment of the employee and prioritises the principle of fitness for work becomes essential.

MATERIAL AND METHODS
AHP is defined as "measurement through pairwise comparisons and relies on the judgments of experts to derive priority scales". The method is widely used and flexible tools for complex decisions (9-11). The principles and priorities of this method were firstly defined by Thomas L. Saaty in the 1970s (11–13). The method includes 6 steps summarized below (14-15);

Research Questions
In Turkey, there isn't any occupational rehabilitation service with a legislative basis and implementation. The questions of this research are as follows;
- Who should benefit from occupational rehabilitation?
- Who should be the occupational rehabilitation service provider?
- Who should be decision maker on occupational rehabilitation-return to work?
- Which organisations/experts should be members of the commission that will decide on return to work?

In this research, with these questions are aimed to select the beneficiaries and providers of Occupational Rehabilitation Service for Turkey.

Expert Selection
This research conducted to select the beneficiaries and providers for occupational rehabilitation used the AHP, which is a multi-criteria decision making technique. In the research conducted based on expert opinion. Six experts were selected for this research. The AHP method can be applied to only one person, case or situation, and it can also be applied to multiple persons or situations. Six experts worked as decision makers in this study. Three of the experts have a bachelor's degree in engineering. These experts have been working on occupational rehabilitaton and occupational health and safety issues at public institutions for minimum ten years. The other experts have a bachelor's degree in medicine and these experts have been working on occupational health, occupational rehabilitation and return to work in universities as an academician for minimum ten years.

Data Collection and Analysis
At this step, the data was collected through online forms created according to the hierarchical structure. Where necessary, experts were consulted through face to face or telephone call to ensure that the form was completed correctly.

The results of 4 components of the research questions were evaluated according to criteria of relevance, human orientation and cost. In the data analysis, Microsoft Excel programme was used for the calculations.

Defining the problem and determining the alternatives
The aim of this study is to select service components for occupational rehabilitation under three criteria are relevance, human orientation and cost. A quetionnaire with 4 question was prepared according to Saaty's scale (9-point). Six experts who have been working on occupational rehabilitation answered the questionnaire as a decision maker.

Establishing the decision hierarchial structure
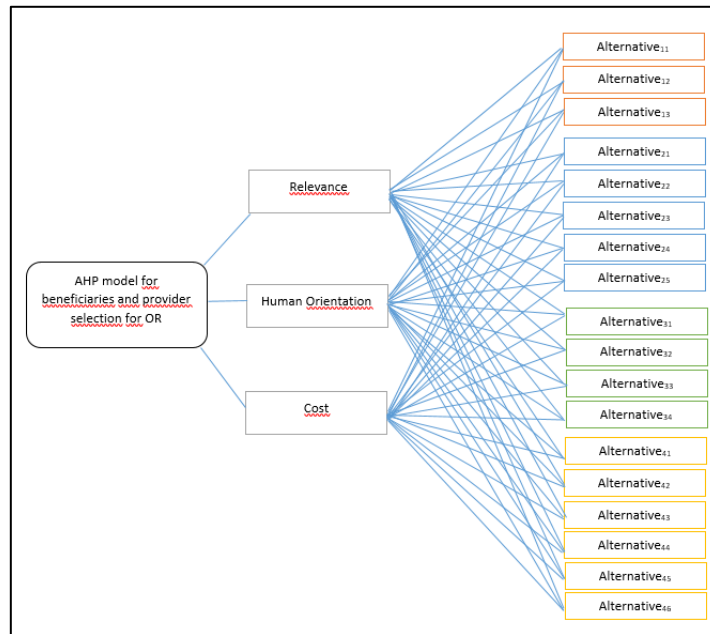Figure 1 shows the established selection model with a total of 18 alternatives for 3 criteria and 4 questions.

Figure 1. The hierarchical structure of AHP for selection

Table 1. Saaty's Scale

Importance	Definition	Explanation
1	Equal importance	Two criteria contribute equally to the objective
3	Moderate importance	Experience and judgement slightly favor one criterion over another
5	Strong importance	Experience and judgement strongly favor one criterion over another
7	Very strong or demonstrated importance	A criterion is favored very strongly over another; its dominance is demonstrated in practice
9	Extreme importance	The evidence favoring one criterion over another is of the highest possible order affirmation
2,4,6,8	Intermadiate	Can be use if necessary

Resource: Suitability Index (16)

Constructing pairwise comparision matrix

After establishing the hierarchial structure, three criteria were compared pairwise. In n-element matrix, there are (n-1)/2 comparisons. The Saaty Scale, given below, was used for comparisons.

According to the Saaty's scale given above, the nxn dimensional pairwise comparison matrix to be prepared for n number of criteria is as follows;

The cells shows the values indicating the degree of importance of the i-row element according to the j-column element. In the evaluation of the pairwise comparison matrix, the value of each target according to itself should be $a_{ij}=1$ since $i=j$. In other cells, if $a_{ij}=k$, $a_{ji}=1/k$.

Normalisation, Calculating weights/eigenvectors

t_i: sum of column i.

For normalisation, it is obtained by dividing each cell in the pairwise comparison matrix by the column sum. Criteria weights are calculated by averaging the normalised matrix rows. Eigenvector (criteria weight) is a mathematical expression calculated as;

$$\frac{1}{n}\sum_{i=1}^{n}\frac{a_{1i}}{t_i} \quad (1)$$

Calculation of Consistency ratio and Consistency Index

In the consistency calculation, the λmax value is first calculated by dividing the product of the pairwise comparison matrix and the eigenvector matrix by the relevant eigenvector and taking the average of the values obtained. The consistency index (CI) is then calculated from the λmax value obtained.

$$CI=\frac{\lambda max-n}{n-1} \quad (2)$$

The calculation of the consistency ratio, the Random Consistency Index values determined by Saaty according to the number of criteria were used.

After the normalisation, weighting and calculation of criteria weights and consistency index, it is needed to determine whether the responses from the experts can produce a consistent decision. In order to ensure expert's individual responses are consistent and measure the degree of this, consistency ratio (CR) is calculated. Consistency measurement is a the significant step for the AHP analysis. If the consistency rate is less than 10%, this indicates that the answers may reveal a consistent decision.

$$(CR) = \frac{CI}{RI} \quad (3)$$

Ranking the alternatives

The alternatives are analysed by pairwise comparisons according to the criteria. The final step of the AHP method is the calculation of the final priority weights and ranking of the alternatives. The final weight is defined as the contribution of each sub-criteria to the final output. The final weight calculation is based on the additive summation used by Saaty. Therefore, the final priority weight of each sub-criteria is obtained by summing up all local weights. The final weight is the sum of the local weights of the main criteria multiplied by the local weights of the respective sub-criteria. The weighted sum of the criteria, sub-criteria and their scores gives the total score of each alternative and the alternative with the highest value is selected as the best alternative.

Ethical Considerations

Ethical approval was obtained from the Science and Engineering Ethical Committee of Ankara Yildirim Beyazit University (Date: 01.04.2024, Decision No: 2024-10).

RESULTS

The experts were asked 4 components to select beneficiaries and providers for occupational rehabilitation services and responses were given according to the criteria of relevance, human orientation and cost. The alternatives that are expected to be evaluated according to the criteria of relevance, human orientation and cost are given in Table 4.

Table 4 shows the expert selections for the 4 components. For Q1 *"Who should benefit from occupational rehabilitation?",* it was determined that those who had occupational accidents/occupational

diseases should benefit from occupational rehabilitation services first with regard to the criteria of relevance and human orientation. According to the cost criterion, non-occupational accidents/illnesses have the highest weight. Considering the total weights, it was determined that the highest weight was "Workers who have had a occupational disease" with 0.444 and the lowest weight is "Workers who have had a accidents/disease for non-work reasons" with 0,232.

For Q2 *"Who should be the occupational rehabilitation service provider?",* "Ministry of Health" has the highest weight according to the criteria of relevance and human orientation. According to the cost criterion, "Ministry of Health" and "Turkish Employment Agency (İŞKUR)" are the highest weighted alternatives. According to the total score, "Ministry of Health" is selected as the highest weighted alternatives with 1.21.

For Q3 *"Who should be decision maker on occupational rehabilitation-return to work?",* according to the criteria of relevance (0,51), human orientation (0,52) and cost (0,52), 'With the commission decision that can give fitness of the work' is the highest level of importance. According to all score, 'With the commission decision that can give

Table 2. Pairwise Comparision Matrix

Criteria (C)	C1	C2	C3	.	.	Cn
C1	1,00	a12	a13	.	.	a1n
C2	a21	1,00	a23	.	.	a2n
C3	a31	a32	1,00	.	.	a3n
.	.	.	.	1,00	.	.
.	.	.	.	.	1,00	.
Cn	an1	an2	an3	.	.	1,00
Total	t1	t2	t3	.	.	tn

Table 3. Random Consistency Index (17)

Matrix Size (n)	Random Consistency Index
1	0,00
2	0,00
3	0,58
4	0,90
5	1,12
6	1,24
7	1,32
8	1,41
9	1,45
10	1,49

Table 4. Criteria-based Alternative Selection Table

Response/criteria	Relevance	Human Orientation	Cost	1-Cost	Total Score
Q1. Who should benefit from occupational rehabilitation?					
R1 Workers who have had a occupational accidents	0,45	0,33	0,54	0,46	0,421
R2 Workers who have had a occupational disease	0,45	0,33	0,3	0,7	0,444
R3 Workers who have had a accidents/disease for non-work reasons.	0,09	0,33	0,16	0,84	0,232
Q2. Who should be the occupational rehabilitation service provider?					
R1 Ministry of Health	0,6	2,72	0,34	0,66	1,21
R2 ÇASGEM	0,1	0,36	0,04	0,96	0,26
R3 SGK	0,1	0,76	0,18	0,82	0,36
R4 İŞKUR	0,1	0,67	0,33	0,67	0,32
R5 Private Sector	0,1	0,49	0,12	0,88	0,29
Q3. Who should be decision maker on occupational rehabilitation-return to work?					
R1 SGK	0,11	0,08	0,08	0,92	0,18
R2 İŞKUR	0,19	0,2	0,2	0,8	0,25
R3 with physician report	0,19	0,2	0,2	0,8	0,25
R4 with a commission decision that can give fitness of the work	0,51	0,52	0,52	0,48	0,51
Q4. Which organisations/experts should be members of the commission that will decide on return to work?					
R1 İŞKUR	0,2	0,08	0,2	0,8	0,22
R2 SGK	0,2	0,14	0,1	0,9	0,25
R3 Ministry of Health	0,2	0,23	0,2	0,8	0,27
R4 ÇASGEM	0,06	0,05	0,05	0,95	0,15
R5 Relevant Employer, occupational physician and OHS expert	0,14	0,14	0,11	0,89	0,21
R6 Case Manager	0,2	0,36	0,34	0,66	0,29

fitness of the work' is also the highest weighted alternatives with 0.51.

For Q4 *"Which organisations/experts should be members of the commission that will decide on return to work?",* it was determined that 'Turkish Employment Agency (İŞKUR)', 'Social Security Institution (SGK)', 'Ministry of Health' and 'Case Manager' are the alternatives with equal level of importance according to the criterion of relevance while 'Case Manager' is the alternative with the highest level of importance according to the criteria of human orientation (0.36) and cost (0.34). According to all criteria, 'Case Manager' is the alternative with the highest level of importance with 0,29.

DISCUSSION

In this study, it was aimed to select the occupational rehabilitation beneficiaries and providers based on the criteria of relevance, human orientation and cost. According to the results of the study, occupational rehabilitation services for Turkey should be provided after occupational accidents and occupational diseases as a priority. Ministry of Health should be also service provider as a priority. It was also found that occupational rehabilitation and return to work should be decided by a commission including case managers.

Occupational rehabilitation services designed to assist workers in returning to work after occupational accidents and disease thereby enhancing their quality of life, preventing long-term disability and reducing societal and economic costs. A systematic review by Cullen et al. (2018) analyzed the effect size of numerous interventions and found that workplace-based programs, especially those integrating ergonomic and psychosocial components, significantly improve return-to-work rates (18). Similarly, Vogel et al. (2017) demonstrated that early intervention and multidisciplinary approaches in occupational rehabilitation are associated with shorter disability durations and higher employment retention. These findings show the effectiveness of

comprehensive occupational rehabilitation services in facilitating successful reintegration into work(19). A study by the OECD (2010) found that comprehensive return-to-work programs not only reduce the economic burden of disability but also improve overall workforce productivity. By facilitating faster recovery and reducing absenteeism, these return to programs help both workers and employers maintain a stable workforce, which in turn has positive effects on the broader economy (20).

In addition, occupational rehabilitation services are associated with the retention rates. A study by Jeong et al. (2018) stated that the relationship between workplace health interventions and employee retention. The study suggests that employees who got occupational rehabilitation service by their employers during recovery are more likely to remain with the company long-term. This not only benefits workers but also provides significant advantages for employers in terms of reduced recruitment and its costs (21).

Occupational rehabilitation services vary in practice from one country to another (22). In Canada and Australia, vocational rehabilitation services are provided as part of health care. In the USA, vocational rehabilitation is carried out by a structure called RETAIN (Retaining Employment and Talent After Injury/Ilness Network). This occupational rehabilitation service covers diseases and injuries such as cancer or disabilities other than occupational accidents/occupational diseases (23). In European countries, vocational rehabilitation is implemented in quite different structures. In Austria, Denmark, Finland, Germany, Netherlands, Norway and Sweden, occupational rehabilitation service covers everyone and any situation that takes them away from work. The most important actor in occupational rehabilitation is the employer and the processes are coordinated by him/her.

In Belgium, France, Iceland, Iceland, Italy, Luxembourg, Switzerland and the UK, occupational rehabilitation is mainly implemented to accelerate return to work after diseases (24). However, recent studies show that with COVID-19, practices have also been developed in France and the UK after more illness and occupational accidents/occupational diseases (25-26). In many countries, the occupational rehabilitation service is provided by private facilities or occupational therapists as a case manager (27).

Limitations

This study has several limitations. First, occupational rehabilitation was not well-known concept in our country. Therefore, the number of experts working in this field is quite limited. Occupational rehabilitation is an unpracticed service in Turkey and there is no legislation on this issue. Therefore, evaluations of the service provider include a priori evaluations of the system.   Second, while the AHP method enables structured decision-making based on expert opinion, the derived judgments reflect the context-specific experiences and professional interpretations of the selected informants. As occupational rehabilitation lacks formal legislative and institutional recognition in Turkey, there may be instances where the judgments obtained differ from internationally established scientific findings or normative approaches. This contextual specificity should be considered when generalizing the results or drawing comparisons with broader global practices.

As a result of this research, it was selected the occupational rehabilitation beneficiaries and providers based on the criteria of relevance, human orientation and cost. This study is novel in terms of identifying/selecting the beneficiaries and service providers in occupational rehabilitation services. Occupational rehabilitation isn't a service defined and implemented by HIC or any other legislation. Occupational rehabilitation service can be implemented with in the existing health system in Turkey. This servise may help to reduce lost of work and economic and social cost caused by occupational accident and disease.

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