

# Efficiency Analysis of Chinese Acupuncture Treatment of Cervical Spondylotic Based on DEA

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**Abstract.** Acupuncture in traditional Chinese medicine is a common therapy for cervical spondylosis, but there is lacking of efficiency evaluation of acupuncture treatment of cervical spondylosis at present. In this paper, twelve patients from The First Affiliated Hospital of Guangxi University of Chinese Medicine were selected to analyze the efficiency of traditional Chinese acupuncture treatment of cervical spondylosis based on BCC model of DEA. The results show that PTE is relatively high and SE is low. We should maintain PTE and enhance SE by the means of technology training and increase time and cost inputs.

## 1. Introduction

Cervical spondylosis is a common and frequently occurring disease in the clinic. Cervical spondylosis is a syndrome caused by compression or stimulation of the cervical nerve, spinal cord, nerve root, sympathetic nerve and peripheral soft tissue due to the degeneration of cervical intervertebral disc, ligament and articular capsule, cervical vertebral hyper osteogeny and so on. Cervical spondylosis belongs to the category of "bone obstruction" in traditional Chinese medicine. Its characteristics are repeated attacks and difficult to cure. At present, in the clinical evaluation of traditional Chinese medicine, complex intervention runs through the whole process, which has the characteristics of multi-dimensional intervention purpose, time and space of syndrome differentiation and treatment and diversified treatment methods. Cervical spondylosis is often due to work posture, living habits, strain or liver and kidney insufficiency, blood cannot nourish tendons and bones caused by local empty veins, wind, cold and dampness, so that Ying Wei Qi and blood discord, meridian obstruction and disease, resulting in a series of clinical symptoms such as neck and back discomfort or pain. Acupuncture of Jiaji acupoint can dredge Du meridian and solar meridian, promote meridian and collateral circulation, promote qi and blood circulation, improve local microcirculation, and regulate nerve and blood vessel function. The narrow intervertebral space with cervical traction, can increase the intervertebral space between the various vertebral bodies, alleviate neurovascular compression and reduce symptoms. Acupuncture can also relieve spasm, eliminate inflammation, alleviate or relieve nerve root stimulation symptoms; can improve the blood supply of vertebral-basilar artery system to the brain in patients with vertebral artery type of cervical spondylosis, relieve symptoms, relieve syncope and other discomfort symptoms. However, in the past clinical evaluation of traditional Chinese medicine, more attention was paid to the single-dimensional evaluation of the clinical outcome indicators of single treatment, and the lack of multi-dimensional outcome measurement of complex intervention of traditional Chinese medicine, thus reducing the exertion of the advantages of traditional Chinese medicine and reducing the actual clinical efficacy.

## 2. Principles and Models of DEA

**Principles of DEA.** In 1978, a method called Data Envelopment Analysis (DEA) was first proposed by famous operational researcher A. Charnes, W. W. Cooper and E. Rhodes to evaluate the relative effectiveness between departments. Data envelopment analysis has been widely used in the research of analysis and comparison at home and abroad. This method involves not only the comparative analysis of multi-input and multi-output, but also the relevant decision-making. Formulation can also

play an important role. DEA mainly uses mathematical programming models to evaluate the relative effectiveness between departments or decision-making units with multiple inputs and multiple outputs. It is a nonparametric evaluation method, and is also an effective method to estimate the frontier of production. The prominent feature of DEA is that it does not need to consider the functional relationship between input and output. It does not need to pre-estimate parameters, any weight assumptions to avoid subjective factors. Data Envelopment Analysis is a comprehensive evaluation method which combines mathematical and economic operations research and management science. It is suitable for the complex intervention characteristics of TCM comprehensive programs and can obtain more accurate analysis. Data envelopment analysis is different from previous evaluation methods that can only deal with individual data. It can be applied to the efficiency evaluation of multi-input and multi-output, and can be effectively refined in the operation process. Data envelopment analysis does not need to give any weight to the constructed index. Instead, it is a process operation based on the actual data input and output by the decision unit. In the analysis and comparison of DMUs, DEA excludes many subjective factors, to maximize the objectivity of the results. At the same time, the DEA method reduces the difficulty of collecting, screening and integrating index data. In this study, DEA was used to evaluate the clinical efficacy of the comprehensive scheme of traditional Chinese medicine in patients with cervical spondylosis.

**CCR Model.** This paper uses DEA (Envelopment Analysis Data) to study the efficiency of Hunan logistics industry. The most basic model of DEA is the CCR model. It is assumed that the scale of remuneration is fixed to calculate the relative comprehensive technical efficiency. If there are  $n$  decision making units,  $m$  input variables for each decision unit, and  $p$  output variables.

$X_j = (x_{1j}, x_{2j}, \dots, x_{mj})^T \quad j = 1, 2, \dots, n$  and  $Y_j = (y_{1j}, y_{2j}, \dots, y_{pj})^T \quad j = 1, 2, \dots, n$  are input variables and output variables for decision making unit DMU. CCR model is described as follows:

$$\begin{aligned} & \min \theta \\ & s.t. \begin{cases} \sum_{j=1}^n \lambda_j x_j + s^- = \theta x_0 \\ \sum_{j=1}^n \lambda_j y_j - s^+ = y_0 \\ s^- \geq 0, s^+ \geq 0, \lambda_j \geq 0, \\ \theta \end{cases} \end{aligned}$$

**BCC Model.** The CCR model assumes that the scale of the decision-making unit is constant. The production efficiency, which is influenced by the scale factor, is called the scale efficiency. It depends on decision making unit resources disposition ability, the efficient use of resources and capacity of comprehensive measurement and evaluation. Return scale refers to the state in which the output changes when all factors of production change in the same proportion. The constant return on scale refers to the fact that all factors of production change in the same proportion and the proportion of factors of production changes is equal. This hypothesis shows that efficiency is not affected by the overall size. This hypothesis is not satisfied in many cases and does not conform to reality. Comprehensive technical efficiency can be decomposed into pure technical efficiency and scale efficiency. Pure technical efficiency reflects the factors that affect the efficiency of decision making units due to the management and technology, and the scale efficiency is the production efficiency of the scale factor.

### 3. Empirical Research of Chinese Acupuncture Treatment of Cervical Spondylotic Based on DEA

**Selection of Index System.** Chinese acupuncture treatment is a complex system of multi input and multi output. We select cost of acupuncture X1 and time of acupuncture X2 as input variables. The

variables of degree of pain reduction Y1 and limb movement function Y2 are selected as the output variables.

**Acquisition of Raw Data.** To ensure the accuracy of the results, DEA model generally requires that the number of decision-making units is three times or more than the total number of variables. Twelve patients with cervical spondylosis were selected as the decision-making unit. There were four input and output variables, which met the above requirements. The subjects were cervical spondylosis patients in The First Affiliated Hospital of Guangxi University of Chinese Medicine from August 2017 to July 2018. The raw data is shown as follows:

Table 1. Input and output variables of Chinese acupuncture treatment of cervical spondylotic

Index name	Degree of pain reduction	Limb movement function	Cost of acupuncture	Time of acupuncture
Variable	Y1	Y2	X1	X2
Unit	1	1	Yuan	Hour
Patient 1	5.0	7.0	362	3.2
Patient 2	5.5	8.5	455	4.5
Patient 3	8.0	3.5	352	4.3
Patient 4	9.5	7.5	801	8.1
Patient 5	3.0	5.0	725	6.2
Patient 6	2.0	4.0	307	2.3
Patient 7	5.0	6.5	557	5.2
Patient 8	6.5	5.5	228	1.5
Patient 9	7.5	7.5	235	3.6
Patient 10	7.0	8.5	1025	5.9
Patient 11	6.5	7.5	620	8.1
Patient 12	3.5	6.0	505	6.4

**Obtainment of Operation Results.** This paper attempts to calculate the comprehensive efficiency, pure technical efficiency and scale efficiency of acupuncture treatment of cervical spondylosis. The analysis software is DEAP2.1 and the BCC model is selected.

Table 2. Operation results of DEA

	TE	PTE	SE	SR
Patient 1	0.612	0.744	0.822	drs
Patient 2	0.787	0.796	0.989	drs
Patient 3	1	1	1	-
Patient 4	0.770	0.899	0.856	irs
Patient 5	0.982	1	0.982	irs
Patient 6	0.703	1	0.703	irs
Patient 7	0.706	0.789	0.895	irs
Patient 8	0.879	0.883	0.996	irs
Patient 9	0.752	1	0.752	irs
Patient 10	0.835	0.969	0.862	irs
Patient 11	0.669	0.912	0.734	irs
Patient 12	0.742	0.855	0.868	drs

#### 4. Results Analysis and Related Suggestions

**Technology Efficiency.** The technology efficiency (comprehensive efficiency) of acupuncture and moxibustion treatment of cervical spondylosis fluctuated greatly from patient 1 to patient 12. The minimum time is only 0.612, the maximum time is 1. The average value is 0.795. A certain scale of capital and time input is necessary. However, we should avoid blind injection of acupuncture time and acupuncture cost according to the actual situation of patients. Patient 3 only invested 352 Yuan and 4.3 hours, and achieved good results. The overall efficiency is 1. We should improve acupuncture technology, avoid blind investment to enhance the comprehensive efficiency.

**Pure Technology Efficiency.** Generally speaking, the low technology efficiency is mainly caused by two aspects: pure technical efficiency and scale efficiency. However, the pure technology efficiency of Chinese acupuncture and moxibustion treatment of cervical spondylosis are relatively high. We can see that the maximum value of pure technology efficiency is 1 (Patient 3, Patient 5 and Patient 6). The minimum value of pure technology efficiency is 0.744 (Patient 1). Overall, the pure technical efficiency acupuncture treatment of cervical spondylosis is in a higher level and the average value is 0.903. The First Affiliated Hospital of Guangxi University of Chinese Medicine should do a good job in technology training and talent recruitment to ensure that the value of pure technical efficiency is at a high level.

**Scale Efficiency and Scale Return.** From the scale efficiency point of view, except for the peak of Patient 3, the scale efficiency of the rest of the patients are less than 1. Especially Patient 6, Patient 9, Patient 11, the scale efficiencies are less than 0.8. From the scale benefit point of view, a total of 8 patients scale benefit is in an increasing stage. We should devote more time and money to the development of acupuncture and moxibustion techniques for the treatment of cervical spondylosis and make due contributions to the health of the residents.

#### 5. Conclusions

Based on data envelopment analysis, we have obtained the great value of Chinese medicine acupuncture in treating cervical spondylosis. In the process of popularization, we should pay more attention to increasing the time and cost of acupuncture and moxibustion. Of course, the deficiency of this study lies in the small number of follow-up sample size, so there may be some limitations in the applications of the study results.

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