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An Evaluation of the Psychological Life Quality of Women with Disabled Children with Box Behnken Experimental Design

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Abstract

*The purpose of this study was to implement the BBD method, which is a response-surface method, quantitatively and compare it with three-way analysis of variance. In the study, we used the short-form The World Health Organization Quality of Life WHOQOL-BREF-TR scale, which was developed by the World Health Organization and was tested by Eser et al. (1999) to determine its validity and reliability. This approach allowed us to attempt to determine the optimal variable combination in the psychological quality of life of mothers with intellectually-disabled children. The research was conducted with 540 mothers who had intellectually-disabled children. By use of 3^3 Box Behnken experimental design (BBD), which is a response surface method, variables and levels were determined according to the balanced incomplete block design. According to the results, the main effects of the mother's age and the number of children were statistically significant. In addition, the interaction effect of "the mother's age*the time she learnt the disability" was significant. The R^2 value of the model was found to be 90.33%. When the same set of data was analyzed via three-way analysis of variance, both the main effects and the interaction effects were found to be insignificant. The response surface method may be an alternative to the analysis of variance in the factorial experiments that are used frequently in the social sciences and in research related to social work.*

Keywords: *Response surface method, Box-Behnken experimental design (BBD), Quality of life, Social work.*

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Engelli Çocuğa Sahip Kadınların Psikolojik Alan Yaşam Kalitelerinin Box-Behnken Deneme Düzeni ile Değerlendirilmesi

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Öz

*Araştırmanın amacı, Yanıt Yüzeyi Metotlarından BDD yöntemini nicel olarak uygulamak ve üç yönlü varyans analizi ile karşılaştırmaktır. Çalışmada Dünya Sağlık Örgütü tarafından geliştirilen, geçerlik ve güvenilirliği Eser vd. (1999) tarafından yapılmış olan, Türkiye için ulusal soru eklenen, kısa form WHOQOL-BREF-TR ölçeği kullanılmıştır. Bu kapsamda, zihinsel engelli çocuğa sahip annelerin ruhsal alan yaşam kalitesindeki optimal değişken kombinasyonunun belirlenmesi amaçlanmıştır. Araştırma 540 zihinsel engelli çocuğa sahip anne ile yapılmıştır. Yanıt yüzeyi metodunun 3^3 Box Behnken deneme düzeni (BDD) kullanılarak, dengeli tamamlanmamış blok tasarımına göre değişkenler ve seviyeleri belirlenmiştir. Sonuçlara göre, annenin yaşı, çocuk sayısı ana etkileri ile yaşı*engelli öğrenme zamanı etkileşimleri istatistiksel olarak anlamlı bulunmuştur. Modelin R^2 değeri %90.33 olarak hesaplanmıştır. Aynı verilere üç yönlü varyans analizi uygulandığında ise, hem ana etkiler hem de etkileşim etkileri anlamsız çıkmıştır. Sonuç olarak, özellikle sosyal bilimlerde ve sosyal hizmet araştırmasında yaygın olarak kullanılan, faktöriyel denemelerdeki varyans analizinin yöntemineinin yerine yanıt yüzeyi metodu bir alternatif olarak kullanılabilir.*

Anahtar Kelimeler: *Yanıt yüzeyi metodu, Box-Behnken deneme düzeni (BDD), Yaşam kalitesi, Sosyal hizmet.*

Introduction

In all societies, children are considered to be the adults of future, so they are raised and educated with care. They are valuable individuals, and societies try to meet their needs by making maximum use of available resources. An intense period of preparation is initiated for the newcomer in the family as soon as the mother's pregnancy is confirmed. While there are different approaches in different societies, they all have in common trying to ensure that the mother-to-be is well cared for and gives birth to a healthy baby (Crinic, et. al., 1983; Ersoy, 1997; Kaner, 2004; Kazak and Marvin, 1984).

However, the birth of a disabled child affects the development of the individual and the development of her or his family. It is a process that requires adaptation phases within the family. This poses a problem both for the disabled person and for the family, and it requires rehabilitation (Lüle, 2008, p.14).

Mothers with disabled children experience problems that are different and more intense than other mothers. They must be concerned about various matters, including the child's health, self-care, education, adolescent development and problems, employment and occupation, in-family psycho-social life, social environment, and the life of the disabled person after the death of the parents. Given these complexities, each mother with a disabled child may have different expectations and needs (Turnbull and Turnbull, 1985; quoted in: Dönmez et al., 2000, p. 16). These situations and concerns are experienced by families with disabled children to a greater extent. This is because mothers of disabled children must provide their care throughout their lives, which results in numerous physical and spiritual problems in their efforts to sustain their children's lives.

Generally, the mother is the person in the family who is most influenced by such a situation. Mothers of disabled children experience more stress and have more emotional demands than other mothers (Smith et al., 1993). Canarslan and Ahmetoğlu (2015) reported that mothers experience a more significant decrease in their quality of life than fathers. Generally, mothers experience a lot of stress because they are usually the only caregiver for most of the hours of the day. They must care for the disabled children as well as the other children and their husband, which leads them

to experience stress, anxiety, and depression. Unfortunately, assuming too much responsibility for the children's care and various other family-related responsibilities enhances the risk of experiencing other stress-related problems (Ganong et al., 2003). Many researchers have concluded that the stressful period that begins when a disabled child is born brings with it as shocking reality that must be dealt with, this can lead to a significant risk of a series of seemingly unending crises (Kazak and Marvin, 1984; Wolfsenberger and Menoloscino, 1970). At times, there may be feelings of guilt, anxiety, depression, and desperation. When growth retardation is diagnosed in the child, families may experience a trauma similar to those of guilty individuals (Ellis and Hirsch, 2000; quoted in: Bumin et al., 2008, p. 7). In addition, it has been reported that the presence of a disabled person in the family may cause mothers to experience negative emotions, such as denial, sorrow, anger, shame, concern, unexpected crises, the desire to withdraw from the external world, frustration, and decreases in self-confidence and self-esteem (Gettinger and Guetschow, 1998; Küçüker, 1993; Tokad et al., 1997). Moreover, experiencing constant anxiety, depression, and concern may lead the family to have psycho-social problems (Işıkhan, 2005, p. 37). Although there are many factors that give rise to these problems, those that are known to have an important influence are the age of mothers, the number of children they have, and how long they have known about the disability.

Therefore, the identification of the variables that can maximize psychological quality of life of mothers with intellectually-disabled children will increase the effectiveness and efficiency of the services to be provided for them.

In this sense, the World Health Organization (WHO) defines quality of life as "an individual's perception of her or his position in life in the context of the culture and value systems in which he or she lives and in relation to goals, expectations, standards and concerns" (Aslan, 2010, p. 102). Bilgin et al. (1985, p. 159) stated that psychological quality of life is based on the reactions of an individual based on her or his own life experiences. The satisfaction one gets from her or his job and family life and her or his characteristics, such as skills and learning, are taken as variables. Furthermore, psychological quality of life is constituted by body image and ap-

pearance, negative feelings, memory, focus of attention, positive emotions, thinking and making decisions, self-esteem, and personal beliefs (Eser, 1999; Özkan, 1999).

Methodology

Initially, an experimental model was created. Analysis was performed according to the specified experimental design levels.

Sampling

The research was conducted with 540 mothers who had intellectually-disabled children. The data obtained from the Ministry of National Education in Turkey, 3,117 individuals from the Yenimahalle District of Ankara Province special education classes. Using the stratified sampling method, 540 people were selected randomly from the data for the study.

Data collection tools

In this study, we used the WHOQOL-BREF-TR scale, which was developed by the World Health Organization with 100 questions and whose validity and reliability were validated by Eser et al. (1999), including some additional questions that were related specifically to Turkey. The total mean scores were calculated for the psychological domain of the scale. In order to minimize the total variance of the psychological scores between mothers, we contacted two or more the mothers who were previously selected from each category, and the mean was calculated.

Analysis of data

The 3^3 Box-Behnken experimental design, which is a response surface method, was used in the study. Variables and levels for balanced incomplete block design were determined at beginning of the study. In addition, three-way analysis of variance was performed, and the results were compared to the results obtained from the Box-Behnken experimental design.

All of the analyses were evaluated using Minitab 17 Statistical Software Program.

Box-Behnken Experimental Design (BBD)

This experimental design was proposed by Box and Behnken in 1980, and it is an effective method for creating a second-order response surface model. The method is based on balanced, incomplete, block-design experiments. The factors in the model should have at least three levels. In the Box-Behnken experimental design, the value of one of the factors is fixed at the central value, while combinations of all of the levels of the other factors are used (Kocabaş 2001; Myers & Montgomery 2002). In summary, the Box-Behnken designs are response surface designs that are used to estimate second-order models, form subsequent designs, and analyze the lack of reliability of the models; they also are used in designs with blocks (Bayrak et al. 2010; Tekindal et al. 2012; Tekindal et al. 2014).

Three-Way Analysis of Variance

Each factor has three components with three levels in three-way analysis of variance. There are various ways to discriminate the influence of factors and the interaction between them. In such experiments, 27 experimental combinations are obtained. Explaining three-way interaction is difficult in these problems. One way to discriminate the influence is to reorganize components I and J in the form of two degrees of freedom effects by using these components over the AB, AC, and BC interactions. It is defined as follows:

$$Y_{ijk} = \mu + A_i + B_j + C_k + AB_{ij} + AC_{ik} + BC_{jk} + ABC_{ijk} + \varepsilon_{ijk}$$

No discrimination can be made over the ABC interaction. Discrimination only can be made by using the table of steep coefficients of polynomial (Banaji and Hardin, 1996; Bruder et al. 1997; Cole et al., 1994; Harris, 1985; Huynh and Mandeville 1979; Marlowe et al., 1996).

The purpose of this study was to use Box-Behnken design, which was a response surface method, and three-way analysis of variance to identify the variables that were maximize the psychological quality of life for mothers with intellectually-disabled children in the social work field and to make a comparative analysis of the results to be obtained from the use of these two methods.

Findings

The normal distribution of residuals, which is the precondition of Box-Behnken experimental design, was checked and the normal distribution of residuals was verified.

Table 1. Descriptive statistics concerning the total scores achieved by mothers in the psychological domain based on the categories. (Age, The time she learnt the disability, The Number of Children)

Age	The time she learnt the disability	The Number of Children	Mean Psychological Quality of Life Score	Std. Dev	Min	Max
1 (15-30)	1 (0-5)	1 (1-2)	57.50	10.61	41.67	75.00
		2 (3-4)	55.15	7.87	37.50	66.67
		3 (5-6)	60.83	14.91	50.00	79.17
	2 (6-10)	1 (1-2)	57.11	11.76	37.50	75.00
		2 (3-4)	56.57	8.91	37.50	79.17
		3 (5-6)	64.58	8.84	58.33	70.83
	3 (11-15)	1 (1-2)	54.86	11.61	41.67	70.83
		2 (3-4)	60.00	2.28	58.33	62.50
		3 (5-6)	56.25	7.80	41.67	62.50
2 (31-45)	1 (0-5)	1 (1-2)	58.16	17.30	0.00	95.83
		2 (3-4)	59.86	15.79	16.67	95.83
		3 (5-6)	64.58	14.47	29.17	79.17
	2 (6-10)	1 (1-2)	62.57	13.55	37.50	95.83
		2 (3-4)	54.86	14.08	16.67	79.17
		3 (5-6)	65.10	13.16	45.83	83.33
	3 (11-15)	1 (1-2)	63.19	12.48	50.00	83.33
		2 (3-4)	52.78	12.84	33.33	70.83
		3 (5-6)	62.50	.	62.50	62.50
3	1 (0-5)	1 (1-2)	62.82	8.91	50.00	75.00
		2 (3-4)	60.16	14.19	16.67	79.17

(45-60)		3 (5-6)	62.50	12.27	50.00	79.17
	2 (6-10)	1 (1-2)	51.56	11.34	33.33	70.83
		2 (3-4)	54.58	11.70	29.17	79.17
		3 (5-6)	60.42	9.92	54.17	75.00
	3 (11-15)	1 (1-2)	51.04	25.54	25.00	83.33
		2 (3-4)	43.06	11.39	25.00	58.33
		3 (5-6)	46.25	17.51	25.00	83.33

Table 2. 3^3 ***BDD regression analysis table***

	t	*p*
Fixed	32.203	0.000*
Age	-2.594	0.049*
The time she learnt the disability	-1.114	0.316
The number of children	2.642	0.046*
Age*Age	-1.291	0.253
The time she learnt the disability*The time she learnt the disability	1.114	0.316
The number of children*The number of children	3.607	0.015*
Age*The time she learnt the disability	-3.720	0.014*
Age*The number of children	0.234	0.825
The time she learnt the disability*The number of children	-1.205	0.282

*p<0.05, R^2= %90,33 R^2(Adjusted) = %72,92

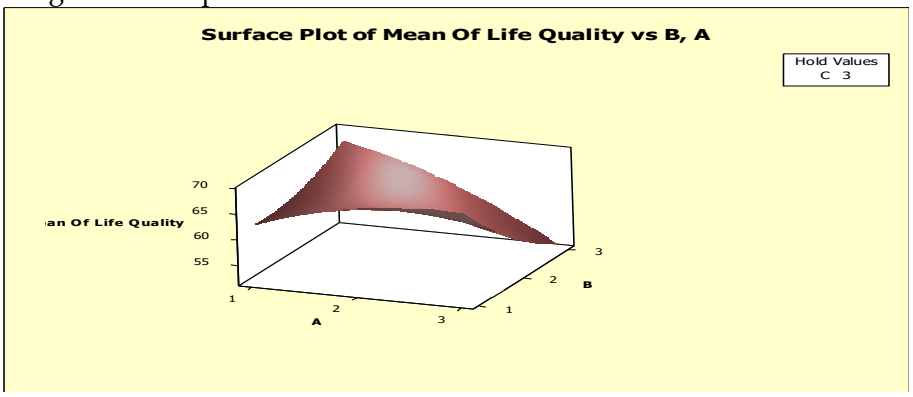
Table 2 shows that, while age, the number of children, and the quadratic form of the number of children were fixed, the interactions between age and the time at which she learned about the disability turned out to be statistically significant factors that influenced her quality of life. In addition, the regression equation explains the variables at a rate of 90.33%.

Table 3. 3^3 ***BDD analysis of variance table***

Source of variation	**Degree of freedom**	**Sum of Squares**	**Mean square**	**F**	**P**
Regression	9	406.537	45.1708	5.19	0.042
Linear	3	130.186	43.3955	4.98	0.058
Quadratic	3	142.737	47.5791	5.46	0.049*

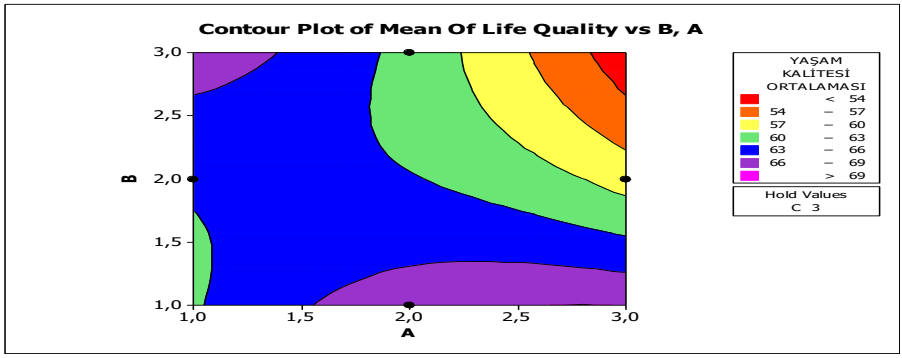
Interaction	3	133.614	44.5379	5.12	0.055
Error	5	43.535	14.5117		
Total	14				

According to Table 3, the quadratic form was found to be statistically significant at the end of the response surface analysis. In order to identify the situations that influence the quality of life of mothers with intellectually-disabled children in the best possible way, the nominal-is-the-best model was employed. The contour and response graphics of the model are given in Shape 1 and 2.



Shape 1. Nominal is the best model response graphics for BDD (A: Age, B: The time she learned about the disability, C: The number of children)

When the number of children is fixed, there is a quadratic form of the relationship between age and the time she learned about the disability, as is clear from the response graphic (Shape 2).



Shape 2. Nominal is the best model contour graphic of BDD (A: Age, B: The time she learned about the disability, C: The number of children)

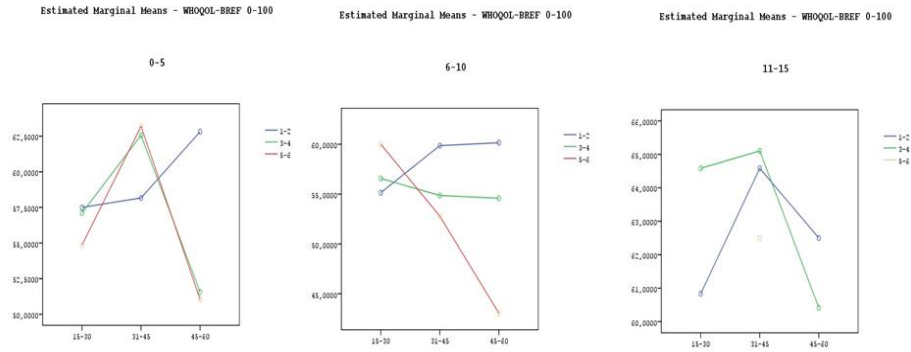
According the contour graphic, keeping the number of children fixed, when the mother is between the ages of 31 and 45 and the time she learned about the disability is 11 to 15 years, her quality of life score is between 66 and 69 out of 100, which is the optimum variable level that yields the highest score.

Table 4. Three-way analysis of variance

Source of Data	Sum of Squares	Degree of Freedom	Mean Square	F	p
Model	1838047.150(a)	25	73521.886	363.453	.000*
Age	683.394	2	341.697	1.689	.186
The number of children	263.954	2	131.977	.652	.521
The time she learnt the disability	607.392	2	303.696	1.501	.224
Age*The number of children	1054.192	4	263.548	1.303	.268
Age*The time she learnt the disability	410.373	4	102.593	0.507	0.730
The number of children *The time she learnt the disability	144.756	4	36.189	0.179	0.949
Age*The number of children*The time she learnt the disability	1305.906	6	217.651	1.076	0.376

Error	104177.850	515	202.287
Total	1942225.000	540	

According to the three-way analysis of variance results (Table 4), R^2= 94.6%. However, neither the main effects nor the interactions were found to be statistically significant.



Shape 3. Total score graphics based on the categories according to the results of the three-way analysis of variance

Shape 3 shows the graphics obtained through analysis of variance. They indicate that, for the age group of 31-45, the psychological quality of life score was nearly 62.5 if the time the mother learned about the disability was 0 to 5 years and the mother has 3-4 or 5-6 children. For mothers who learned about the disability 6 to 10 years ago, their psychological quality of life scores were between 50 and 55 if they had 5 or 6 children, 55 if they had 3 or 4 children, and 60 if they had 1 or 2 children. For mothers who learned about the disability 11 to 15 years ago, their psychological quality of life score was between 64 and 66 if they had 1, 2, 3, or 4 children.

Discussion

This study provided useful results by analyzing mothers with disabled children according to the number of children, their ages, and the time at which they learned about the disability. We investigated how these criteria influence their psychological quality of life and determined and analyzed various variables that influence the quality of life. Canarslan and

Ahmetoğlu (2015) reported that the psychological quality of life scores of families were low. Social support systems lead to a rise in a lot of the domains of the quality of life, including, but not limited to, the domain of psychological quality of life. Similarly, Meral (2011) observed that women with social support had higher levels of quality of life. In this sense, social support systems form an important variable to analyze psychological quality of life. In addition, financial status directly influences the psychological quality of life of a family. As the financial situation of the family gets better, the psychological quality of life score increases. Similar results also were reported by Hu et al. (2012). They reported that families that receive home care payments are better in the psychological quality of life domain and in all other domains.

The present study indicated that the quantitative use of the Box-Behnken design, which is a response surface method, is possible in the field of social services. In this study, the main effects of "the number of children" and "age", which are among the factors influencing the psychological quality of life of mothers with intellectually disabled children, were found to be statistically significant. Moreover, the interaction effect of "the mother's age*the time she learnt the disability" was statistically significant (Table 2). According to the results, keeping the number of children fixed, when the mother is between the ages of 31 and 45 and the time she learned about the disability is 11 to 15 years ago, her quality of life score was between 66 and 69 out of 100, which is the optimum variable level yielding the highest score level (Shape 2). Despite the results shown in Shape 3, the analysis of variance results indicated no significant main effect or interaction among the factors that influenced the quality of life (Table 4).

Conclusion

It is possible to say that the response surface method yielded more precise results than the classic factorial analysis of variance method. Thus, it is a method that can be preferred in such studies. Moreover, this method enables a selection of optimum independent variable combinations through methods of 'the larger the better,' 'the smaller the better,' and 'the nominal is the best.' This is not possible with the classic factorial analysis of vari-

ance approach. Briefly, if studies are planned according to response surface methods beforehand, more precise and beneficial results will be obtained. The response surface method can be an alternative to the analysis of variance in factorial experiments, which is used extensively in social sciences (social work).

Scientific and occupational studies aimed at raising the psychological quality of life of mothers with intellectually-disabled children have reported that the age of a mother and how long she has known about the disability of her child are of great importance. If a mother is between the ages of 31 and 45 and has known about her child's intellectual disability for 11 to 15 years, she has developed coping strategies and adapted to the situation she has to deal with.

In addition, independent of all of the other factors, the number of children has a large influence on the psychological quality of life of the mother. When a mother has an intellectually-disabled child, her psychological quality of life decreases as the number of children she has increases. Based on these results, social work experts working in the field of disability should aim at increasing the quality of life of women in all aspects within the scope of their occupational requirements. The studies to be conducted within this scope to enhance the quality of life in psychological terms should primarily include mothers who are in the age ranges of 15-30 or 45-60, mothers who have known the disability for less than 10 years, and mothers who have more than one child. Micro-level, mezzo-level, and macro-level studies should be conducted within this context.

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