



## An Ergonomic Approach to Thalassemia Center Design: A Case Study of North Cyprus

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### Abstract

This research evaluated 163 Thalassemia patients in North Cyprus, a region only with one treatment center. Thalassemia patients must remain within the center or extended periods of time during treatment, necessitating a well-designed, safe, and comfortable environment.

However, the current analysis demonstrates that the current facility in North Cyprus is far from an appropriate physical, ergonomic design. This finding was well supported by the study, which included technical inspections based on ergonomic standards and a comprehensive assessment of patients' satisfaction with the design of the facility *via* a Likert-scale questionnaire. As a result of our ergonomic examination, numerous segments of the health center must be redesigned, including the beds, chairs, lighting, doors, ceiling, corridors, waiting area, reception office, entrance room, and toilets. On the other hand, the results of our cross-sectional analysis of patient satisfaction corroborated and expanded on the ergonomics based investigation. Additionally, this research discovered that not only the center's architectural design should be considered, but the services given by the center should be appropriately expanded to non-medical areas to mitigate the influence of Thalassemia on the patients' daily lives. Finding work, working in a medically influenced environment, studying in schools, and caring for family members at home are identified as the primary challenges that may affect a patient's life.

**Keywords:** Cross-sectional study; Ergonomics; Health center design; North cyprus; Thalassemia

component. To survive, Thalassemia patients desperately depend on blood transfusions and chelation therapy. There is only one center in North Cyprus, which opened in 1988. This study considered 163 Thalassemia patients, 36% of whom are under the age of 18. The sole study on Thalassemia in North Cyprus back in 1976 prevented the disease in affected newborns and provided adequate therapy for current Thalassemia patients [1].

Thalassemia patients may experience a variety of difficulties throughout their lives; nevertheless, one of their primary difficulties, particularly during childhood, is a lack of confidence in social interactions. Numerous Thalassemia patients experience isolation self-sufficient lifestyles. School absenteeism occurs as a result of frequent hospitalizations for treatment, highlighting the critical nature of treatment length for Thalassemia patients once again. This could have a negative impact on children's schooling and the careers of Thalassemia patients. Another potential source of concern for these patients is the threat of mortality, which can negatively affect the parent-child connection and increase anxiety in both the kid and parents [2].

Additionally, these individuals require specialized care in order to maintain a successful treatment plan. A healthcare system's treatment may provide risks of harm to individuals. This issue results in hundreds of thousands of patient deaths and billions of dollars in total expenditure worldwide. It seems there are a limited number of published researches evaluating the quality of life in Thalassemia patients [3], but there is also no study on this subject in North Cyprus. One way to mitigate the effect of these daily challenges is to implement ergonomic guidelines and design in Thalassemia health centers in order to improve patients' quality of life and safety [4,5].

### Ergonomics in health care

Ergonomics is the science of fitting the job to the human. Physical, cognitive, social, organizational, and environmental ergonomics are all approaches to this scientific study [6]. Ergonomic sciences support aims at reducing injury risks and increasing performance and productivity, which are all crucial in this decade [7]. Human error, a lack of adequate design and services in health care environments, and the high risk of accidents need the application of a holistic ergonomic approach to health care environments in order to improve patient safety and treatment outcomes [8]. Ergonomic design strategies enhance a health care environment's physical, technological, psychological, and cultural components [9].

A desired and efficient workplace design should consider the worker's tasks and workplaces, as well as their safety, health, and comfort. Given that workers come in a variety of sizes, the design should accommodate everyone from a short woman to a tall man, ensuring that the work environment is comfortable for everyone. Additionally, the design of chairs and seating equipment is critical in a medical environment, as they are used by people of different sizes. The chair design

### Introduction

#### Thalassemia in north cyprus

Thalassemia is a major health problem that has primarily affected Mediterranean regions, the Middle East, Asia, and some parts of the United Kingdom. This inherited blood disorder inhibits the development of hemoglobin, the red blood cells oxygen carrying

should allow workers to adjust their leg position and working circumstances as necessary during job performance [10]. As a result, it is necessary to conduct a size-independent design. The work of ergonomic sciences is built on this principle of creating a modular, customizable, and adaptable workplace that enables people to customize their surroundings to match their unique demands.

The application of ergonomics in health care and patient safety stretches back to 1950 when Safren and Chapanis began investigating drug errors in a hospital [11]. They reported a total of 178 medication mistakes. According to their research, failure to review procedures, misreading or misunderstanding prescriptions, transcribing problems, misfiled drug tickets, and computational errors accounted for more than 90% of pharmaceutical errors. They offered new insights into how to reduce pharmaceutical errors, such as how to improve written communication and handwriting legibility. It was suggested that pharmaceutical practices be double-checked to avoid errors. Additionally, nurse station units and pharmaceutical preparation spaces were advised to be redesigned in work contexts [12]. Adhering to ergonomics guidelines in health care facilities would benefit productivity, safety, and health. The standards include standardized techniques and strategies for assessing and reducing physical and mental stress and fatigue in workers and patients. There are multiple sample standards, each containing hundreds of ergonomics principles. For example, Environmental Health and Safety recommends adjustable equipment due to the varying sizes of people and the Oregon Coalition for HealthCare Ergonomics (OCHE) recommends considering three key points in the design of health care facilities: enhancing human abilities, overcoming human limitations, and fostering user acceptance.

The purpose of this study is to describe the current state of the Thalassemia center in North Cyprus and, using ergonomic standards, to evaluate several segments of the center to enhance patient safety and satisfaction. Along with the assessment, a cross-sectional evaluation becomes essential to ascertain patients' satisfaction with various aspects of the center. This method is intended to assist patients and staff in experiencing a secure, easily accessible, healthy, and comfortable environment.

### **Cross-sectional study**

Cross-sectional surveys are used to determine the frequency (or quantity) of occurrence of a certain feature, such as a specific disease or another health-related event, in a distinct population at a particular period. However, these investigations occasionally go beyond simply revealing the frequency of an observed feature and identifying relevant risk factors. They are also valuable for assessing a population's practices, attitudes, knowledge, and perspectives on a particular health-related event. The findings of such research reveal the scale of the problem for a particular period and population and provide a basis for developing appropriate public health solutions. Health planners can use the results of these studies to define health priorities and prioritize the use of protective and remedial health services [13].

Numerous studies have been conducted using cross-sectional data and statistical analysis to examine health related characteristics and risk factors [14-18]. Several studies on Thalassemia have been completed. These studies, conducted in Hong Kong [19,20], assess the prevalence of Thalassemia heterozygous carriers, as well as growth, puberty, and endocrine function in Thalassemia patients, as well as the problems of Thalassemia major in North America [21]. On the other hand, several researchers concentrated on assessing patient's satisfaction with health care facilities. For example, a cross-sectional study analyzed client's satisfaction with primary health care in four urban primary health care clinics in Tehran [22] and the United States and 12 European countries evaluated patient safety, satisfaction, and quality of hospital care [23]. However, no cross-sectional study has been conducted to assess Thalassemia patient's satisfaction. As a result of the delicate nature of Thalassemia patients' conditions in particular and the fact that North Cyprus has just one Thalassemia health facility, it was necessary to evaluate the center using a cross-sectional survey in combination with an ergonomic study. With this approach, we addressed the following major questions: whether redesigning the center is necessary; whether there is any aspect of the center which is causing patient's dissatisfaction and is concealed from the ergonomic evaluation; whether ergonomic and cross-sectional evaluations have the same results; what the reasons are and causes of these results; and finally what are the risk factors for patients' dissatisfaction.

## **Materials and Methods**

### **Ergonomics evaluation**

The interior health research paper and Interior health workstation and office guidelines were used to determine the design and sizing guidelines for this study [24,25]. The furniture and office equipment in offices and workstations should conform to the Interior Health Authority's regional criteria for workstations and chairs. We saw and learned about Thalassemia therapy in North Cyprus under normal conditions in this regard. The study was communicated to all workers working in these rooms. The data were gathered throughout the patient's treatment sessions. Following a thorough inspection and comparison of all the elements specifics to available ergonomics standards, we made design recommendations for the center's current design.

### **Field survey**

**Subjects:** This study was conducted at a Thalassemia center in North Cyprus, where 30 hours were spent over a three months period observing and learning about Thalassemia treatment under normal conditions. The center is divided into several primary rooms, including a treatment room, a secretary's office, a Thalassemia society meeting room, and a room for blood donation. The center had one nurse, two secretaries, and two doctors (one psychologist), all of whom worked seven hours a day [26]. All patients were given questionnaires. The authors informed patients in advance about the purpose and substance of the questionnaire and obtained their consent to participate in the study. Some patients appeared insecure and

refused to participate, which could be a result of their lack of confidence in social relations. The questionnaire was completed by 29 patients in total. The majority of patients who responded to the

questionnaire (93.1 percent) were over the age of 18, with a nearly equal number of male and female respondents. Table 1 summarizes the descriptive statistics for the patients [27].

	Demographic items	Frequency	Percent	Valid percent	Cumulative percent
Age	Under 18	2	6.9	6.9	6.9
	19-30	4	13.8	13.8	20.7
	31-40	12	41.4	41.4	62.1
	41-50	10	34.5	34.5	96.6
	Over 51	1	3.4	3.4	100
Gender	Male	15	51.7	51.7	51.7
	Female	14	48.3	48.3	100
Marital status	Single	12	41.4	41.4	41.4
	Married	17	58.6	58.6	100
Children	Yes	14	48.3	48.3	48.3
	No	15	51.7	51.7	100
No. of children	1	6	20.7	46.2	46.2
	2	7	24.1	53.8	100
Age of children	Less than 2	1	3.4	7.1	7.1
	3-8	6	20.7	42.9	50
	9-14	5	17.2	35.7	85.7
	15-20	1	3.4	7.1	92.9
	More than 20	1	3.4	7.1	100
Educational status	Middle school	4	13.8	14.3	14.3
	High school	18	62.1	64.3	78.6
	University	6	20.7	21.4	100
Permanent job	Yes	15	51.7	51.7	51.7
	No	14	48.3	48.3	100
Salary	No salary	1	3.4	4.5	4.5
	Less than 1000 TL	8	27.6	36.4	40.9
	1000-2000 TL	3	10.3	13.6	54.5
	2000-3000 TL	5	17.2	22.7	77.3
	More than 3000 TL	5	17.2	22.7	100

**Table 1:** Demographic items for registered patients.

**Questionnaires:** A cross-sectional investigation was conducted. A Likert-type questionnaire with 59 questions was prepared and translated into Turkish before being distributed to the patients [28]. The questionnaire included questions about the participants' demographic conditions, their level of satisfaction with personnel, their level of satisfaction with medical care and non-medical aspects of the center, their level of knowledge about Thalassemia, their level of access to necessary center facilities, the extent to which treatment

affected their lives, and their needs and preferences. Patients' age, gender, marital status, number of children, age of children, educational attainment, work status, and pay range were all considered demographic variables (Table 1). The questionnaire replies were graded on a five-point scale (*i.e.*, strongly agree to strongly disagree or always to never). Each question required respondents to choose one of these categories [29].

Numerous questions in this questionnaire addressed the center's physical design, including those about seats, illumination, beds, color,

heating and cooling systems, as well as location and parking. Thus, the amount of satisfaction with these questions reflected the patients' overall happiness with the center's design. Nonetheless, there was a specific question that inquired specifically about the patients' level of satisfaction with the center's general design. Other queries can be related to the center's services. These services could include medical services, treatment related services, or any other form of service. Certain questions were reclassified into more specific subject categories. For instance, medical care in the center, the function of workers in the Thalassemia center, and the patients' personal lives were all covered.

**Data analysis:** After gathering the data statistical analyses were performed with 95% confidence intervals (95% CIs) were calculated

by t-test statistical analysis to understand the patients' overall expectations, views, and preferences regarding the center. The mean value for each item represents the mean level of patients' satisfaction with respect to that item. The values of 1 and 5 for an item represent the lowest to the highest level of satisfaction, respectively. High mean values support patients' satisfaction against low mean values representing their dissatisfaction. Moreover, the *Chi-square* test was employed in order to assess univariate associations between all reported items and the center's internal design, personnel's performance as well as patient's personal life (Table 2).

No	Item	Location	N of items	Current dimension	Recommended dimension	Comment	Ref
1	Corridor width	Toward Dr. offices	NA	1.06 m	2.44 m	Increasing corridor width towards doctor office by 138 cm	36
2	Corridor width	Toward cafeteria	NA	1.85 m	2.00 m	Increasing corridor width towards cafeteria by 15 cm	36
3	Illumination	Both corridors	12	2567 lx	3000-10000 lx	Increasing the number of lights	31, 32
4	Ceiling height	Waiting room	NA	3.76 m	2.70 m	Decreasing ceiling height of waiting room by 106 cm	37
5	Ceiling height	Secretary office	NA	3.76 m	2.70 m	Decreasing ceiling height of secretary office by 106 cm	37
6	Ceiling height	Cafeteria	NA	3.55 m	2.70 m	Decreasing ceiling height of cafeteria by 85 cm	37
7	Door (width and height)	Center entrance	2	1.88 m and 2.18 m.	2.44 m and 1.98 m	Increasing entrance door width by 56 cm	37, 36
8	Door (width and height)	Treatment room	2	0.91 m and 2.03 m	1.50 m and 2.03 m	Increasing door width of treatment room by 59 cm	37,36
9	Chair (length, height, and width)	Waiting room	3	0.49 m., 0.66 m., and 0.27 m	0.45 m, 0.83 m, and 0.47 m	Increasing width and height of chairs by 20 cm and 17 cm resp.	35, 13
10	Alarm	Toilet	2	No alarm	NA	Installing alarms	29, 13
11	Ventilation	Toilet	2	No ventilation	NA	Installing ventilation	13

**Table 2:** Current status and ergonomic standards of the elements of the center along with the recommended alterations.

**Patients responses**

Results of the questionnaire for almost 20% of Thalassemia patients

in North Cyprus health center are shown in Table 3. Mean and standard deviation values are presented for each item, expressing the

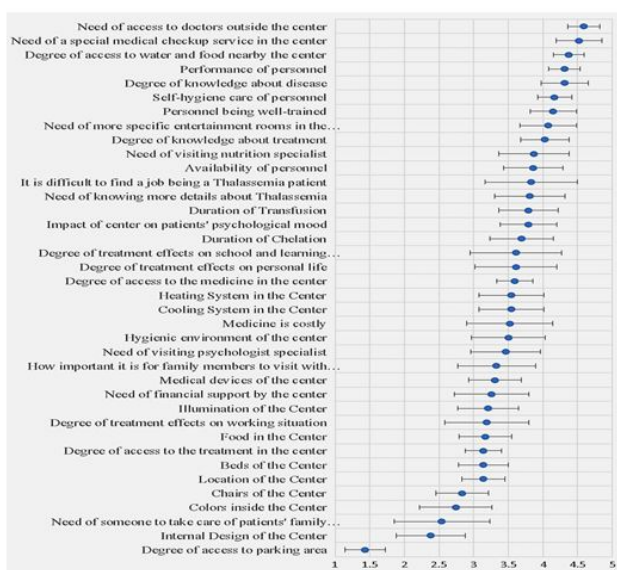
level of patients' needs, access, or satisfaction towards the center's elements. In order to have a good perceptive of all patients' views, t-test analyses were performed. Intervals for the satisfaction levels of the whole population with the confidence of 95% are presented in Figure 1. In Table 3, there are two columns for each item indicating the ranking values, *i.e.*, ranking in each category and the overall ranking. The former ranks the level of patients' satisfaction to the

corresponding items in the same category in question. The latter ranks the level of patients' satisfaction to the corresponding items in the questionnaire considering the whole questions. The lower the ranking, the higher level of satisfaction or need. In this regard, among the important items, the lowest ranking requires more consideration than the others since it caused less satisfaction among Thalassemia patients.

Category	Item	Mean	Std.	Ranking category in the	Overall ranking
Level of satisfaction about personnel	Performance	4.31	0.604	1	4
	Self-hygiene care	4.17	0.658	2	6
	How well-trained	4.15	0.834	3	7
	Availability	3.86	1.125	4	11
Level of satisfaction about the center (medically)	Duration of Transfusion	3.79	1.021	1	14
	Duration of Chelation	3.69	0.873	2	16
	Hygienic environment	3.5	1.304	3	23
	Medical devices	3.31	1.004	4	26
Level of satisfaction about the center (not medically)	Heating System in the Center	3.54	1.174	1	20
	Cooling System in the Center	3.54	1.174	1	20
	Illumination of the Center	3.21	1.177	3	28
	Food in the Center	3.17	1.002	4	30
	Beds of the Center	3.14	0.953	5	32
	Location of the Center	3.14	0.833	5	32
	Chairs of the Center	2.83	1.002	7	34
	Colors inside the Center	2.74	1.318	8	35
	Internal Design of the Center	2.38	1.321	9	37
Degree of knowledge	Disease	4.31	0.891	1	4
	Treatment	4.03	0.906	2	9
Degree of access in the center	Water and Food nearby	4.37	0.565	1	3
	Medicine	3.59	0.682	2	19
	Treatment	3.14	0.651	3	31
	Parking	1.43	0.742	4	38
Degree of treatment effects	School and Learning Conditions	3.61	1.53	1	17
	Working situation	3.19	1.497	3	29
	Personal life	3.61	1.498	1	17
Patients' needs	Access to Doctor	4.59	0.572	1	1

	Medical service	checkup	4.52	0.849	2	2
	Entertainment room		4.08	1.017	3	8
	Visiting specialist	nutrition	3.87	1.18	4	10
	Knowing more details about thalassemia		3.81	1.2	5	13
	Visiting specialist	psychologist	3.46	1.179	6	24
	Financial support by the center		3.26	1.375	7	27
	Caring family member during the treatment		2.54	1.641	8	36
Other	Difficulty to find a job		3.83	1.579	1	12
	Impact of center on patients' mood		3.79	1.067	2	15
	Cost of medicines		3.52	1.503	3	22
	Family visits with a psychologist		3.33	1.414	4	25

**Table 3:** List of items, their categories, means, standard deviations, as well as their category and overall rankings.



**Figure 1:** Patient's opinion about their needs, access, and satisfaction along with 95% confidence intervals for the mean (ordered regarding the attributes' overall ranking)

The statistical results from the questionnaire revealed dissatisfaction of the patients is mostly about the internal design and the parking availability of the center. The former indicated a poor level of satisfaction about the chairs, color, and illumination of the center, and the latter has become a serious problem because almost all patients use personal vehicles to come to the center. Moreover, they expressed their needs regarding having access to doctors outside the center, and a special medical check-up service as well as more specific entertainment rooms in the center.

Regarding the center services, the analyses of the questionnaire responses revealed, in average, patients' satisfaction with the performance of the personnel as well as the availability of doctors and medical services. However, no systematic schedule was made to visit a nutrition specialist or a psychologist, while the former is due to the lack of a nutrition specialist at the center. For Thalassemia patients, visiting a nutrition specialist is crucial for the control of their regular diet, as they need to monitor the level of iron in their body. Moreover, a regular visit to a psychologist is a need, seeing the considerable effects of this disease over patient's personal lives. It is worth mentioning, according to the questionnaire, most patients believe center design can affect their psychological mood. This fact and their dissatisfaction regarding the internal design of the center can be inferred as their indirect complaint about the negative effect of the center on their psychological state, which reaffirms the need to visit a psychologist.

The statistical analyses performed on the results of the questionnaire showed most patients feel their personal life is strongly influenced by Thalassemia. Careful analyses indicated the treatment affected their school learning as well as finding jobs and working situations. This fact makes it very critical the center provides additional services for helping the patients, e.g., arranging home tutors for the missed lectures due to their presence in the center for the treatment. Additionally, the center can negotiate with industries and companies to create special openings for these patients under a non-competitive process. Another key finding was that Thalassemia patients require special care for their family, elderly members, or children, at home while they are being treated at the center. Thus, providing some types of home assistants to resolve this problem seems necessary. The patients also showed their interest and need for getting some financial support from the center, which makes it very helpful if the center tries to raise some funding from public and non-profit or

governmental organizations. Furthermore, providing some training courses for the patients to increase their knowledge and awareness about Thalassemia, safety, health, even ergonomics and also other social challenges of this disease would be very effective.

In the questionnaire, there are also some questions asking about patient's interest about meeting other patients, along with the details of this meeting, displayed in Figure 2.

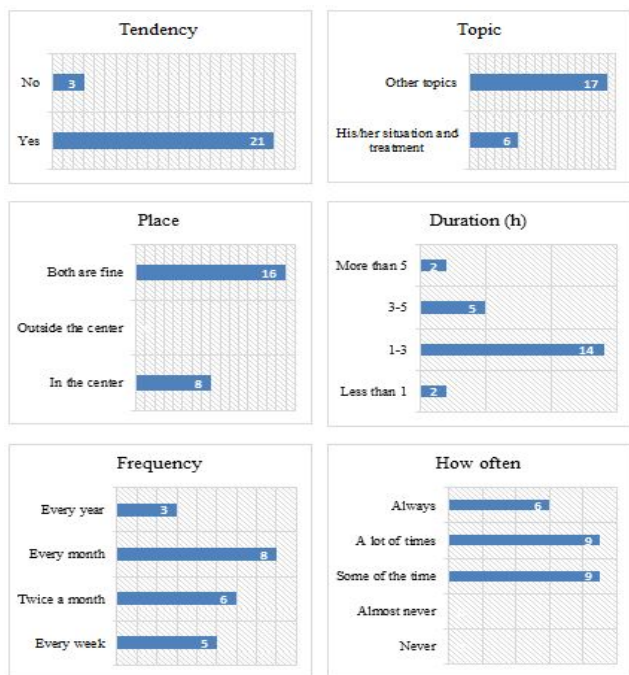


Figure 2: Patients opinion about meeting other patients.

Independent variable	Internal design			Personnel performance			Patient's personal life		
	Statistics		Significance	Statistics		Significance	Statistics		Significance
	Chi-square	df		Chi-square	df		Chi-square	df	
Age	10.171	16	p>0.05	5.446	8	p>0.05	12.149	12	p>0.05
Gender	9.148	4	p>0.05	0.056	2	p>0.05	4.078	4	p>0.05
Marital status	3.381	4	p>0.05	3.773	2	p>0.05	7.276	4	p>0.05
Children	4.056	4	p>0.05	2.309	2	p>0.05	5.122	4	p>0.05
Education status	8.867	8	p>0.05	11.926	4	p<0.05	8.646	8	p>0.05
Permanent job	5.715	4	p>0.05	2.059	2	p>0.05	4.228	4	p>0.05
salary	14.575	16	p>0.05	9.251	8	p>0.05	13.92	16	p>0.05

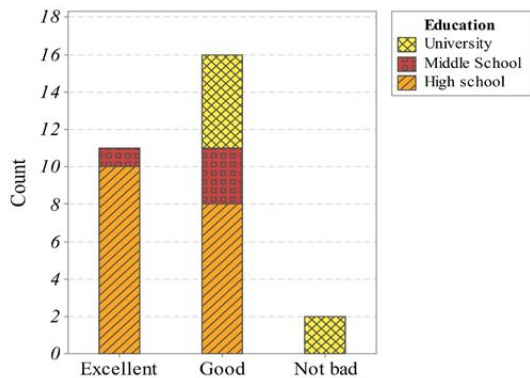
Table 4: Associations of the internal design of the center, and performance of personnel as well as the personal life of patients with patient's descriptions.

According to this figure, social activities and networking among the Thalassemia patients and their families are demanded by the patients, which have not been systematically practiced to date. Thus, conducting monthly meetings, gatherings, and social activities among these patients, their families, and even with healthy people can be a great relief for a patient to live equally among others.

**Potential associations between the attributes**

Chi-square test was employed to evaluate univariate associations between perceived variables and three key factors of center's internal design, personnel's performance, and patients' personal life. The important results of this analysis are presented in Tables 4 and 5, reporting chi-square statistics, degree of freedom, and p-value of the test. In this study, those associations with p-values less than 0.05 are considered statistically significant and meaningful.

The analyses revealed that internal design and patient's personal life had no significant association with demographic variables, while patient's responses to the evaluation of personnel performance showed a meaningful relationship with their education status (Table 4. As it is shown in Figure 3, more educated patients exhibited less satisfaction regarding the personnel performance.



**Figure 3:** Stacked chart of personnel performance regarding patients' education.

Similarly, there were no significant associations between internal design and patient's personal life with personnel's evaluations, medical evaluation of the center, and patient's access in the center. However, as

expected availability and self-hygiene care of personnel were associated with their performance. Moreover, dissatisfaction of the patients with respect to the center's internal design was found to be linked with color and illumination inside the center as well as center's food did not fulfill their expectations. The association between patients level of satisfaction about center's beds and personnel's performance, as well as between their level of gratification about center's food and their personal life seems fascinating and call for detailed analysis. The Association of patients satisfaction towards center's beds with their idea about personnel performance can also be related to the fact that they may consider the employment of badly designed beds in the center as the indication of inexpert center recruits. Association between patients knowledge about treatment with their opinion about center internal design is an interesting finding indicating knowledge about treatment could be related to the education and consequently to the expectations of the patient's about internal design. Finally, the impact of the Thalassemia disease on the personal lives of the patients was found to be centered around taking care of their families during the treatment, their working situation, and the cost of their medicines (Table 5).

Independent variable	Internal design			Personnel performance			Patients personal life		
	Statistics		Significance	Statistics		Significance	Statistics		Significance
	Chi-square	df		Chi-square	df		Chi-square	df	
Availability of personnel	14.575	12	p>0.05	27.523	6	p<0.001	11.683	12	p>0.05
Self-hygiene care of personnel	15.216	8	p > 0.05	27.836	4	p < 0.001	6.326	8	p>0.05
Level of satisfaction about colors inside the center	37.967	16	p<0.01	5.374	8	p>0.05	21.57	16	p>0.05
Level of satisfaction about illumination of the center	33.745	16	p<0.01	6.093	8	p>0.05	15.893	16	p>0.05
Level of satisfaction about beds of the center	15.052	12	p>0.05	13.443	6	p<0.05	7.702	12	p>0.05
Level of satisfaction about food in the center	28.936	16	p<0.05	8.525	8	p>0.05	26.601	16	p<0.05
Need of access to doctor outside the center	21.106	8	p<0.01	6.51	4	p>0.05	10.662	8	p>0.05
Need of visiting	16.283	16	p>0.05	16.807	8	p<0.05	13.493	16	p>0.05



Psychologist specialist									
Need of taking care of family member during the treatment	29.205	16	p<0.05	3.483	8	p>0.05	29.636	16	p<0.05
Level of knowledge about the treatment	23.773	12	p<0.05	5.407	6	p>0.05	11.616	12	p>0.05
Treatment affects working situation	23.125	16	p>0.05	11.642	8	p>0.05	39.965	16	p<0.05
Medicines cost	10.451	12	p>0.05	5.324	6	p>0.05	21.296	12	p<0.05

**Table 5:** Associations of the internal design of the center and performance of personnel as well as the personal life of patients with other evaluations.

### Conclusion

According to the ergonomic analyses performed through observation and measurements, which were further supported by the survey, the Thalassemia center in North Cyprus needs improvements to reach the standard level. It was found the chairs, doors, beds, corridors, ceiling height, illumination, and colors of the center, as well as the parking area require substantial changes and enhancement. The evaluation of the current design was followed by some design recommendations, resulting from anthropometric data and ergonomic standards as well as knowledge about the level of patients' satisfaction. The newly proposed center considers the medical, physical, and psychological needs of the patients, in order to enhance the comfort and safety of the patients while being treated. The literature review supports the idea of this study, which considers the ergonomic design of a center as an effective tool in patient safety and patient satisfaction. A center that not only concentrates on medical treatments but also changes the quality of life for Thalassemia patients by applying ergonomic rules was proposed in this study. The satisfaction of Thalassemia patients regarding personnel, medical and non-medical aspects of the center, their knowledge about Thalassemia, their access to necessary facilities in the center, the effects of the treatment on their lives, and their needs and preferences were investigated. The highest and the lowest satisfaction were related to patients' accessibility to food and water near the center, and the internal design of the center, respectively. Statistical results of the questionnaire in this study were backed up with our analyses of the equipment through the ergonomic approach. In our model, for the center's internal design, personnel's performance, and patients' personal life, there were no significant associations with the patients' demographic variables, except higher expectations for patients with higher education levels. The association of the personnel performance with their availability and self-hygiene, however, tended to be high, as expected. Most items in the category of patient satisfaction about non-medical issues tended to have relatively lower means indicating patients' dissatisfaction about physical aspects of the center. This dissatisfaction necessitates urgent attention to the matter. Thus, it was suggested the center needs to be redesigned based on the ergonomic standards. The new design should make some

changes or additions with respect to the following parts of the center: chairs, beds, door, corridors, ceiling, lighting, illuminations, patient rooms, secretary office, and parking.

Organizational ergonomics is required to be considered for the center. This consideration is likely to be several sections for non-medical services. Moreover, the center needs to care about the personal life of the patients to some extent. Home assistants, school tutors, job finding counseling, fundraising, and social activities are the recommended activities to the center. Separate departments need to be created in the center to care about these issues. Similarly, applying organizational ergonomics, such as improved interactive teamwork and establishing nutritional, psychological, and social divisions are crucial for the treatment of Thalassemia patients. Further studies, however, are necessary, to investigate the effects of exploiting an electronic medical record system, proper signing, and labeling in order to speed up the information transfer among the center staff and minimize human errors. Furthermore, some future work could focus on the evaluation of human factors regarding the needs of children. This would help redesign systems of health care with the aim of optimizing children's safety as well as the performance of their care providers.

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