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Turkish Studies - Economics, Finance, Politics

eISSN: 2667-5625

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Research Article / Araştırma Makalesi

Optimization of the 112 Emergency Health Stations in the Province of Muğla

Muğla İli 112 Acil Sağlık İstasyonlarının Optimizasyonu

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Abstract: The need for emergency health services may arise anytime and anywhere. The emergency need arises in cases of accidents, natural disasters, diseases, or attacks encountered in routine life. Early and quality intervention in a case is of great importance as soon as an emergency arises. Timely and right intervention increases the life chances of patients. At this point, the location of the stations becomes important. Station locations should facilitate access in the event of a possible incident and increase the chances of survival by shortening the time of transportation and intervention to people. The aim of the study is to minimize the time for the 112 health service teams to access any case in the province of Muğla, Turkey. For this purpose, the optimal settlements of all 112 Emergency Health Service (EHS) Stations that were active in 2019 were evaluated. Determining the optimal locations keeps emergency response time to a minimum, and prevents unnecessary resource use. The study sample consists of 45 EHS stations that provide active service in Muğla province in 2019. To determine the optimal locations of these stations, the maximum covering location model was used in the study. The problem solution was obtained with the Excel solver. According to the results obtained, it was revealed that 30 of the 45 stations in Muğla province can continue to serve and that the remaining 15 stations adversely affect resource efficiency.

Structured Abstract: Introduction: The need for emergency services arises in cases of accidents, natural disasters, diseases, or attacks encountered in routine life. To respond to these needs, the 112 Emergency Health Service (EHS) Stations have been established. The EHS stations aim to ensure that emergency health services are carried out equally, accessibly, quickly, efficiently, and in high quality throughout the country (Health Statistics Yearbook, 2022). Emergency health service stations are of great importance, especially in extraordinary and unexpected situations that pose a significant, life-threatening health risk. The rapid calls made by the people at the scene to the emergency health station, the transportation of the units to the scene as soon as possible, and the provision of quality and effective emergency health intervention increase the chance of people surviving and therefore the likelihood of getting positive outcomes with early medical treatment to be applied in the hospital (Demirhan, 2003). A possible emergency condition starts with the emergency case report to the 112 call center, the incoming call is evaluated, if the report requires an urgent medical

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Cite as/ Atıf: Demirtaş, M. & Turan, A. (2023). Muğla ili 112 acil sağlık istasyonlarının optimizasyonu. *Turkish Studies - Economy*, *18*(1), 97-107. https://dx.doi.org/10.7827/TurkishStudies.66107
Received/Geliş: 01 November/Kasım 2022
Accepted/Kabul: 20 March/Mart 2023
Published/Yayın: 25 March/Mart 2023
Checked by plagiarism software

intervention, the request is approved, the appropriate team is assigned, and the nearest appropriate team is directed to the scene. A team and an ambulance are mobilized to access the case as soon as possible. When the case is reached, the necessary first medical intervention is made at the scene, if necessary, the case is transferred to the hospital, and the ambulance returns to the station after transferring the case to the hospital emergency service (Emergency Health Services Regulation, 2000). The time elapsed between the departure of the ambulance and the arrival time at the scene is considered the intervention time. One of the objectives of emergency health services is to provide access to the case as soon as possible. The shortest intervention time depends on the availability of emergency health care services, the time it takes for the vehicle to leave the institution, and the time it takes for the vehicle to reach the case (Ingolfsson et al., 2008). According to the literature review, there were similar studies in cities such as Istanbul, Konya-Selçuk, Konya-Center, Samsun, Manisa, and İzmir in Turkey, but there were no studies on the optimal location of the 112 health service stations in the province of Muğla. In line with this importance, the study aims to determine the optimal emergency health station locations that will provide access to the case as soon as possible in the province of Muğla. Although in some countries the intervention time is considered the time from the moment the emergency medical aid call to the arrival to the requested area, the time interval indicated by the time between the departure of the ambulance and the arrival at the scene is generally accepted as the intervention time. As an important variable, the intervention time is defined as the time spent on the road to access the scene since the departure of the ambulance. In many countries, there is no generally accepted standard duration for this period. In the literature, this intervention time was generally considered 8 minutes (Ateş et al., 2011). In Turkey, the target of the Ministry of Health for the response time to emergency cases is 10 minutes in cities and 30 minutes in rural areas, starting from the moment of the emergency call (Ministry of Health, 2016). In the study, this period was accepted as 10 minutes in line with the targets of the Ministry of Health. For the province of Muğla, this period was 90 seconds for the departure of the ambulance from the moment the call was directed to the emergency health institution, 10 minutes for the transportation to the case in the urban region, and 30 minutes for the transportation to the case in the rural area. The study will guide policymakers in terms of efficient use of available resources, allocating funds to new technologies by avoiding resource waste and ensuring integration into technology, organizing the working system, capacity planning, determining vehicle and station locations, assigning personnel when necessary, and providing timely transportation to all people in need of emergency health service, providing effective service by equipped teams.

Literature Review and Conceptual Framework: In the study, the Maximum Covering Location Model developed by Church and ReVelle in 1974, which is an accepted model in the literature, was used. In the literature, the first location set covering model was proposed by Toregas et al. in 1971. This model is called the Location Set Covering Model. In this model, only the areas of need where demand arises are covered with the least number of vehicles or facilities (Toregas et al., 1971). The model does not offer full coverage of all areas of need. In 1974, Church and ReVelle proposed the first maximum deterministic covering model called the Maximum Covering Location Problem (Church & Revelle, 1974). This model aims to meet the maximum demand with a limited number of resources (Li et al., 2011). Since it is assumed that only one station serves certain remote areas, in the study, the Maximum Covering Location Model developed by Church and ReVelle (1974), which is an accepted model in the literature, was used. According to the literature review, there were similar studies in cities such as Istanbul, Konya-Selçuk, Konya-Center, Samsun, Manisa, and İzmir in Turkey, but there were no studies on the optimal location of the 112 health service stations in the province of Muğla. In line with this importance, the study aims to determine the optimal emergency health station locations that will provide access to the case as soon as possible in the province of Muğla.

Method: This study is a cross-sectional study. The study population consists of all the 112 Emergency Medical Service Stations in Turkey. As the study sample, all 112 Emergency Health Service stations (45) that are actively serving in Muğla province in 2019 were included in the research. All actively servicing 112 road stations located in the province were included, but 112 airline stations were not included in the study. Second-hand data were used, and station data were obtained from Muğla Provincial Health Directorate. The distances between the 112 emergency stations were obtained using Google Earth. Distances were obtained as air distance measurements between stations, and the distances obtained between each station were entered into the Excel file to form a 45*45 matrix. The location set covering model used in the study is the binary 0-1 integer model, in which all constraints have an '$\geq$' inequality, all the values on the right side are 1, and the coefficient matrix is the 0-1 matrix (Çetin, 2007). The network consists of 45 nodes

and the edges connecting these nodes. Z is the objective function and gives the minimum number of stations that can be established (Church & Revelle, 1974).

$$Z = \sum_{k \in N} y_k$$

Here, all decision variables that equal 1 indicate the points where a station needs to be established. The y_k values calculated will decide which stations will continue to serve and which ones need to be closed. Operations in Microsoft Excel Solver were performed.

Results and Discussion: The maximum number of stations to be opened with the maximum covering set model was found to be 30 by multiplying the $A=a_{ik}$ matrix by the y_k decision variables of the algorithm in the Excel program. According to the results of the program, it was obtained that 112 emergency health services in Muğla could provide services with 30 stations instead of 45 stations. The stations that need to remain open are the locations whose solution values are 1, and the stations that need to be closed are the locations with a solution result of 0.

Conclusion: Based on the findings, it was concluded that Muğla province needs an effective emergency health services planning. It is recommended to either close 15 emergency health stations in Muğla province and to transfer the existing personnel and resources to other stations, or in order to obtain optimum benefit for these 15 stations, new layout arrangements are recommended after optimum measurements are made. This will allow costly station locations to be closed or merged with other stations in need of to use their resources more efficiently. However, it should be noted that population density, summer and winter population differences, and geographical conditions, which are important factors preventing transportation between regions in Muğla, constitute the limitations of the study. For the active planning of EHS stations in the city, more comprehensive studies are needed that also take into account especially the changing population density of the regions in summer and winter.

Keywords: Healthcare management, 112 emergency health service, optimization, optimal location, maximum set covering model

Öz: Acil sağlık ihtiyacının ne zaman ve nerede ortaya çıkacağı bilinmemektedir. Normal hayat akışı içerisinde karşılaşılan yer yer doğal afetlerin yer yer kazalar, hastalıklar veya saldırıların neden olduğu durumlarda, acil hizmete erişim ihtiyacı ortaya çıkmaktadır. Acil bir durum ortaya çıktığı anda, olay yerine erken ve kaliteli müdahale önem arz etmektedir. Erken ve doğru müdahale hastaların yaşam şansını arttırmaktadır. Bu noktada istasyonların kurulum yerleri önemli olmaktadır. İstasyon yerleri olası bir vaka durumunda erişimi kolaylaştırmalı, kişilere ulaşımı ve müdahale süresini kısaltarak olaya maruz kalan kişilerin yaşama tutunma şansını arttırmalıdır. Çalışmanın amacı Muğla il sınırları içerisinde hizmet veren 112 sağlık ekiplerinin herhangi bir vakaya ulaşım süresinin en aza indirgenmesidir. Bu amaçla 2019 yılında aktif hizmet veren tüm 112 Acil Sağlık Hizmet (ASH) İstasyonlarının optimal yerleşim yerleri değerlendirilmiştir. Optimal yerleşim yerinin belirlenmesi acil duruma müdahale süresini minimum düzeyde tutarken, gereksiz kaynak kullanımını da önlemektedir. Çalışma örneklemi Muğla ilinde 2019 yılında aktif hizmet sunmakta olan 45 tane 112 ASH kara yolu istasyonundan oluşmaktadır. Bu istasyonların optimal yerleşim yerlerini belirlemek için çalışmada Maksimum küme kapsama modeli kullanılmış. Problem çözümü Excel Solver ile elde edilmiştir. Elde edilen sonuca göre, Muğla ilindeki 45 istasyonun 30'u ile hizmete devam edilebileceği, mevcut 15 istasyonun kaynak verimliliğini olumsuz yönde etkilediği ortaya çıkmıştır.

Anahtar Kelimeler: Sağlık yönetimi, 112 acil sağlık hizmetleri, optimizasyon, optimal lokasyon, maximum küme kapsama modeli

Introduction

The need for emergency services arises in cases of accidents, natural disasters, diseases, or attacks encountered in routine life. To respond to these needs, the 112 Emergency Health Service (EHS) Stations have been established. The EHS stations aim to ensure that emergency health services are carried out equally, accessibly, quickly, efficiently, and in high quality throughout the

country (Health Statistics Yearbook, 2022). Emergency health service stations are of great importance, especially in extraordinary and unexpected situations that pose a significant, life-threatening health risk. The rapid calls made by the people at the scene to the emergency health station, the transportation of the units to the scene as soon as possible, and the provision of quality and effective emergency health intervention increase the chance of people surviving and therefore the likelihood of getting positive outcomes with early medical treatment to be applied in the hospital (Demirhan, 2003). At this point, the location of the stations becomes important. As stated in Article 11 of the regulation published in the official gazette dated May 11th, 2000, numbered 24046, the station locations are determined for a maximum population of fifty thousand according to the difficulty of the population in need of health service in accessing the health services, the limited transportation facilities, the incidence of events requiring emergency health services, the number of traffic and work accidents and similar incidents (Emergency Health Services Regulation, 2021). Station locations should facilitate access in the event of a possible incident and increase the chances of survival by shortening the time of transportation and intervention to people. A possible emergency condition starts with the emergency case report to the 112 call center, the incoming call is evaluated, if the report requires an urgent medical intervention, the request is approved, the appropriate team is assigned, and the nearest appropriate team is directed to the scene. A team and an ambulance are mobilized to access the case as soon as possible. When the case is reached, the necessary first medical intervention is made at the scene, if necessary, the case is transferred to the hospital, and the ambulance returns to the station after transferring the case to the hospital emergency service (Emergency Health Services Regulation, 2000).

The time elapsed between the departure of the ambulance and the arrival time at the scene is considered the intervention time. One of the objectives of emergency health services is to provide access to the case as soon as possible. The shortest intervention time depends on the availability of emergency health care services, the time it takes for the vehicle to leave the institution, and the time it takes for the vehicle to reach the case (Ingolfsson et al., 2008). Although in some countries the intervention time is considered the time from the moment the emergency medical aid call to the arrival to the requested area, the time interval indicated by the time between the departure of the ambulance and the arrival at the scene is generally accepted as the intervention time. As an important variable, the intervention time is defined as the time spent on the road to access the scene since the departure of the ambulance. In many countries, there is no generally accepted standard duration for this period. In the literature, this intervention time was generally considered 8 minutes (Ateş et al., 2011). In Turkey, the target of the Ministry of Health for the response time to emergency cases is 10 minutes in cities and 30 minutes in rural areas, starting from the moment of the emergency call (Ministry of Health, 2016). In the study, this period was accepted as 10 minutes in line with the targets of the Ministry of Health. For the province of Muğla, this period was 90 seconds for the departure of the ambulance from the moment the call was directed to the emergency health institution, 10 minutes for the transportation to the case in the urban region, and 30 minutes for the transportation to the case in the rural area.

Emergency health services in Turkey started in 1986 under the name of "Hızır Emergency Service" primarily in the provinces of Ankara, Istanbul, and Izmir, and patients were transported to hospitals by ambulance. In 1994, a model with the new name "112 Emergency Aid and Rescue" was implemented with the ambulance emergency service team, which included a general practitioner, nurse, and driver. Today, there are also paramedics and emergency medical technicians in the ambulance emergency service team (Kıdak et al., 2009).

When we look at the 2019 health statistics yearbook, the number of 112 emergency health service stations in Turkey in 2019 was 2,886 and the number of emergency station ambulances was 5,382 as shown in Figure 1 and Figure 2. It is observed that there are 46 stations and 89 ambulances in Muğla province in 2019 (Health Statistics Yearbook, 2021). As of 2019, 45 emergency stations are actively serving in the province of Muğla, Turkey.

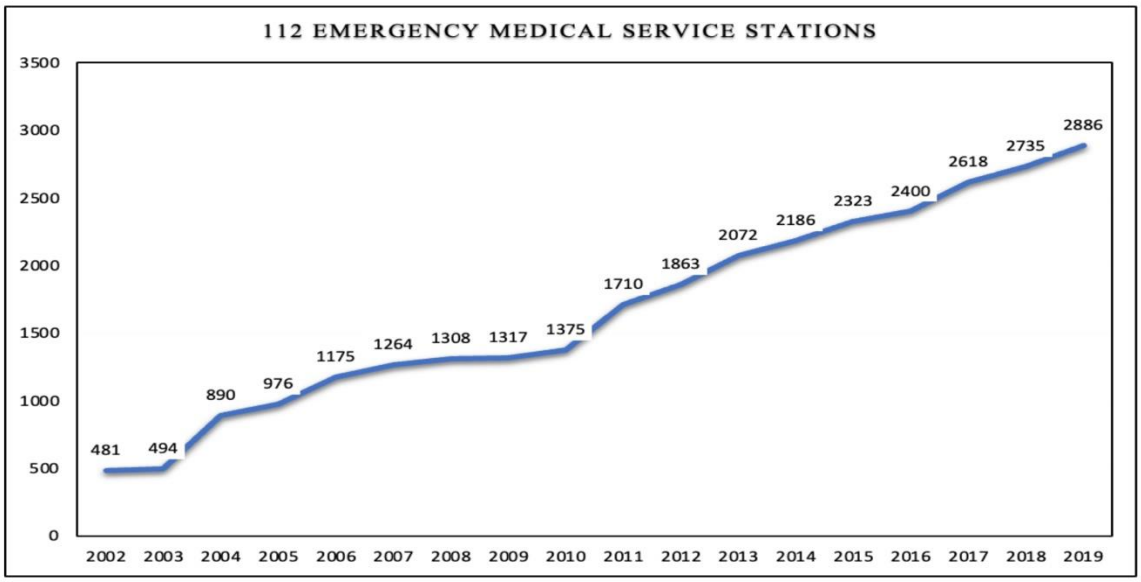

Figure 1: Number of 112 Emergency Medical Service Stations by Year, Ministry of Health (Health Statistics Yearbook, 2021)

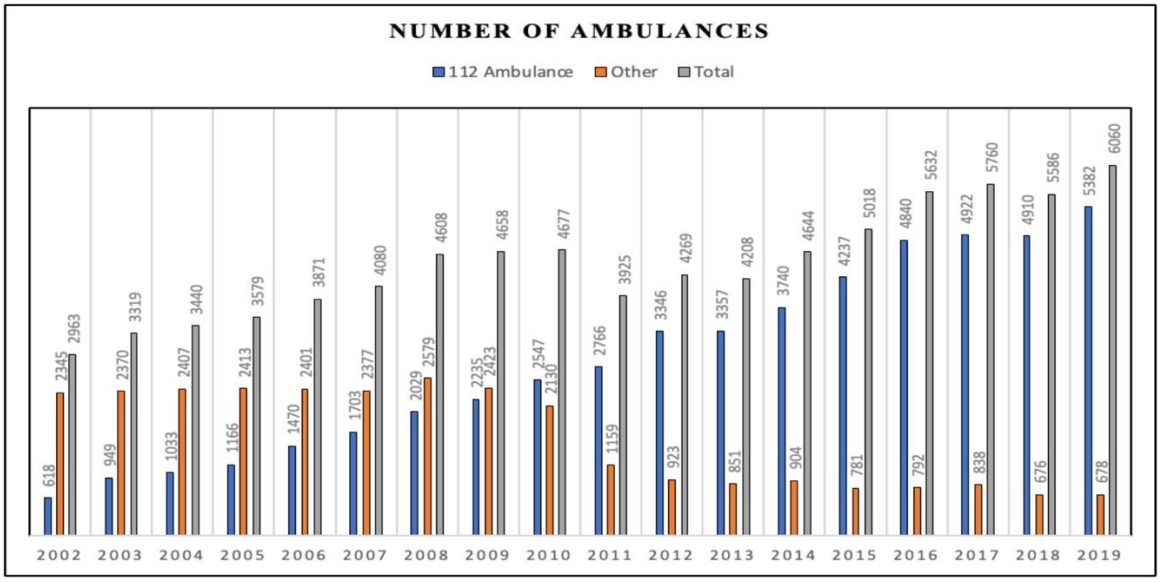

Figure 2: Number of Ambulances by Year, Ministry of Health (Health Statistics Yearbook, 2021)

According to the literature review, there were similar studies in cities such as Istanbul, Konya-Selçuk, Konya-Center, Samsun, Manisa, and İzmir in Turkey, but there were no studies on the optimal location of the 112 health service stations in the province of Muğla. Especially in the province of Muğla, whose population increases during the tourism season (about 6 months), emergencies increase in the summer months, and it becomes important to determine the station locations that will provide access to the case as soon as possible. In line with this importance, the study aims to determine the optimal emergency health station locations that will provide access to the case as soon as possible in the province of Muğla. Future studies are needed on the locations of stations in other provinces in Turkey.

In the study, the Maximum Covering Location Model developed by Church and ReVelle in

1974, which is an accepted model in the literature, was used. In determining the optimal locations, the Maximum Covering Location Model accepted in the literature was used, and the solution was obtained with Solver in the Microsoft Excel program.

The study will guide policymakers in terms of efficient use of available resources, allocating funds to new technologies by avoiding resource waste and ensuring integration into technology, organizing the working system, capacity planning, determining vehicle and station locations, assigning personnel when necessary, and providing timely transportation to all people in need of emergency health service, providing effective service by equipped teams.

Literature Review and Conceptual Framework

In the literature, the first location set covering model was proposed by Toregas et al. in 1971. This model is called the Location set covering model. In this model, only the areas of need where demand arises are covered with the least number of vehicles or facilities (Toregas et al., 1971). The model does not offer full coverage of all areas of need. In 1974, Church and ReVelle proposed the first maximum deterministic covering model called the Maximum Covering Location Problem (Church & Revelle, 1974). This model aims to meet the maximum demand with a limited number of resources (Li et al., 2011). Since it is assumed that only one station serves certain remote areas in the study, the Maximum Covering Location Model developed by Church and ReVelle (1974), which is an accepted model in the literature, was used. Studies on the subject in the literature are as follows.

Eaton et al. (1985), discussed the Maximum covering location model for redesigning locations of the emergency medical service in Austin, Texas. As a result of the application of this model, better conditions were obtained in the region in terms of intervention time and cost (Eaton et al., 1985).

Eaton et al. (1986), used the sequential optimization model in their study applied in Santa Domingo. Here, they determined the maximum population, that is, the minimum number of vehicles to cover all demand, with the location set covering model, and with the maximum covering location model, they maximized the covered multiple demands with the limited number of vehicles (Eaton et al., 1986).

Öztürk et al. (2013), used the maximum covering location model for determining the location model of 112 emergency health stations in the Selçuk district of Konya province. As a result of this model, researchers have recommended that some stations in the district should be removed, and new stations should be established in some regions where there are no stations (Öztürk et al., 2013).

Kısakol (2015), addressed the problem of the locations of emergency health stations for the city center of Manisa and analyzed 7 stations. He used the P-Median model for the evaluations with, the maximum covering location model. Based on the distance and access times taken into consideration for the population and case models established by the mathematical models, he achieved positive and good results in terms of maximum coverage of the region to be served (Kısakol, 2015).

Method

This study is a cross-sectional study. Only the 2019 data were used to evaluate the locations of Muğla 112 emergency health stations, and to find optimal locations. In the study, the Maximum Covering Location Model developed by Church and ReVelle (1974), which is an accepted model in the literature, was used. The main reason for using this model is that each location coverage to be serviced is served by only one 112 station. The model, which aims to cover the maximum population or distance within a fixed distance, was used to determine the maximum demand area covered by a single station in the study. Ethics committee approval was not required

as no living, individual, personal data or survey was used in the study.

The study population consists of all the 112 Emergency Medical Service Stations in Turkey. As the study sample, all 112 Emergency Health Service stations (45) that are actively serving in Muğla province in 2019 were included in the research. All actively servicing 112 road stations located in the province were included, but 112 airline stations were not included in the study. Second-hand data were used, and station data were obtained from Muğla Provincial Health Directorate. The distances between the 112 emergency stations were obtained using Google Earth. Distances were obtained as air distance measurements between stations, and the distances obtained between each station were entered into the Excel file to form a 45*45 matrix.

In the study, the speed of an ambulance was considered as 60 km/h, so it was considered that every 1 km of the road would be taken in 1 minute, and a 45*45 distance matrix for the distances between stations was entered into the Excel file accordingly. Since the intervention time considered in practice will be 10 minutes accepted in Muğla, the intervention time was converted to kilometers. If 1 km is traveled in 1 minute, 10 km is traveled in 10 minutes is taken as a basis. The maximum covering location model was used based on the 10 minutes of access time to the case in the urban area. If the distances between stations are greater than 10 minutes, i.e. 10 kilometers, then 0 is entered into the 45*45 $A = a_{ik}$ binary matrix to exclude from the coverage, if the distances are smaller or equal to 10 kilometers then 1 is entered to include the stations in the coverage area.

The location set covering model used in the study is the binary 0-1 integer model, in which all constraints have an '≥' inequality, all the values on the right side are 1, and the coefficient matrix is the 0-1 matrix (Çetin, 2007). The network consists of 45 nodes and the edges connecting these nodes. *Z* is the objective function and gives the minimum number of stations that can be established. Information about this network is as follows (Church & Revelle, 1974):

- *Z* is the objective function, Min= $\sum_{k \in N} y_k$.
- y_k is the decision variable. $y_k \in \{0,1\}$
- *r* is the intervention time, and it was considered 10 min/10 km in the study.
- $\sum_{k \in N} a_{ik} y_k \geq 1$ is the constraint.
- $A = a_{ik}$ is a 45*45 matrix that shows the service status of stations by distance.
- $i =$ possible service station
- $k =$ possible service area

$$Z = \sum_{k \in N} y_k \qquad (1)$$

function (1) gives the minimum number of stations. This function is the objective function and allows the minimization of the number of stations that can be established.

$$y_k = \begin{cases} 1, if\ a\ station\ will\ be\ established\ at\ the\ potential\ area \\ 0, if\ no\ station\ will\ be\ established\ at\ the\ potential\ area \end{cases}$$

Constraints,

$$\sum_{k \in N} a_{ik} y_k \geq 1 \qquad (2)$$

r is the constraint that ensures that each region that can be visited at least 1 time during the intervention period is covered at least 1 time.

$$y_k \in \{0,1\} \quad (3)$$

y_k is the decision variable to assign 0 or 1 integers.

$$a_{ik} = \begin{cases} 1, if\ it\ can\ access\ the\ potential\ area\ k\ within\ the\ specified\ time, \\ 0, if\ it\ can\ not\ acess\ the\ potential\ area\ k\ within\ the\ specified\ time \end{cases}$$

Here, $A = a_{ik}$ is a 45*45 matrix that shows the service status of stations by distance.

When determining the population to be covered for intervention, the intervention distance is effective in determining the locations of the 112 Emergency Health Stations that are not required to be located in these areas.

Excel Program Algorithm software;

- In the program, first of all, the stations from 1 to 45 were entered on the Excel sheet, and the distances between these stations were entered in km. Then, the distance between each station from the 1st station to the 45th station was compared with the determined intervention distance of 10 km (including the distances to the stations themselves). As a result of the comparisons, a matrix was obtained by entering the following commands:
- If the distance between both stations is ≤ 10, (r ≤10), then put 1 in the matrix,
- If the distance between both stations is > 10, (r >10), then put 0 in the matrix,

If we call this matrix *A*, the solution we are looking for is as follows;

- A.$y_k \geq 1$
- All y_k points that meet the constraint of the A.$y_k \geq 1$ will be assigned the value of 1.

Here, all decision variables that equal 1 indicate the points where a station needs to be established. The y_k values calculated will decide which stations will continue to serve and which ones need to be closed. Operations in Microsoft Excel Solver were performed.

Results and Discussion

The maximum number of stations to be opened with the maximum covering set model was found to be 30 by multiplying the A=a_{ik} matrix by the y_k decision variables of the algorithm in the Excel program. According to the results of the program, it was obtained that 112 emergency health services in Muğla could provide services with 30 stations instead of 45 stations. The stations that need to remain open are the locations whose solution values are 1 and the stations that need to be closed are the locations with a solution result of 0. These are given in the Table 1 in detail.

Table 1: Stations That Need to Continue Service, and Stations That Need to Be Closed According to the Result of the Program Solution

Station Number	Decision Variable	Station Name
1.	1	Fethiye No:9 Karadere
2.	1	Fethiye No:6 Eşen
3.	1	Fethiye No:5 Bekçiler
4.	1	Fethiye No:3 Kemer
5.	1	Fethiye No:7 Ölüdeniz
6.	0	Fethiye No:1 Center
7.	1	Fethiye No:4 Çamköy
8.	0	Fethiye No:8 Üzümlü
9.	1	Fethiye No:2 Göcek
10.	1	Dalaman No:2 Gürleyik
11.	0	Dalaman No:1 Center
12.	1	Ortaca No:1 Center
13.	1	Ortaca No:2 Dalyan
14.	0	Köyceğiz No:1 Center
15.	1	Köyceğiz No:2 Beyobası
16.	0	Ula No:1 Gökova
17.	1	Ula No:2 Center
18.	0	Muğla No:3 Kötekli
19.	0	Muğla No:6 Yerkesik
20.	1	Muğla No:1 Center
21.	0	Muğla No:4 Gazeller
22.	1	Muğla No:7 Göktepe
23.	0	Muğla No:2 Bayır
24.	0	Marmaris No:1 Center
25.	1	Marmaris No:2 Turgutköyü
26.	1	Marmaris No:4 Bozburun
27.	1	Marmaris No:3 Armutalan
28.	1	Datça No:1 Center
29.	1	Datça No:2 Palamutbükü
30.	1	Kavaklıdere No:1 Center
31.	1	Yatağan No:1 Center
32.	0	Yatağan No:2
33.	1	Milas No:5 Ortaköy-Türbe
34.	0	Milas No:1 Center
35.	1	Milas No:2 Selimiye
36.	1	Milas No:6 Kazıklı
37.	1	Milas No:7 Beçin
38.	1	Milas No:3 Ören
39.	0	Milas No:4 Güllük
40.	1	Bodrum No:3 Güvercinlik
41.	1	Bodrum No:4 Göltürkbükü
42.	0	Bodrum No:1 Center
43.	1	Bodrum No:5 Kumbahçe
44.	1	Bodrum No:2 Turgutreis
45.	1	Bodrum No:6 Yalıkavak

Conclusion

Based on the findings, it was concluded that Muğla province needs an effective emergency health services planning. It is recommended to either close 15 emergency health stations in Muğla province and to transfer the existing personnel and resources to other stations, or in order to obtain

optimum benefit for these 15 stations, new layout arrangements are recommended after optimum measurements are made. Advised solutions will allow costly station locations to be changed or merged with other stations in need of to use their resources more efficiently.

The study will guide policymakers in terms of efficient use of available resources, allocating funds to new technologies by avoiding resource waste and ensuring integration into technology, organizing the working system, capacity planning, determining vehicle and station locations, assigning personnel when necessary, and providing timely transportation to all people in need of emergency health service, providing effective service by equipped teams.

However, it should be noted that population density, summer and winter population differences, and geographical conditions, which are important factors preventing transportation between regions in Muğla, constitute the limitations of the study. For the active planning of EHS stations in the city, more comprehensive studies are needed to take into account especially the changing population density of the regions in summer and winter.

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Beyan ve Açıklamalar (Disclosure Statements)

1. Araştırmacıların katkı oranı beyanı / Contribution rate statement of researchers:

    1. Yazar/First author % 50

    2. Yazar/Second author % 50

2. Yazarlar tarafından herhangi bir çıkar çatışması beyan edilmemiştir (No potential conflict of interest was reported by the authors).