

# Epidemiology of patients with musculoskeletal soft tissue sarcomas in a cancer hospital in Central China: A study of 1624 cases.

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## Research article

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# Abstract

**Background :** To analyze the incidence characteristics of 1624 inpatients with soft tissue sarcoma (STS) during 2006 to 2016 in Henan Province Cancer Hospital in Central China.

**Methods :** The information of electronic medical record from the first hospitalized patients with STS in Henan Province Cancer Hospital during January 1, 2006 to December 31, 2016 was collected, and descriptive statistics was analyzed on age, gender, pathological type and tumor location by using SPSS21.0 software.

**Results :** There were 1624 inpatients with STS in Henan Province Cancer Hospital in 2006~2016. The top nine pathological subtypes of STS with high constituent ratio were undifferentiated pleomorphic sarcoma (UPS, 23.83%), synovial sarcoma (16.69%), liposarcoma (13.67%), fibrosarcoma (10.22%), sarcoma without definite type (8.99%), leiomyosarcoma (7.02%), dermatofibrosarcoma protuberant (5.79%), rhabdomyosarcoma (4.68%) and malignant neurilemmoma (4.25%). The average age of inpatients was  $44.71 \pm 17.91$ , and the inpatients aged 35-64 accounted for 56.34%. The number of UPS inpatients reached the peak at the age of 45 to 59; The median age of inpatients with rhabdomyosarcoma was 17 year. In total 1624 inpatients of STS, the number of male and female inpatients were 923 and 701, respectively. The gender ratio was 1.32:1. The proportion of UPS in either male or female inpatients was the highest, accounting for 23.07% and 24.82%, respectively. The number of male inpatients was more than that of female in the top nine pathological subtypes of STS except leiomyosarcoma (the gender ratio was 0.84:1). The most common initiation location of UPS, synovial sarcoma, liposarcoma was lower extremity, accounting for 51.16%, 53.13% and 52.25% in corresponding pathological type group, respectively. Dermatofibrosarcoma protuberant, rhabdomyosarcoma and fibrosarcoma were all mainly initiated in trunk, accounting for 72.34%, 47.83% and 45.57%, respectively. Leiomyosarcoma tend to occur in retroperitoneum.

**Conclusion :** The top three pathological subtypes of STS with high constituent ratio were UPS, synovial sarcoma and liposarcoma. UPS should be paid more attention on the prevention, treatment and research in Henan province in future for its highest proportion of STS.

## Background

Soft tissue sarcomas (STSs) are rare malignant tumors of mesenchymal origin with high aggressiveness and heterogeneity. More than 50% histopathological subtypes have been identified, and may occur in any part of body [1]. STSs are usually derived from bone supporting structures, including muscle, fascia, fiber, nerve sheath, fat, lymphoid tissue and blood vessel. STS is account for approximately 0.7% of estimated new cancer cases [2], and the study from Japan and England shows that the incidence of soft tissue sarcoma in childhood cancer (aged 0-14) is on the rise [3]. There are good published literatures on the incidence of STS in the western populations, but there is a paucity of

data from Asia, particularly on the epidemiology in China [4, 5]. It deserves our extensive research because it is highly hazardous to people for its high invasiveness, recurrence and metastasis.

The data of inpatients with malignant tumors are used to study the pathological subtype proportion and demographic characteristics. Dynamic analysis is carried out to explore the trend of the epidemiology of malignant tumors, which could point out the focus and direction of future work and provide reference for the prevention and treatment of malignant tumors. The epidemiological characteristics of STS have been reported in many literatures both inside and outside the country. In United States, there will be 13,130 newly diagnosed STS including the heart site in 2020 according to the latest research data released by the American Cancer Society, which include 7,470 male and 5,660 female inpatients, and the sex ratio between males and females is 1.32:1. Moreover, 5350 cases of STS is estimated to die in the United States in 2020, including 2,870 males and 2,480 females [2]. Lei Y [6] et al. found that there were 2048 cases of STS diagnosed in Beijing in the past 15 years, with an incidence rate of 1.15/100,000 according to the population-based STS data collected by the Beijing Cancer Registry from 1999 to 2013. The incidence rate of China's population standardization and the world population standardization rate were 0.74/100,000 and 0.86/100,000 respectively. In addition, it was found that the incidence and the common pathological types of STS in Beijing and Taiwan [7] were not the same. However, the characteristics of STS in Henan Province, which is one province of Central China, have not been reported up to now.

In this study, an epidemiological analysis of the incidence characteristic of STS inpatients was done for the first time in Henan Province Cancer Hospital in Central China during January 1, 2006 to December 31, 2016. According to the Henan Province Cancer Prevention Office, the STS patients treated in Henan Province Cancer Hospital account for approximately 75% of the total STS patients in Henan province, therefore, analyzing the composition of the age, gender, pathological type and tumor location of patients with STS in Henan Province Cancer Hospital during the 11 years would provide a reference of the epidemiological status and time trend of patients with STS in Henan province, and provide clues for the health administrative department to develop effective prevention and control measures for STS.

## **Subjects And Methods**

### **2.1 Subjects**

The hospitalized 1624 patients with STS in Henan Province Cancer Hospital during January 1, 2006 to December 31, 2016 were included. The tumor classification criteria were based on the 10th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10), C47 and C49 in ICD-10 were regarded as inclusion criteria for STS. C47 was a peripheral and autonomic nervous system malignancy, and C49 was other connective tissue and soft tissue malignant tumors. The classification criterion for histopathological types was ICD-O-2. Patients with recurrence, incomplete data, non-hospitalization or visceral STS, such as gastrointestinal stromal tumors, uterine leiomyosarcoma and

epididymis sarcoma, et al, were excluded in the research. The study was approved by the ethical committee of Zhengzhou University, and all the participating patients signed the informed consent.

## **2.2 Data Source and Collection**

The information of electronic medical record of the inpatients with STS meeting the inclusion criteria in Henan Province Cancer Hospital was collected, including admission number (AD), age, gender, date of birth, place of birth, date of admission, date of discharge, location of tumor and pathological subtypes. Certainly, privacy information of the inpatients was not involved. The basic information of electronic medical records was input and stored in Microsoft Excel.

## **2.3 Data Processing and Statistical Analysis**

In the latest STS WHO classification (2013 edition), the malignant fibrous histiocytoma (MFH) was renamed undifferentiated pleomorphic sarcoma (UPS). The reason was that MFH was lack of a specifically identified line of differentiation when analyzed by presently available technology. Furthermore, there were some literatures published after 2013 that clearly stated that UPS was previously known as MFH[8, 9]. In this study, the cases with pathological diagnosis of MFH before 2013 or UPS after 2013 were uniformly named UPS for statistics.

The inpatients were divided into groups of 5 years old, a total of 18 groups. SPSS21.0 software was used to descriptively analyze the age, sex, tumor location and pathological types of inpatients with STS. And the ratio of different pathological types was calculated respectively. Microsoft Excel was used to make graphs.

## **2.4 Quality Control**

The investigators need to clarify the purpose and significance, and clarify the items and precautions of the research before collecting information. The investigators and the staffs in Department of Medical Record double checked and confirmed the information of the original inpatients meeting the inclusion criteria to ensure accurate and completed data.

# **Results**

## **3.1 General situation of inpatients with STS in Henan Province Cancer Hospital**

A total of 1624 inpatients with STS in Henan Province Cancer Hospital from 2006 to 2016 were included. The overall number of inpatients showed a significant growth trend before 2010, which decreased slightly in 2011 and increased from 2011 to 2013. Then the total number of inpatients decreased slightly from 2013 to 2014 and increased again after 2014. The number of male inpatients were more than female inpatients in all most every year from 2006 to 2016 except 2014 (As shown in Figure 1).

The top nine pathological subtypes of STS with high constituent ratio were UPS (23.83%), synovial sarcoma (16.69%), liposarcoma (13.67%), fibrosarcoma (10.22%), Sarcoma without definite type (8.99%), leiomyosarcoma (7.02%), dermatofibrosarcoma protuberant (5.79%), rhabdomyosarcoma (4.68%) and malignant neurilemmoma (4.25%), accounting for 95.15% of total number of inpatients with STS in Henan Province Cancer Hospital (As shown in Table 1).

### **3.2 Age characteristic of inpatients with STS in Henan Province Cancer Hospital**

Inpatient age with STS in Henan Province Cancer Hospital from 2006 to 2016 distributed over a wide range (1–82 year), with an average age of  $44.71 \pm 17.91$ . The number of inpatients with STS increased significantly since the age of 15, reached the peak at the age of 45-59, and decreased rapidly after 75 years old. The results showed a single peak distribution. The median age of inpatients with STS was 46 years old, and the inpatients at the age of 35-64 accounted for 56.34% (As shown in Figure 2).

Table 2 showed that the median age of inpatients with STS of the top nine pathological types. It was found that the median age of inpatients with UPS, sarcoma without definite type and leiomyosarcoma was more than 50 years old. While the median age of rhabdomyosarcoma was 17 years old for containing embryonal rhabdomyosarcoma, which was more common in newborn.

### **3.3 Gender characteristic of inpatients with STS in Henan Province Cancer Hospital**

From 2006 to 2016, 923 men and 701 women were hospitalized with STS in Henan Province Cancer Hospital. The male-female ratio was 1.32:1. UPS, accounting for 23.07% of STS, was the most common pathological type in males, followed by synovial sarcoma, liposarcoma and fibrosarcoma, accounting for 15.49%, 14.63% and 11.16% in males, respectively. Similar results were shown in females. The most common type was UPS accounting for 24.82% in females, followed by synovial sarcoma, liposarcoma and sarcoma without definite type, accounting for 18.26%, 12.41% and 8.99% in females, respectively. As shown in Table 2.

Males were significantly more susceptible to STS except leiomyosarcoma among the top nine pathological subtypes of STS in Henan Province Cancer Hospital from 2006 to 2016. UPS was found in 213 males and 174 females, the ratio of male to female of UPS was 1.22:1, while leiomyosarcoma was found in 52 males and 62 females, male-to-female ratio of which was 0.84:1. Malignant neurilemmoma was the most prominent sex-specific subtype with male-to-female ratio was 2:1, followed by dermatofibrosarcoma (1.69:1), fibrosarcoma (1.63:1), and rhabdomyosarcoma (1.6:1). As shown in Table 2.

### **3.4 Tumor location of inpatients with the top nine rank of different pathological subtypes of STS in Henan Province Cancer Hospital.**

Table 3 demonstrated that UPS, which was the most common pathological subtype of STS, was mainly occurred in lower extremity, accounting for 51.16% of the total number of UPS, then followed by trunk

(including shoulder, armpit, back, chest wall, abdominal wall, pelvis, groin, hip, pelvis, perineum and buttock), accounting for 26.61% of the total number of UPS.

Besides UPS, the most common initiation location of synovial sarcoma, liposarcoma, sarcoma without definite type and malignant neurilemmoma was also lower extremity, accounting for 53.13%, 52.25%, 42.46% and 36.84% in corresponding pathological type group, respectively. While dermatofibrosarcoma protuberant, rhabdomyosarcoma and fibrosarcoma were all mainly initiated in trunk, accounting for 72.34%, 47.83% and 45.57% , respectively. Leiomyosarcoma tend to occur in retroperitoneum, accounting for 32.46% in its pathological type group. (As shown in Table 3).

## Discussion

In this study, the characteristics of 1624 inpatients with STS from Henan Province Cancer Hospital in Central China from 2006 to 2016 were analyzed. We found that the top nine were UPS (accounting for 23.83% all STS), synovial sarcoma (16.69%), liposarcoma (13.67%), fibrosarcoma, sarcoma without definite type, leiomyosarcoma, dermatofibrosarcoma protuberant, rhabdomyosarcoma, and malignant neurilemmoma. The number of inpatients with STS in the first three pathological types accounted for 54.19% of all the inpatients with STS in Henan Province Cancer Hospital. Fang's[10] research was consistent with ours. He analyzed the information of 1118 patients with STS from north China, northeast China, and northwest China, and found that the most common first three pathological types were UPS(35.24%), synovial sarcoma(17.08%) and liposarcoma(16.28%). However, The first three pathological types of over 45 years old STS inpatients in Beijing were UPS(19.22%), liposarcoma (19.04%) and malignant neurilemmoma (10.18%)[6], the first three pathological subtypes of STSs in Taiwan were liposarcoma(23%), UPS(18.9%) and leiomyosarcoma(7.6%)[7],and the first three pathological types of STSs in Japan were UPS(19.46%), well differentiated liposarcoma(19.23%), myxoid/round cell liposarcoma (9.35%)[11]. These results were all different from ours. Distinctly, the common pathological subtypes of STSs were not similar in different areas. We speculated that the reason may be different methods of data collection and analysis. In our study, the number of patients with all age was analyzed, but population-based incidence was analyzed in Beijing, Taiwan and Japan; Furthermore, the patients with STS in Beijing was divided into three age groups: 0-14 years old, 15~44 years old and over 45 years old, and the first three pathological types of STS were analyzed only in the group of over 45 years old.

In this study, the peak age of inpatients with STS was 45-59 years old. However, the peak age of STS in Beijing was 80-84 years old[6], which may be related to the grouping method. The peak age of patients with STS initiated in extremities in Korea from 2009 to 2011 was 70-89 years old[12], and the peak age of STS patients in Ireland from 1994 to 2012 was 70-84 years old[13], which were different from the results in our study. The reason may be that the patients of STS only in extremities were analyzed in Korea, but not in the whole body excluding visceral sarcoma; and the research in Ireland was about the STS in whole body including visceral sarcoma. While in our study, we analyzed the STS in whole body, but visceral sarcoma was excluded. The lower peak age in this study may be that embryonal rhabdomyosarcoma was included, most patients with embryonal rhabdomyosarcoma were very young. What's more,

rhabdomyosarcoma was typically a childhood and adolescents cancer, and it can rarely occur in adults[14], in our study, we found that the median age of rhabdomyosarcoma was 17, which verified the view.

We analyzed the gender distribution of STS in Henan Province Cancer Hospital in Central China from 2006 to 2016, and found that there were 923 males and 701 females in 1624 inpatients, and the ratio of male to female was 1.32:1. Lei Y[6] et al showed that the incidence of STS in male in Beijing was higher than that in female (the ratio was 1.38:1) according to the population-based STS data from 1999 to 2013 collected by the Beijing Cancer Registry. Meanwhile, the gender ratio was 1.34:1 in Taiwan [7]. The two results mentioned above were similar to our study. However, the STS surveillance data from 27 countries in Europe showed that the female incidence rate was 5.0/100,000, the male incidence rate was 4.4/100,000, and the incidence in female was slightly higher than that in male[15]. In the study in Europe, visceral sarcoma was included, and the incidence of uterine leiomyosarcoma and mammary sarcoma in women was significantly higher than that of epididymis sarcoma in man, that's why the incidence rate of STS in women was higher. In contrast, visceral sarcoma was excluded in our study.

The primary locations of STS with different subtypes were different. most STSs, such as UPS, synovial sarcoma, liposarcoma and malignant neurilemmoma, were initiated in lower extremity, followed by trunk and upper extremity, which was consistent with a Japanese report[11]. Particularly, It was noteworthy that synovial sarcoma was most common diagnosed in foot and ankle[16]. In a report of extremity soft tissue sarcoma, the number of cases occurred in the lower extremity was about 2.87 times that that in the upper extremity[12]. Our study showed that retroperitoneum was not a common location of soft tissue sarcoma excluding leiomyosarcoma, and rhabdomyosarcoma tend to occur in the trunk. Those results in our study were consistent with Chinese expert consensus on diagnosis and treatment of soft tissue sarcomas (2015 edition)[17]. We anticipate that this situation should be attributed to STS's unique histological and biological characteristics.

In short, we analyzed the sex, age, cancer location and pathological subtypes of 1624 inpatients with soft tissue sarcomas (excluding visceral organs) from Henan Province Cancer Hospital in Central China from 2006 to 2016 in the study. It could give us a clearer understanding of the basic situation and epidemiological trends of STS in Henan province represented by Henan Province Cancer Hospital, and point out the direction for the prevention and treatment of STS in future.

## Abbreviations

STS: soft tissue sarcoma; ICD-10: the International Statistical Classification of Diseases and Related Health Problems; AD: admission number; MFH: malignant fibrous histiocytoma; UPS: undifferentiated pleomorphic sarcoma

## Declarations

## Ethics approval and consent to participate.

The study and the protocol were approved by the ethical committee of Zhengzhou University.

## Consent for publication

Not applicable.

## Availability of data and materials

The data is available and the corresponding author should be contacted for inquiries.

## Competing interests

The authors declare that they have no competing interests..

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## Authors' contributions

PZ and JL searched literatures and wrote the manuscript; FF analyzed the data; QZ, GD and WY provided guidance. All authors have read and approved the final manuscript.

## Acknowledgements

Not applicable.

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## Tables

**Table 1** The number and percentage of inpatients with different pathological subtypes of STS in Henan Province Cancer Hospital in 2006~2016

Rank	Pathological name of STS	N	Percentage (%)
1	Undifferentiated pleomorphic sarcoma	387	23.83
2	Synovial sarcoma	271	16.69
3	Liposarcoma	222	13.67
4	Fibrosarcoma	166	10.22
5	Sarcoma without definite type	146	8.99
6	Leiomyosarcoma	114	7.02
7	Dermatofibrosarcoma protuberant	94	5.79
8	Rhabdomyosarcoma	76	4.68
9	Malignant peripheral nerve sheath tumor	69	4.25
10	Ewing's sarcoma	19	1.17
11	Epithelioid sarcoma	16	0.98
12	Angiosarcoma	13	0.80
13	Clear cell sarcoma	11	0.68
14	Alveolar soft part sarcoma	7	0.43
15	Neurofibrosarcoma	5	0.31
16	Small cell sarcoma	3	0.18
17	Kaposi's sarcoma	3	0.18
18	Giant cell sarcoma	2	0.12
Total		1624	100

Note: Percentage (%) =  $N / 1624 * 100\%$

**Table 2** The age and gender characteristic of inpatients with the top nine rank of different pathological subtypes of STS in Henan Province Cancer Hospital in 2006~2016

Pathological subtypes	Age [Median (Mix, Max)]	Male		Female		The ratio of male to female
		N	Percentage (%)	N	Percentage (%)	
Undifferentiated pleomorphic sarcoma	54 (1,89)	213	23.07	174	24.82	1.22 : 1
Synovial sarcoma	35 (4,77)	143	15.49	128	18.26	1.12 : 1
Liposarcoma	49 (19,81)	135	14.63	87	12.41	1.55: 1
Fibrosarcoma	44 (8,82)	103	11.16	63	8.99	1.63 : 1
Sarcoma without definite type	52 (7,82)	82	8.88	64	9.13	1.28 : 1
Leiomyosarcoma	50 (2,78)	52	5.63	62	8.84	0.84 : 1
Dermatofibrosarcoma protuberant	37 (8,74)	59	6.39	35	4.99	1.69: 1
Rhabdomyosarcoma	17 (1,82)	47	5.09	29	4.14	1.60 : 1
Malignant neurilemmoma	49 (5,83)	46	4.98	23	3.28	2.00 : 1

Note: Male Percentage (%) = N / Total number of male inpatients (923)\*100%; Female Percentage (%) = N / Total number of female inpatients (701) \*100%;

**Table 3** The number and constituent ratio of inpatients of the top nine rank of pathological subtypes with different tumor location in Henan Province Cancer Hospital in 2006~2016 [N (%)]

	Upper extremity	Lower extremity	Retroperitoneum	Trunk	Head/Neck
Undifferentiated pleomorphic sarcoma	65(16.79)	198(51.16)	11(2.84)	103(26.61)	10(2.58)
Synovial sarcoma	47(17.34)	144(53.13)	1(0.37)	62(22.88)	17(6.27)
Liposarcoma	11(4.95)	116(52.25)	34(15.31)	56(25.22)	5(2.25)
Fibrosarcoma	28(16.87)	61(36.75)	3(1.80)	69(45.57)	5(3.01)
Sarcoma without definite type	20(13.70)	62(42.46)	6(4.11)	51(34.93)	7(4.79)
Leiomyosarcoma	13(11.40)	35(30.70)	37(32.46)	26(22.81)	3(2.63)
Dermatofibrosarcoma protuberant	8(8.51)	14(14.89)	0(0)	68(72.34)	4(4.26)
Rhabdomyosarcoma	13(18.84)	8(11.59)	4(5.80)	33(47.83)	11(15.94)
Malignant neurilemmoma	18(23.68)	28(36.84)	0(0)	21(27.63)	9(11.84)

Constituent ratio(%)=N/Total number of inpatients in different pathological subtype group\*100%

Trunk includes shoulder, armpit, back, chest wall, abdominal wall, pelvis, groin, hip, pelvis, perineum and buttock.

# Figures

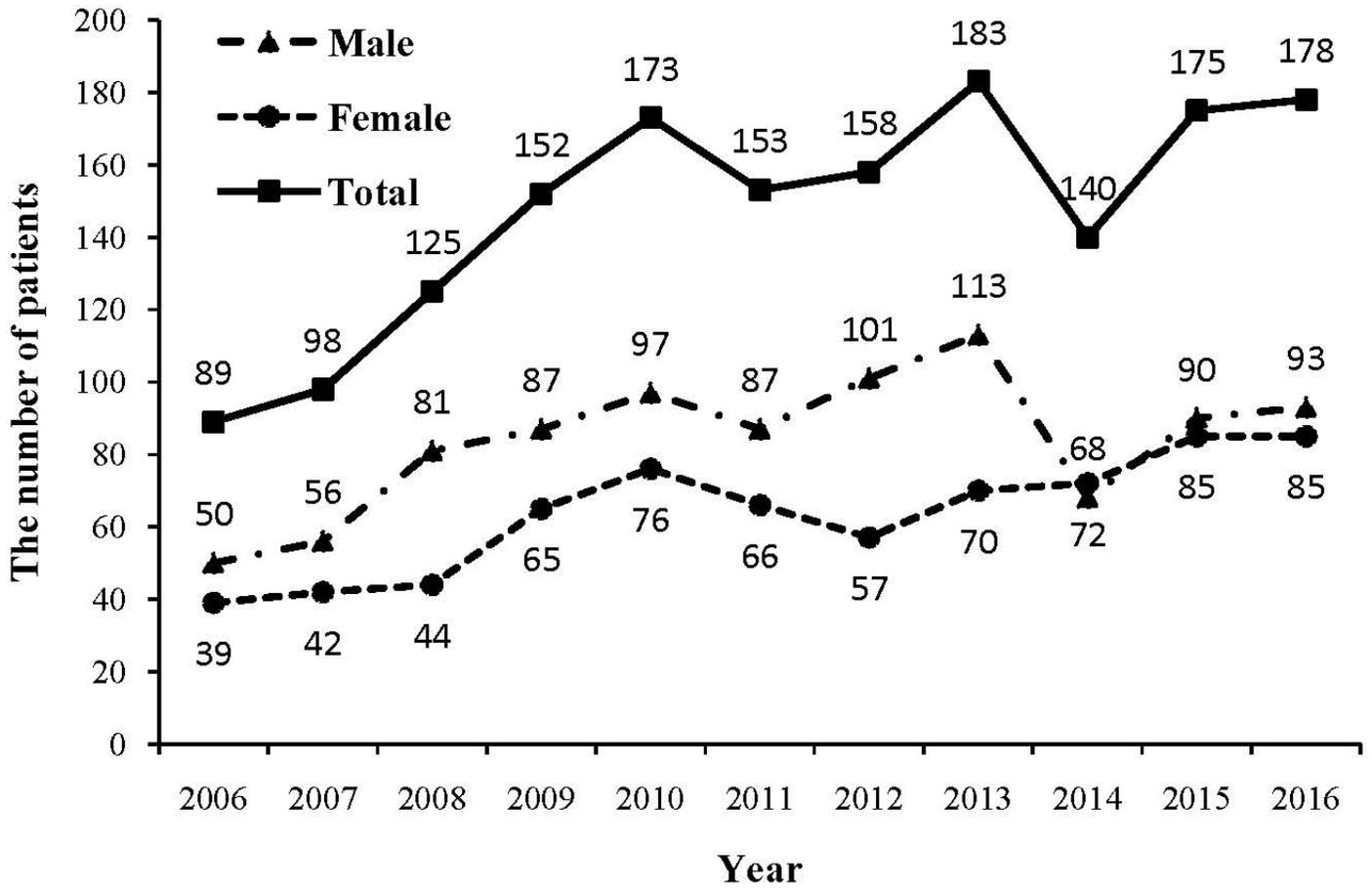
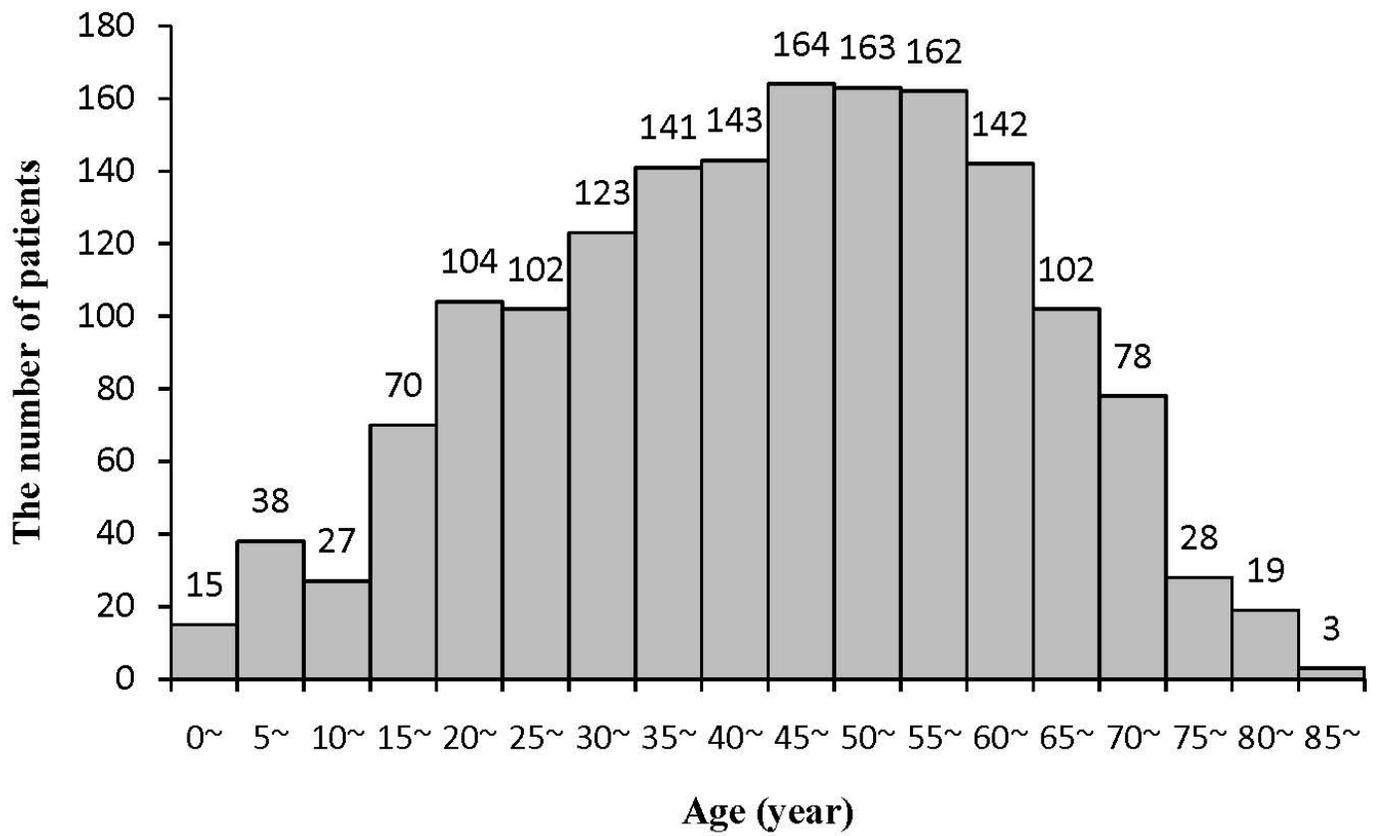


Figure 1

The trend of inpatients with STS in Henan Province Cancer Hospital in 2006~2016



**Figure 2**

The number of inpatients of STS in different age groups in Henan Province Cancer Hospital in 2006~2016