The incidence, comorbidity and mortality of sarcoidosis in Korea, 2008–2015: a nationwide population-based study

Mi Hye Jeon¹, Taeuk Kang¹, Sang Hoon Yoo², Heather S. Swan³, Hyunjung Kim⁴, Hyeong Sik Ahn⁴

¹Department of Public Health, Graduate School, Korea University; ²Division of Pulmonology, Department of Internal Medicine, College of Medicine, Daejeon St. Mary’s Hospital, The Catholic University of Korea; ³School of Sociology and Anthropology, University of Ottawa; ⁴Department of Preventive Medicine, College of Medicine, Korea University

Abstract. Background: Few national level, population-based studies are present on the epidemiology of sarcoidosis and it is unclear whether these patients have higher mortality than the general population. The objective of this study was to investigate the nationwide epidemiology, comorbidity and mortality in sarcoidosis in Korea. Material and Methods: For the period between 2008 to 2015, we used the national population-based database operated by Rare Intractable Disease registration program in which patients’ diagnosis are based on uniform criteria. All sarcoidosis patients were identified and followed-up using the National Health Insurance database to determine their incidence, comorbidity, mortality, causes of death and standardised mortality ratio (SMR). Results: During the study period, we identified 3,259 new sarcoidosis patients. The average annual incidence was 0.81 per 100,000. The annual mortality rate was 9.26 per 1,000 person-years. The mortality rate were significantly higher than those of the general population (SMR 1.91, 95% confidence interval 1.62-2.25). The major comorbidities of sarcoidosis patients were the diseases of the respiratory system (17.64%), heart (5.43%), eyes (4.27%) and cancer (2.3%). Mortality was higher in patients with lung involvement. Of the 84 deaths identified in this study from 2008-2013, the most common cause of death was cancer (41.7%), followed by respiratory disease (13.1%), sarcoidosis (13.1%) and heart disease (8.3%). Conclusions: We reported a nationwide incidence of sarcoidosis as 0.81 per 100,000 in Korea. The mortality of sarcoidosis patients was higher compared to the general population and the major causes of death were cancer, respiratory disease and sarcoidosis. Sarcoidosis patients with comorbid diseases showed increased mortality. (Sarcoidosis Vasc Diffuse Lung Dis 2020; 37 (1): 24-36)

Key words: sarcoidosis, incidence, comorbidity, mortality, cause of death

Introduction

Sarcoidosis is an inflammatory disease characterized by non-caseating granuloma that generally affects the lungs, but can also involve various organs such as the liver, skin, eyes, heart and nervous system (1).

The incidence of sarcoidosis is known to vary according to race and region (2, 3). It is observed to be higher among African Americans compared to Caucasians (4, 5), and higher in northern European countries than southern countries. Although lower incidence has been reported in Asia (6-8), these studies were conducted based on a small population.
The morbidity of sarcoidosis is associated with the extent of organ involvement and the diseases resulting from them (9-13). These comorbid conditions affect the prognosis of sarcoidosis in patients (14, 15), however the relationship between comorbidity of sarcoidosis and mortality has been poorly studied. Previous studies (14, 16, 17) that have investigated comorbidities in sarcoidosis were mostly hospital-based where limited number of patients were available. The effect of comorbidity on mortality has rarely been researched specially in Asian countries where the incidence is relatively low.

Although sarcoidosis is usually a self-limited disease (18), it can be fatal when accompanied by organ failure, especially in the lungs, heart and nervous system (19, 20). However, it remains controversial whether sarcoidosis patients have a higher risk of mortality than the general population and only a few studies have investigated the causes of death (21-24). Also, though it reported that patients of Asian ethnicity have less severe symptoms (6), there is insufficient evidence if the severity and mortality of sarcoidosis differs according to race or region (9, 19).

Previous epidemiological studies on sarcoidosis included only a small number of patients from a specific geographical areas (8, 22). In particular, the majority of mortality studies were cross-sectional in nature by using routinely collected administrative data rather than following-up patients, and were hospital-based instead of population-based (7, 25). Since few comorbidity and mortality studies followed-up sarcoidosis patients (23, 24), data from large-scale population-based nationwide studies are needed.

This study investigated the epidemiology, comorbidity, mortality and cause of death of sarcoidosis patients in Korea using Rare Intractable Diseases (RID) database linked with National Health Insurance (NHI) database which covers entire Korean population. To be registered in the RID program, which is run by the Korean government, patients must receive a physician-certified diagnosis based on uniform criteria. In this study, all sarcoidosis patients identified from the RID database were followed from 2008-2015 to determine their incidence, comorbidity and mortality.

**Materials and methods**

**Data source**

This study used claims data from the NHI database and registration data from the RID database. The Korean government implemented a national health insurance program for all citizens, which covers more than 50 million individuals. Each medical institution submits an electronic form including the diagnosis and treatments of all inpatients and outpatients to the NHI for claims of reimbursement. These data recorded in the NHI database contain information from the time of patients’ diagnosis and thereafter, including the diagnosis, demographics, prescription history, surgical records and screening history. Patients’ diagnostic information was recorded according to the International Classification of Diseases, 10th Revision (ICD-10).

Within this system, the NHI has established a registration program for rare intractable diseases (RIDs), including sarcoidosis, that provides copayment reduction to patients. To be registered in this RID program, specific diagnostic criteria need to be met and certified by a physician. Thus, the RID database allowed the current study to analyze reliable epidemiological features of sarcoidosis. We used this database to investigate the national incidence, mortality and causes of death of sarcoidosis in Korea.

**Identification of sarcoidosis patients**

Our study was based on data of all sarcoidosis patients registered in the RID program extracted from the NHI-RID database from January 2008 to December 2015.

All patients registered in the RID were identified and followed-up until 2015. Patients identified using the RID registration code (V111) combined with the ICD-10 codes (D860-D863, D868, D869) were included. The NHI diagnostic criteria for sarcoidosis (26) include noncaseating epithelioid cell granulomas detected microscopically from a histologic biopsy of pulmonary or suspected organ and a compatible clinical presentation as well as the finding from chest radiography. In making the diagnosis, other granulomatous diseases, such as silicosis, berylliosis, hypersensitivity pneumonitis etc., should be excluded.
Identification of comorbidity

In order to identify the comorbidity, we followed up the sarcoidosis patients using the NHI-RID database. From previous studies (6, 22, 23, 25, 27-30) we employed commonly related organ systems affected by sarcoidosis (neoplasm, respiratory disease, heart disease, renal disease, liver disease et al) as comorbidities for sarcoidosis, a list of which is provided in the supplementary material (Supplementary 1). We defined the comorbid disease as diagnosed code based on the ICD-10 codes for inpatient hospitalization and the comorbidities before diagnosis of sarcoidosis were excluded.

Identification of mortality and causes of death

To determine the mortality and causes of death, we linked patients’ data to Statistics Korea. Statistics Korea is a government operated database established in 1981 that includes death certificates of all deceased persons in Korea. By law, death certificates must contain the cause of death issued by the attending physician at the time of death and recorded according to the ICD-10. Statistics Korea is supplemented by the NHI and the National Police Agency information to ascertain the cause of death when the diagnosis was uncertain. A 91% agreement rate has been reported (31) between the causes of death recorded in Statistics Korea and those confirmed through medical chart review. By using this database, we followed-up all sarcoidosis patients from 2008 to the end of 2013 to determine the causes of death.

The personal information of patients was protected and kept anonymous. Anonymous data linkage was processed by a third party organization. This study was approved by the Korea University.

Statistical Analysis

In this study, we calculated and stratified into different age bands sarcoidosis incidence, annual mortality and the standardised mortality ratio (SMR) from 2008-2015 and causes of death from 2008-2013.

We defined an incident case as a newly diagnosed sarcoidosis patient registered in the RID program in the same year. Only patients identified as an incident patient during the study period were included in the numerator of this study. Annual incidence was calculated by dividing the number of total incident cases by the total population number as of July in the corresponding year. As prevalent cases may confound incident cases, we applied a 3-year washout period to exclude patients who had been diagnosed before they were registered in the RID program. The average age- and sex-specific incidences were calculated by dividing the number of cases in each age and sex group by the age- and sex-specific population and averaging these data from 2008-2015. We used the Poisson regression and Cochran-Armitage Trend Test to investigate the annual incidence trends. Incidence and mortality were calculated for each involved organ. As the RID program does not include diagnostic criteria for specific types of sarcoidosis, organ involvement type was determined by using ICD-10 codes. We classified organ involvement as lung, lymph nodes, skin and other organ (eyes, heart and nerves), based on the ICD-10 codes. When one person had multiple organ involvement, they were counted as separate cases.

All individuals with sarcoidosis were followed up till they were diagnosed with comorbidity, and then all individuals with each of the comorbidities were tracked till 2016 and at that point they were assessed for their vital status and the mortality was calculated. The comorbidity was presented as frequency (as a percentage), defined as the number of patients with specific comorbidity divided by the total number of sarcoidosis patients and it was also presented as an organ system. The mortality with each comorbidity was presented as the percentage of death among the sarcoidosis with comorbidity.

From the mortality data including causes of death obtained from Statistics Korea, the annual mortality rate was calculated by dividing the number of sarcoidosis patients who had died in the year by the person-years of sarcoidosis patients registered in RID. Person-years for patients were accumulated at the time of entry in this study until death. Mortality was compared to the general Korean population using SMR with 95% confidence interval (CI). The SMR is the ratio of observed deaths over expected deaths derived from the mortality of the total Korean population obtained from Statistics Korea data.
Survival data from Statistics Korea linked to the NHI-RID database were used in our survival analysis. We evaluated survival curves according to the Kaplan-Meier method. The date of initial registration in the database was considered the date of diagnosis. Patients were censored when a patient was alive at the time of last follow-up. A log-rank test was used to compare the cumulative survival of sarcoidosis patients by gender.

For all mortality cases, the causes of death were analyzed and presented by major disease classification. Causes of death were investigated for all sarcoidosis mortality cases using the Statistics Korea database between 2008 and 2013. We calculated the SMR by cause of death to compare cause-specific mortality between sarcoidosis patients and the general population.

**Results**

**Incidence**

Table 1 shows the annual incidence of all sarcoidosis patients from 2008 to 2015. A total of 3,259 sarcoidosis patients were diagnosed. The incidence rate averaged during the study period at 0.81 per 100,000. The annual incidence showed a statistically significant increasing trend, with an increase of 1.03 cases per year on average. The male incidence rate was 0.64 per 100,000 and female incidence was 0.98 per 100,000 with a male:female ratio of 1:1.5. The age- and sex-specific incidence of sarcoidosis is displayed in Figure 1. Male patients exhibited a bimodal distribution, peaking at 30-39 years and again at 60-69 years, whereas females had a single peak at 50-59 years.

Our analysis of the distribution of organ involvement showed that lung involvement accounted for at most 60% (1,955 cases). 35.4% of patients (1,154 cases) exhibited involvement of the lymph nodes, 10.2% (332 cases) had skin involvement and 12.9% (421 cases) had other involvements, including eyes, heart and nervous system (Table 2).

**Comorbidity and Mortality**

The major comorbidities of sarcoidosis patients were the diseases of lungs (575 cases, 17.64%), heart (177 cases, 5.43%), eyes (139 cases, 4.27%) and cancer (75 cases, 2.3%). Interstitial lung disease, chronic obstructive pulmonary disease, lung cancer and pneumonia were common comorbid respiratory disorders, while cardiomyopathy, ischemic heart disease and heart failure were common cardiac comorbidities. Iridocyclitis was the most common eye disease identified as comorbidity and colon and rectum cancer among malignancies, while chronic kidney disease and acute renal failure among renal disease. Among them, higher mortality was observed with pneumonia (63 deaths), chronic obstructive pulmonary disease (30 deaths), interstitial pulmonary disease (24 deaths), chronic kidney disease (13 deaths), acute renal failure (11 deaths), and lung cancer (7 deaths). Among patients with cardiac involvement, we identified mortality as 34.5% (25 deaths/ 73 patients) for patients with heart failure, 17.95% (7 deaths/ 39 patients) for patients with cardiomyopathy and 14.58% (7 deaths/ 48 patients) for patients with chronic ischemic heart disease.

The post-diagnosis survival of sarcoidosis patients is shown in Figure 2. We tracked 3,259 incident cases of sarcoidosis from diagnosis during a mean follow-up of 4.4 years, amounting to 15,119 person-years of observation. Women exhibited a slightly higher survival rate of 96.8%, while male survival was 93.4%.

The annual mortality rates are shown in Table 3. From 2008 to 2015, 140 of 3,259 patients with sarcoidosis died (78 males and 62 females). The annual mortality rate was 9.26 per 1,000 person-years, with a male and female annual mortality rate of 13.69 per 1,000 person-years and 6.58 per 1,000 person-years, respectively. The male: female ratio was 2.1:1. A high mortality rate of 38.43 per 1,000 person-years was observed among patients aged 0-19 years, after which mortality increased with increasing age, from 2.63 in the 20-39 year age group to 21.90 in the 60-79 year age group.

The age- and sex-specific SMRs for sarcoidosis are shown in Table 3. The mortality of sarcoidosis patients was significantly higher than the general population. The SMR was 1.91 (95% CI 1.62, 2.25), with a male SMR of 2.17 (95% CI 1.74, 2.71) and female SMR of 1.66 (95% CI 1.29, 2.12), indicating a higher mortality among males. Compared to the general population, the younger age groups of 0-19 years and 20-39 years exhibited significantly higher
SMRs of 240.83 and 3.74, respectively, while patients aged over 40 years had an SMR of 2.69.

According to organ involvement, mortality was higher in sarcoidosis patients with lung involvement, at 8.30 per 1,000 person-years than in patients with other involvement including lymph nodes (6.91 per 1,000 person-years) and skin (3.12 per 1,000 person-years) (Table 2).

**Cause of Death**

Of the 84 deaths identified in this study from 2008–2013, the most common cause of death was neoplasms (35 deaths, 41.7%), followed by diseases of the respiratory system (11 deaths, 13.1%), sarcoidosis (11 deaths, 13.1%), and cardiac disease (7 deaths, 8.3%) (Table 4). Among the respiratory
diseases, 54.5% (6 cases) of patients had interstitial pulmonary disease.

**Table 2.** Incidence and mortality by distribution of organ involvement at the time of diagnosis among patients with sarcoidosis in Korea, 2008-2015

| Site of lesion                  | Incidence | Mortality |
|--------------------------------|-----------|-----------|
|                                | No of patients(%) | Person-years | No of observed deaths(%) | Mortality rate (per 1000 person-years) |
|--------------------------------|-------------|-------------|-------------------------|----------------------------------------|
| lung                           | 1,955(60.0) | 9,160       | 76(54.2)                | 8.30                                   |
| lymph nodes                    | 1,154(35.4) | 5,356       | 37(26.4)                | 6.91                                   |
| skin                           | 332(10.2)   | 1,602       | 5(3.6)                  | 3.12                                   |
| eye, heart and nervous system  | 421(12.9)   | 2,314       | 16(11.4)                | 6.90                                   |
| total                          | 3,259       | 140         |                         |                                        |

**Fig. 2.** Survival curve of patients with sarcoidosis by gender. The vertical axis represents survival rate; the horizontal axis represents years after diagnosis.

**Discussion**

In this nationwide population-based study, we identified 3,259 incident cases of sarcoidosis from
### Table 3. The annual mortality and age-and sex-specific standardised mortality ratios (SMR) of sarcoidosis in Korea, 2008-2015

| Age group | No of deaths/No of person | Annual mortality per 1000 person-years (95% confidence interval) | SMR (95% confidence interval) |
|-----------|---------------------------|---------------------------------------------------------------|-------------------------------|
|           | Male | Female | Total | Male | Female | Total | Male | Female | Total |
| 0-19      | 2/12 | 2/8    | 4/20  | 31.35 (7.84, 125.35) | 49.64 (12.41, 198.48) | 38.43 (14.42, 102.39) | 160.74 (40.20, 642.70) | 480.03 (120.06, 1900.00) | 240.83 (90.39, 641.68) |
| 20-39     | 6/580| 5/317  | 11/897| 2.31 (1.04, 5.15)    | 3.15 (1.31, 7.58)     | 2.63 (1.46, 4.75)    | 3.01 (1.35, 6.70)     | 5.91 (2.22, 15.74)     | 3.74 (2.01, 6.96) |
| 40-59     | 30/456| 22/1,174| 52/1630| 14.46 (10.11, 20.68)| 3.90 (2.57, 5.92)    | 6.73 (5.13, 8.84)    | 3.02 (2.06, 4.44)    | 2.36 (1.54, 3.62)     | 2.69 (2.02, 3.58) |
| 60-79     | 36/227| 31/468  | 67/695| 38.09 (27.47, 52.80)| 14.66 (10.31, 20.85)| 21.90 (17.23, 27.82)| 1.72 (1.25, 2.38)    | 1.34 (0.93, 1.92)     | 1.53 (1.20, 1.94) |
| ≥80       | 4/8  | 2/9    | 6/17  | 187.96 (70.54, 500.80)| 57.11 (14.28, 228.37)| 106.57 (47.88, 237.22)| 1.85 (0.88, 3.89)    | 0.97 (0.44, 2.16)     | 1.31 (0.76, 2.25) |
| overall   | 78/1,283| 62/1,976| 140/3,259| 13.69 (10.96, 17.09)| 6.58 (5.13, 8.44)    | 9.26 (7.85, 10.93)   | 2.17 (1.74, 2.71)    | 1.66 (1.29, 2.12)     | 1.91 (1.62, 2.25) |

Annual mortality = \( \frac{\text{total deaths with sarcoidosis}}{\text{The person-years of total sarcoidosis}} \times 100,000 \)

---

**Fig. 3. Mortality associated with comorbidities in sarcoidosis in Korea, 2008-2015.** The vertical axis represents comorbidities in sarcoidosis; the horizontal axis represents the number of comorbidity and death in sarcoidosis.
Sarcoidosis comorbidity and mortality in Korea

2008–2015. The average annual incidence of sarcoidosis was 0.81 per 100,000. The average annual mortality rate was 9.26 per 1,000 person-years and the 5-year survival rate was 95.5%. Commonly associated comorbidities in sarcoidosis patients were the disease of lungs (575 cases, 17.64%), heart (177 cases, 5.43%), eyes (139 cases, 4.27%) and cancer (75 cases, 2.3%). It was also observed that the patients with these comorbidities show higher mortality.

Our study based on population-based data covering the entire population is less at risk of selection bias compared to surveys or hospital-based studies. Also, incidence, mortality and survival rates were investigated in the same cohort during an 8-year follow-up period and so the entire mortality pattern and natural course of sarcoidosis could be understood. Similar with many existing reports (6, 32), the NHI diagnostic criteria for sarcoidosis used in our study required the identification of granulomas through histological findings, thus our findings are more comparable.

The incidence reported in this study is markedly lower than findings from the United States and Europe. The incidence of sarcoidosis in the United

| Condition (ICD-10 code) | Male   | Female  | Total  |
|------------------------|--------|---------|--------|
| Neoplasms (C00–D48)    |        |         |        |
| Malignant neoplasms of colon (C18) | 4 (4.8) | 2 (2.4) | 6 (7.1) |
| Malignant neoplasm of bronchus and lung (C34) | 4 (4.8) | 0 (0.0) | 4 (4.8) |
| Malignant neoplasm of connective tissue of breast (C50) | 0 (0.0) | 4 (4.8) | 4 (4.8) |
| Malignant neoplasm of bone and articular cartilage of other and unspecified sites (C41) | 2 (2.4) | 1 (1.2) | 3 (3.6) |
| others                | 6 (7.1) | 12 (14.3) | 18 (21.4) |
| Disease of the respiratory system (J00–J99) | 8 (9.5) | 3 (3.6) | 11 (13.1) |
| Pneumonia, organism unspecified (J18) | 1 (1.2) | 1 (1.2) | 2 (2.4) |
| Other chronic obstructive pulmonary disease (J44) | 2 (2.4) | 0 (0.0) | 2 (2.4) |
| Status asthmaticus (J46) | 0 (0.0) | 1 (1.2) | 1 (1.2) |
| interstitial pulmonary disease (J84) | 5 (6.0) | 1 (1.2) | 6 (7.1) |
| Sarcoidosis (D86)      | 5 (6.0) | 6 (7.1) | 11 (13.1) |
| Diseases of the circulatory system (I00–I99) | 6 (7.1) | 1 (1.2) | 7 (8.3) |
| Acute myocardial infarction (I21) | 1 (1.2) | 0 (0.0) | 1 (1.2) |
| Chronic ischemic heart disease (I25) | 2 (2.4) | 0 (0.0) | 2 (2.4) |
| Acute myocarditis (I40) | 1 (1.2) | 0 (0.0) | 1 (1.2) |
| Heart failure (I50)    | 1 (1.2) | 1 (1.2) | 2 (2.4) |
| Intracerebral hemorrhage (I61) | 1 (1.2) | 0 (0.0) | 1 (1.2) |
| Diseases of the nervous system (G00–G99) | 1 (1.2) | 2 (2.4) | 3 (3.6) |
| Encephalitis, myelitis and encephalomyelitis (G04) | 0 (0.0) | 1 (1.2) | 1 (1.2) |
| Spinal muscular atrophy and related syndromes (G12) | 1 (1.2) | 0 (0.0) | 1 (1.2) |
| Multiple sclerosis (G35) | 0 (0.0) | 1 (1.2) | 1 (1.2) |

Table 4. The cause of death among patients with sarcoidosis in Korea, 2008–2013
States is about 10.00 - 39.10 per 100,000 (5, 22, 33), and that in Europe is 3.80 - 7.00 per 100,000 (24, 34, 35). Our findings are analogous with a Japanese study that reported an incidence of 1.01 per 100,000 (6). In Asia, incidences have been reported ranging from 0.56-4.00 per 100,000 (29, 36, 37), and the incidence of this study falls within this range. However, a direct comparison with these studies

### Table 5. Comorbidities associated with sarcoidosis in Korea, 2008-2015

| Disease Condition (ICD-10 code) | The number of comorbidity(%) |
|---------------------------------|-----------------------------|
|                                 | Male | Female | Total |
| Neoplasms                       |      |        |       |
| Malignant neoplasm of bronchus, trachea and lung (C33–34) | 19(0.58) | 19(0.58) | 38(1.17) |
| Malignant neoplasms of colon, rectosigmoid junction and rectum (C18–C20) | 9(0.28) | 15(0.46) | 24(0.74) |
| Malignant neoplasm of connective tissue of breast (C50) | 0(0) | 9(0.28) | 9(0.28) |
| Malignant melanoma of skin (C43) | 1(0.03) | 1(0.03) | 2(0.06) |
| Disease of the respiratory system |      |        |       |
| Pneumonia(J17, J18)             | 149(4.57) | 171(5.25) | 320(9.82) |
| Chronic obstructive pulmonary disease (J44) | 64(1.96) | 61(1.87) | 125(3.84) |
| Interstitial pulmonary disease (J84) | 61(1.87) | 61(1.87) | 122(3.74) |
| Pulmonary hypertension(I27.0, I27.2) | 3(0.09) | 5(0.15) | 8(0.25) |
| Diseases of the circulatory system |      |        |       |
| Heart failure (I50)             | 27(0.83) | 46(1.41) | 73(2.24) |
| Ischemic heart disease (I25)    | 20(0.61) | 28(0.86) | 48(1.47) |
| cardiomyopathy (I42)            | 18(0.55) | 21(0.64) | 39(1.20) |
| Acute myocardial infarction (I21) | 11(0.34) | 3(0.09) | 14(0.43) |
| Stroke (I64)                    | 7(0.21) | 7(0.21) | 14(0.43) |
| Intracerebral hemorrhage (I61)  | 4(0.12) | 6(0.18) | 10(0.31) |
| myocarditis (I40, I41.8)        | 2(0.06) | 1(0.03) | 3(0.09) |
| Diseases of the renal system    |      |        |       |
| Chronic kidney disease (N18)    | 25(0.77) | 20(0.61) | 45(1.38) |
| Acute renal failure (N17)        | 21(0.64) | 7(0.21) | 28(0.86) |
| Diseases of the Liver           |      |        |       |
| Hepatic failure(K72)            | 3(0.09) | 6(0.18) | 9(0.28) |
| Diseases of the nervous system   |      |        |       |
| Multiple cranial nerve palsies in sarcoidosis (G53.2) | 3(0.09) | 3(0.09) | 6(0.18) |
| Encephalitis, myelitis and encephalomyelitis (G04) | 3(0.09) | 2(0.06) | 5(0.15) |
| Spinal muscular atrophy and related syndromes (G12) | 1(0.03) | 0(0) | 1(0.03) |
| Diseases of the musculoskeletal system |      |        |       |
| Myositis in sarcoidosis (M63.3) | 1(0.03) | 3(0.09) | 4(0.12) |
| Diseases of the eye and adnexa   |      |        |       |
| Iridocyclitis (H20, H22.1)      | 45(1.38) | 93(2.85) | 138(4.23) |
| Diseases of the skin             |      |        |       |
| erythema nodosum(L52)           | 0(0) | 5(0.15) | 5(0.15) |
may be difficult considering differences in methodology.

The incidence of sarcoidosis was 1.5 times higher in women. The female dominance observed in our study is comparable to other reports, in which incidence ranged from 1.22–2.08 times higher among women (6, 38). In males, the pattern of the age-specific incidence of sarcoidosis was biphasic, peaking twice at 30–39 and at 60–69 years of age, and monophasic in females, peaking at 50–59 years of age. Due to the preventive effect of female hormones, the peak of sarcoidosis among women is over fifty years of age (39).

In our study, lung and respiratory diseases were common comorbid disease with higher mortality. These findings are in line with previous studies that report common comorbidity as chronic pulmonary disease and obstructive pulmonary disease (14, 16, 17) and common cause of death as pneumonia, pulmonary fibrosis and obstructive airway disease (23, 25, 30) in sarcoidosis patients.

This study found that the 5-year survival rate after sarcoidosis diagnosis was 95.5%, which is comparable to the survival rate of 93.0% reported in a study of sarcoidosis in the UK (24). The annual mortality rate for patients with sarcoidosis was 9.26 per 1,000 person-years, which is similar to two previous studies that reported mortality rates of 9.40 per 1,000 person-years and 14.00 per 1,000 person-years (23, 24). Even though the incidence of sarcoidosis in Asia is much lower, our mortality and survival findings are similar to western countries.

Notably, the mortality of younger patients aged 20 years and under (38.43 per 1,000 person-years) was higher than adult patients aged 20 to 60 years (5.29 per 1,000 person-years). The main cause of deaths under 20 years of age were, systemic involvement of connective tissues, followed by breast cancer and heart failure. While skin melanoma accounted for all deaths under the age of 10 years. Though published data on the long-term prognosis of sarcoidosis in children are scarce, previous studies have found a poorer prognosis among young children with sarcoidosis (40, 41) associated with sequelae and progressive disease (42, 43). Our findings reflect the need for further detailed studies on the prognosis of sarcoidosis.

The SMR of sarcoidosis patients in this study was higher than the general population. Earlier (21, 22) no difference in mortality rates between sarcoidosis patients and the general population was reported, while some studies (23, 24) found a higher hazard ratio among sarcoidosis patients compared to the general population, which is similar to our results. In interpreting results, it should be taken into consideration that previous studies used hospital-based design which only included sarcoidosis patients followed up at hospitals, while our study used a population-based design in which all Korean sarcoidosis patients were followed with reliable SMR estimates.

Among organ involvement, lungs accounted for 60.0% of cases in our study (1,955 cases), which is consonant with previous studies from other countries (6, 28). Mortality was higher in lung involvement than with any other organ. This coincides with a previous study where pulmonary disease and upper respiratory mucosal involvement had unfavourable clinical courses compared to acute arthritis and bilateral hilar lymphadenopathy (19).

We found that cancer, respiratory disease and sarcoidosis were the main causes of death and these showed higher cause-specific SMRs compared to the general population. This finding is in line with several studies (10) that reported higher incidence of cancer among sarcoidosis patients. We reported that among the different types of cancer, colon and lung cancer were the most common causes of death. Our study also found that respiratory disease was also significant cause of death in sarcoidosis, with interstitial pulmonary disease in particular showing higher mortality. Consistent with our findings, one report (44) found interstitial lung involvement with pulmonary fibrosis and pulmonary hypertension were associated with increased mortality and another study reported that pulmonary fibrosis accounted for 9.0% of deaths (30).

In this study although cardiac involvement was relatively common among sarcoidosis patients, the deaths due to cardiovascular disease were low. In interpreting the cause of death in our study we should take into account the cause of death registration system in Korea, where the National Statistics Office registers the cause of death for each deceased patient as one single underlying disease. In this system, the cause of death of patients with underlying cardiovascular disease may be registered as immediate cause such as pulmonary embolism or as primary disease
such as sarcoidosis. In this case, cardiovascular diseases may not be recorded as underlying cause of death.

In order to identify the type of treatment for sarcoidosis patients, we searched the KoreaMed, domestic medical research database with the keyword “sarcoidosis” and identified 103 studies (3 case series and 100 case reports (supplementary 2). Of the 260 patients with sarcoidosis, 162 (62.3%) were treated with steroids. In some of the patients in these studies, methotrexate (45–49), hydroxychloroquine (50, 51), and azathioprine (45, 52) were combined with steroids when multiorgan involvement was present such as lungs, eyes, muscles, liver, joints, and gastrointestinal tract and the results were similar to the standard treatment of sarcoidosis (53). In several cases, it has been reported that corticosteroids are effective in sarcoidosis treatment, but some studies report recurrences or steroid related complications due to long term use (54–57). In the literature, the effect of steroids for sarcoidosis still remains unclear.

The limitations of this study are as follows. First, because we used registration data, we were unable to identify detailed clinical features of sarcoidosis including clinical and radiological results. Second, ICD-10 code does not include information on specific organ involvement and therefore we could not determine the organ involvement separately for eye, heart and nervous system involved. Rather the patients invaded in eye, heart and nervous system were confirmed through comorbidity disease followed up in NHI database. Third, because we relied on government administrative cause of death data which includes one underlying cause, we could not investigate in detail the causes of death specifically designed for sarcoidosis patients. Therefore, sometimes it is difficult to distinguish whether designated cause of death was immediate cause or underlying disease. Finally, the use of ICD code registration data as diagnosis may raise questions concerning the diagnostic accuracy. However, the NHI provides uniform diagnostic criteria that must be followed in order to be registered in the RID and each diagnosis is reviewed at the healthcare institution before submission to the NHI to assure it meets the criteria. Through this process, we assumed that we maintained a high diagnostic reliability in this study.

Conclusion

This nationwide population-based study investigated the incidence, comorbidity, mortality and causes of death of sarcoidosis in Korea. The incidence of sarcoidosis was 0.81 per 100,000, which is lower than the United States and Europe, but similar with Japan. The annual mortality rate of 9.26 per 1,000 person-years and the survival rate of 95.5% were similar with previous studies. The mortality was significantly higher than the general population (SMR 1.91, 95% CI 1.62, 2.25) and was particularly high in younger age groups. The most common causes of death were cancer, sarcoidosis itself and respiratory diseases. Increased mortality was observed in sarcoidosis patients with comorbid diseases.

Reference

1. Iannuzzi MC, Rybicki BA, Teirstein AS. Sarcoidosis. N Engl J Med. 2007;357(21):2153–65.
2. Rybicki BA, Iannuzzi MC. Epidemiology of sarcoidosis: recent advances and future prospects. Semin Respir Crit Care Med. 2007;28(1):22–35. doi: 10.1055/s-2007-970331.
3. Dubrey S, Shah S, Hardman T, Sharma R. Sarcoidosis: the links between epidemiology and aetiology. Postgrad Med J. 2014;90(1068):582–9. doi: 10.1136/postgradmedj-2014-132584. PubMed PMID: 25230946.
4. Cozic YC, Berman JS, Palmer JR, Boggs DA, Wise LA, Rosenberg L. Reproductive and hormonal factors in relation to incidence of sarcoidosis in US Black women: The Black Women's Health Study. Am J Epidemiol. 2012;176(7):635–41.
5. Rybicki BA, Major P, Popovich JJ, Mialiark MJ, Iannuzzi MC. Racial differences in sarcoidosis incidence: A 5-year study in a health maintenance organization. Am J Epidemiol. 1997;145(3):234–41.
6. Morimoto T, Azuma A, Abe S, Usuki J, Kudoh S, Sugisaki K, et al. Epidemiology of sarcoidosis in Japan. Eur Respir J. 2008;31(2):372–9. doi: 10.1183/09031936.0007307.
7. Hillerdal G, Nou E, Osterman K, Schmekel B. Sarcoidosis: epidemiology and prognosis. A 15-year European study. Am Rev Respir Dis. 1984;130(1):29–32.
8. Nicholson TT, Plant BJ, Henry MT, Bredin CP. Sarcoidosis in Ireland: regional differences in prevalence and mortality from 1996–2005. Sarcoidosis, Vasc Diffuse Lung Dis. 2010;27(2):111–20.
9. Gerke AK. Morbidity and mortality in sarcoidosis. Curr Opin Pulm Med. 2014;20(3):472–8. doi: 10.1097/MCP.0000000000000800.
10. Bonifazi M, Brafi F, Gasparini S, La Vecchia C, Gabrielli A, Wells AL, et al. Sarcoidosis and cancer risk: systematic review and meta-analysis of observational studies. Chest. 2015;147(3):778–91.
11. Tuleta I, Pingel S, Biener L, Pizarro C, Hammerstingl C, Ozuruk C, et al. Atherosclerotic vessel changes in sarcoidosis. Adv Exp Med Biol. 2016;910:23–30.
12. Ramos-Casals M, Brito-Zeron P, Garcia-Carrasco M, Font J. Sarcoidosis or Sjogren syndrome? Clues to defining mimicry or coexistence in 59 cases. Medicine. 2004;83(2):85–95.
13. Ramos-Casals M, Mana J, Nardi N, Brito-Zeron P, Xaubet A, Sanchez-Tapias JM, et al. Sarcoidosis in patients with chronic hepatitis C virus infection: analysis of 68 cases. Medicine. 2005;84(2):69–80.
14. Martusewicz-Boros MM, Boros PW, Wiatr E, Roszkowski-Śliż K. What comorbidities accompany sarcoidosis? A large cohort (n=1779) patients analysis. Sarcoidosis Vasc Diffuse Lung Dis. 2015;32(2):115-20.

15. Pohle S, Baty F, Brutsche M. In-Hospital Disease Burden of Sarcoidosis in Switzerland from 2002 to 2012. PLoS One. 2016;11(3):1-13.

16. Nowiński A, Puścińska E, Goljan A, Peradzynska J, Bednarek M, Korzybski D, et al. The influence of comorbidities on mortality in sarcoidosis: a observational prospective cohort study. Clin Respir J. 2017;11(5):648-56.

17. Brito-Zerón P, Acar-Denizli N, Sisó-Almirall A, Bosch X, Hernández F, Vilanova S, et al. The burden of Comorbidity and Complexity in Sarcoidosis: Impact of Associated Chronic Diseases. Lung. 2018;196(2):239-48.

18. Lazarus A. Sarcoidosis: epidemiology, etiology, pathogenesis, and genetics. Dis Mon. 2009;55(11):649-60. doi: 10.1016/j.disamonth.2009.04.008.

19. Neville E, Walker AN, James DG. Prognostic factors predicting the outcome of sarcoidosis: an analysis of 818 patients. Q J Med. 1993;80(2):525-33.

20. Perry A, Vuitch F. Causes of death in patients with sarcoidosis. A month. 2009. 04. 008.

21. Yamaguchi M, Odaka M, Hosoda Y, Iwai K, Tachibana T. Excess death of lung cancer among sarcoidosis patients. Sarcoidosis. 1991;8:51-5.

22. Ungrapaert P, Carmona EM, Utz JP, Ryu JH, Crowson CS, Matteson EL. Epidemiology of Sarcoidosis 1946-2013: A Population-Based Study. Mayo Clin Proc. 2016;91(2):183-8. doi: 10.1016/j.mayocp.2015.10.024.

23. Strayer D, Berman BS, Boggs DA, White LF, Rosenberg L, Cozier YC. Mortality among African American women with sarcoidosis: data from the Black Women's Health Study. Sarcoidosis, Vasc Diffuse Lung Dis. 2013;30(2):128-33.

24. Gribbin J, Hubbard RB, Le Jeune I, Smith CJ, West J, Tata LJ. Incidence and mortality of idiopathic pulmonary fibrosis and sarcoidosis in the UK. Thorax. 2006;61(11):980-5. doi: 10.1136/thx.2006.062836.

25. Gideon NM, Mannino DM. Sarcoidosis mortality in the United States 1979-1991: an analysis of multiple-cause mortality data. Am J Med. 1996;100(4):423–7.

26. The Korea Center for Disease Control and Prevention. Information for rare intractable disease: National Institute of Health; 2018. Available from: http://helpline.nih.go.kr/cdchelp/disease.gat?method=listView.

27. Kim BY, Kim SR, Hwang J, Jin SY, Kim HS. A Case of Gastrointestinal Sarcoidosis without Pulmonary Involvement. Korean J Intern Med. 2011;183(11):1524-30. doi: 10.1111/j.1445-5994.2011.01365.x.

28. Coquart N, Cadelis G, Tressières B, Cordel N. Epidemiology of Sarcoidosis Combined with Massive Ascites. J Rheum Dis. 2010;78(5):654-9.

29. Afterno M, Salvador M, Noel M, Arroyo M, et al. Severe Sarcoidosis. Clin Chest Med. 2008;29(3):565-74, x. doi: 10.1016/j.ccm.2008.03.006.

30. Gibson GJ, Prescott RJ, Muers MF, Middleton WG, Mitchell DN, Connolly CK, et al. British Thoracic Society Sarcoidosis study: effects of long term corticosteroid treatment. Thorax. 1996;51:68-97.

31. Park SK, Hwang PH, Yun SK, Kim HU, Park J. Tumor Necrosis Factor Alpha Blocker-Induced Erythrodermic Sarcoidosis in with Juvenile Rheumatoid Arthritis. Tuberc Respir Dis. 2011;71(6):464-9.

32. Chae DR, Lim SU, Ciuffreda GJ, Lim JH, Ju JY, Kwon YS. Sarcoidosis Initially Presenting as a Nasal Cavity Mass Misdiagnosed as Tuberculosis. Tuberc Respir Dis Res. 2008;65(2):121-4.

33. Han JY, Cho MK, Kim HS. A case of sarcoidosis associated with acute tubular necrosis and pulmonary hemorrhage. Korean J Med. 2010;78(5):654-9.

34. Park SK, Hwang PH, Yun SK, Kim HU, Park J. Tumor Necrosis Factor Alpha Blocker-Induced Erythrodermic Sarcoidosis in with Juvenile Rheumatoid Arthritis: A Case Report and Review of the Literature. Ann Dermatol. 2017;29(1):74-8.

35. Nagar S, Handa T, Tsoh Y, Ohta K, Tamaya M, Isumi T. Outcome of sarcoidosis. Clin Chest Med. 2008;29(3):656-74, x. doi: 10.1016/j.ccm.2008.03.006.
51(3):238–47.
55. Johns CJ, Schonfeld SA, Scott PP, Zachary JB, MacGregor MI. Longitudinal study of chronic sarcoidosis with low-dose maintenance corticosteroid therapy. Outcome and complications. Ann N Y Acad Sci. 1986;465:702-12.
56. Sugisaki K, Yamaguchi T, Nagai S, Ohmiti M, Takenaka S, Morimoto S, et al. Clinical characteristics of 195 Japanese sarcoidosis patients treated with oral corticosteroids. Sarcoidosis Vasc Diffuse Lung Dis. 2003;20(3):222–6.
57. Pietinalho A, Tukiainen P, Haahela T, Persson T, Selroos O. Finnish Pulmonary Sarcoidosis Study Group. Early treatment of stage II sarcoidosis improves 5-year pulmonary function. Chest Surg Clin N Am. 2002;121(1):24–31.
## Supplementary 1. Comorbidity list

### Condition (ICD-10 code)

#### Neoplasms
- Malignant neoplasms of colon (C18)
- Malignant neoplasm of bronchus and lung (C34)
- Malignant neoplasm of bone and articular cartilage of other and unspecified sites (C41)
- Malignant melanoma of skin (C43)
- Connective and soft tissue of other connective and soft tissue (C49)
- Malignant neoplasm of connective tissue of breast (C50)

#### Disease of the respiratory system
- Pneumonia in disease classified elsewhere (J17)
- Pneumonia, organism unspecified (J18)
- Other chronic obstructive pulmonary disease (J44)
- Other interstitial pulmonary disease (J84)
- Other interstitial pulmonary diseases with fibrosis (J84.1)
- Primary pulmonary hypertension (I27.0)
- Other secondary pulmonary hypertension (I27.2)

#### Diseases of the circulatory system
- Acute myocardial infarction (I21)
- Chronic ischemic heart disease (I25)
- Acute myocarditis (I40)
- Myocarditis in other diseases classified elsewhere (I41.8)
  * D86.8+I41.8: Sarcoid myocarditis
- Heart failure (I50)
- Cardiomyopathy (I42)
- Intracerebral hemorrhage (I61)
- Stroke, not specified as haemorrhage or infarction (I64)

#### Diseases of the renal system
- Acute renal failure (N17)
- Chronic kidney disease (N18)

#### Diseases of the Liver
- Hepatic failure (K72, K72.0, K72.1)
- Hepatic sclerosis (K74)

#### Diseases of the nervous system
- Encephalitis, myelitis and encephalomyelitis (G04)
- Spinal muscular atrophy and related syndromes (G12)
- Multiple cranial nerve palsies in sarcoidosis (G53.2)
  * D86.8+G53.2: Multiple cranial nerve palsies in sarcoidosis
Condition (ICD-10 code)

Diseases of the musculoskeletal system

* D86.8+M14.8: Sarcoid arthropathy

Diseases of other specified diseases classified elsewhere (M14.8)

* D86.8+M63.3: Sarcoid myositis

Diseases of the eye and adnexa

Keratoconjunctivitis (H16.2)

Iridocyclitis (H20)

Iridocyclitis in other diseases classified elsewhere (H22.1)

* D86.8+H22.1: Iridocyclitis in sarcoidosis

Diseases of the skin

Erythema nodosum (L52)
### Supplementary 2

| no | Type of study | First author(year) (reference) | Subject (n)                                                                 | Therapy                                                                 |
|----|---------------|--------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------|
| 1  | case series   | Kim MS (2017)(1)               | Sarcoidosis (99)                                                             | Systemic steroid treatment was initiated in 23.2% of cases.             |
| 2  | case series   | Lee SY (2009)(2)               | Ocular sarcodiosis (22)                                                      | Of 22 patients, 20 patients(90.9%) was managed with topical, systemic or local steroid treatment. |
| 3  | case series   | Kim TW (2008)(3)               | Sarcoid uveitis (31)                                                         | Steroid therapy                                                        |
| 4  | case report   | Lee CH (2018)(4)               | Cardiac sarcoidosis presenting as complete atriventricular block (1)         | Steroid therapy                                                        |
| 5  | case report   | Park H (2018)(5)               | Cardiac sarcoidosis (1)                                                      | Corticosteroid therapy                                                 |
| 6  | case report   | Choi SY (2017)(6)              | Sarcoidosis of the nasal septum (1)                                          | Steroid therapy                                                        |
| 7  | case report   | Kim TK (2017)(7)               | Pulmonary sarcoidosis that developed during the treatment of a patient with Crohn disease by using infliximab (1) | Infliximab was discontinued                                             |
| 8  | case report   | La YK (2017)(8)                | Isolated leptomeningeal neurosarcoidosis (1)                                 | Methylprednisolone                                                     |
| 9  | case report   | Park SK (2017)(9)              | Tumor necrosis factor alpha blocker-induced erythrodermic sarcoidosis in with juvenile rheumatoid arthritis (1) | The etanercept treatment was discontinued and changed to hydroxychloroquine and prednisolone to treat the underlying juvenile rheumatoid arthritis. |
| 10 | case report   | Kang JH (2016)(10)             | Sarcoidosis that developed after etanercept treatment of patients with ankylosing spondylitis (1) | Etanercept discontinued.                                               |
| no | Type of study | first author(year) (reference) | Subject (n) | therapy |
|----|--------------|--------------------------------|-------------|---------|
| 11 | case report  | Kim EH (2016)(11)             | Splenic sarcoidosis concurrent with the ovarian cancer (1) | Prednisolone |
| 12 | case report  | Kim HJ (2016)(12)             | Sarcoidosis presenting with multiple lung parenchymal nodules (1) | The patient improved without any additional treatment |
| 13 | case report  | Kim M (2016)(13)              | Spinal cord neurosarcoidosis after cervical compressive myelopathy (1) | Methylprednisolone |
| 14 | case report  | Lee JW (2016)(14)             | Sarcoidosis that involved the lungs and mediastinal lymph nodes (1) | Systemic corticosteroid |
| 15 | case report  | Sim JK (2016)(15)             | Pulmonary sarcoidosis induced by adalimumab (1) | Discontinuation of adalimumab |
| 16 | case report  | Cho NH (2015)(16)             | Papillary thyroid carcinoma coexistent with thyroid sarcoidosis (1) | Radioiodine therapy and thyroid hormone therapy after thyroidectomy |
| 17 | case report  | Hong SH (2015)(17)            | Gastric involvement of pulmonary sarcoidosis (1) | Methylprednisolone |
| 18 | case report  | Jeon JH (2015)(18)            | Pulmonary sarcoidosis with mediastinal lymphadenopathy (1) | Oral prednisone |
| 19 | case report  | Jeong DE (2015)(19)           | Immune thrombocytopenia associated with sarcoidosis (1) | Intravenous immunoglobulin and oral steroid |
| 20 | case report  | Kim BY(2015)(20)              | Gastrointestinal sarcoidosis without pulmonary involvement (1) | Prednisolone, azathioprine |
| no  | Type of study | first author(year) (reference) | Subject (n)                                                                 | therapy                                                                 |
|-----|---------------|--------------------------------|---------------------------------------------------------------------------|-------------------------------------------------------------------------|
| 21  | case report   | Ohn J (2015)(21)                | Nonspecific lesions of cutaneous sarcoidosis with venous leg ulcers (1)   | Methylprednisolone, pentoxifylline, folic acid                          |
| 22  | case report   | Park HS (2015)(22)              | Hepatic sarcoidosis with Chronic Hepatitis B Virus infection (1)          | Prednisolone                                                            |
| 23  | case report   | Cho JW(2014)(23)                | Neurosarcoïdosis after uveitis (1)                                        | Methyprednisolone                                                       |
| 24  | case report   | Kim DH(2014)(24)                | Solitary Cavernous sinus neurosarcoïdosis (1)                             | Steroid treatment                                                      |
| 25  | case report   | Kim HS(2014)(25)                | Pulmonary sarcoidosis in a patient with breast cancer(1)                  | Because the patient did not complain of any respiratory symptom, her sarcoidosis was left untreated. |
| 26  | case report   | Kwon DH(2014)(26)               | Intramedullary spinal cord sarcoidosis (1)                                | Steroid therapy                                                        |
| 27  | case report   | Park JS(2014)(27)               | Isolated orbital sarcoidosis (1)                                          | Oral steroid, methotrexate, azathioprine                                |
| 28  | case report   | Byun CW(2013)(28)               | Sarcoidosis characterized by erythema nodosum, bilateral hilar lymphadenopathy and polyarthralgia or polyarthritis (1) | Prednisolone                                                            |
| 29  | case report   | Cho KH(2013)(29)                | Pulmonary sarcoidosis with endobronchial nodular involvement (1)          | Oral prednisolone                                                      |
| 30  | case report   | Han EJ(2013)(30)                | Muscular sarcoidosis (1)                                                 | Prednisolone                                                            |
| 31  | case report   | Kim MH(2013)(31)                | Sarcoidosis that developed after chemotherapy for ovarian cancer (1)     | These lesions resolved spontaneously without treatment                |
| 32  | case report   | Kwon YS(2013)(32)               | Cervical lymph node sarcoidosis (1)                                      | Prednisolone                                                            |
| no | Type of study | first author(year) (reference) | Subject (n)                                                                 | therapy                                                                 |
|----|---------------|-------------------------------|-----------------------------------------------------------------------------|-------------------------------------------------------------------------|
| 33 | case report   | Lee JH(2013)(33)              | Ocular sarcnodiosis with early axial spondylarthritsis (1)                  | Oral prednisolone, celecoxib, methotrexate                              |
| 34 | case report   | Lee JK(2013)(34)              | Orbital sarciodiosis presenting as diffuse swelling of the lower eyelid (1) | Prednisolone                                                            |
| 35 | case report   | Jang JY(2012)(35)             | Dermal and subcutaneous sarciodiosis (1)                                    | Steroid treatment                                                       |
| 36 | case report   | Kang SM(2012)(36)             | Capecitabine-induced sarcriodiosis (1)                                     | The discontinuation of capecitabine                                     |
| 37 | case report   | Lee IS(2012)(37)              | Pleural sarciodiosis with lymph node and endobronchial involvement (1)      | Prednisolone                                                            |
| 38 | case report   | Lee JH(2012)(38)              | Early-onset childhood sarciodiosis accompanied by incidentally noted enchondromatosis (1) | Oral prednisolone                                                       |
| 39 | case report   | Lee JM(2012)(39)              | Cardiac sarciodiosis presenting with complete atrioventricular block and sustained monomorphic ventricular tachycardia (1) | Systemic glucocorticoid                                                 |
| 40 | case report   | Lee SJ(2012)(40)              | Sarciodiosis combined with hepatic and peritoneal involvement (1)           | Corticosteroids and methotrexate                                        |
| 41 | case report   | Min KD(2012)(41)              | Muscular sarciodiosis (1)                                                   | Prednisolone                                                            |
| 42 | case report   | Yoon H(2012)(42)              | POEM Syndrome associated with sarciodiosis (1)                              | The patient was treated with Immunosuppression and dexamethasone        |
| 43 | case report   | Ahn SW(2011)(43)              | Spinal cord neurosarciodiosis (1)                                           | Corticosteroid, immunosuppressant, thalidomide                          |
| 44 | case report   | Im MH(2011)(44)               | Takayasu's arteritis combined with sarciodiosis, lymphoma or metastatic adenopathy (1) | Prednisolone                                                            |
| no | Type of study | first author(year) (reference) | Subject (n)                                                                 | therapy                                                                 |
|----|--------------|--------------------------------|---------------------------------------------------------------------------|-------------------------------------------------------------------------|
| 45 | case report  | Kim YB(2011)(45)               | Extensive systemic sarcoidosis with testicular involvement (1)            | Corticosteroid                                                          |
| 46 | case report  | Lee HJ(2011)(46)               | Sarcoaidosis occurred after treatment of tuberculous lymphadenitis (1)    | Oral steroid                                                            |
| 47 | case report  | Lee SH(2011)(47)               | Sarcoaidosis induced by adalimumab in Rheumatoid arthritis (1)            | The patient was treated for sarcoidosis with prednisolone and methotrexate instead of adalimumab |
| 48 | case report  | Lee YB(2011)(48)               | Cutaneous and pulmonary sarcoidosis that was associated with interferon treatment for active chronic HCV infection (1) | Withdrawal of the interferon treatment and topical corticosteroid therapy for 2 weeks resulted in resoluton of the cutaneous sarcoidosis. |
| 49 | case report  | Park SY(2011)(49)              | Development of sarcoidosis during tumor necrosis factor-alpha antagonist therapy (1) | The patients was treated for sarcoidosis with prednisolone instead of etanercept. |
| 50 | case report  | Choi SC(2010)(50)              | Morpheaform sarcoidosis (1)                                               | Triamcinolone intralesional injection                                   |
| 51 | case report  | Han JY(2010)(51)               | Sarcoaidosis associated with acute tubular necrosis and pulmonary hemorrhage (1) | Prednisolone and hydroxychloroquine                                     |
| 52 | case report  | Kim DC(2010)(52)              | Systemic sclerosis coincidence with sarcoidosis (1)                       | Corticosteroid therapy                                                 |
| 53 | case report  | Kim SH(2010)(53)              | Intramedullary sarcoidosis of cervical spinal cord (1)                    | Prednisolone                                                            |
| 54 | case report  | Kim SH(2010)(54)              | Neurosarcoidosis presenting as spinal nerve root pain of trunk (1)        | Oral prednisolone                                                       |
| 55 | case report  | Lee CH(2010)(55)              | Hydrocephalus as a presenting manifestation of neurosarcoidosis (1)       | The patients was performed ventriculoperitoneal shunt operation and administered corticosteroids. |
| no | Type of study | first author/year (reference) | Subject (n)                                                                 | therapy |
|----|--------------|-------------------------------|----------------------------------------------------------------------------|---------|
| 56 | case report  | Lee KH(2010)(56)              | Systemic sarcoidosis associated with early gastric cancer (1)               | The patient was performed with endoscopic submucosal dissection |
| 57 | case report  | Yang MY(2010)(57)             | Pulmonary sarcoidosis (1)                                                  | Prednisolone |
| 58 | case report  | Yun SE(2010)(58)              | Diffuse subcutaneous sarcoidosis presenting as thickened extremities (1)   | Corticosteroid treatment |
| 59 | case report  | Cho HJ(2009)(59)              | Isolated cardiac sarcoidosis (1)                                           | Heart transplantation |
| 60 | case report  | Choi HH(2009)(60)             | Pulmonary sarcoidosis (1)                                                  | Prednisolone |
| 61 | case report  | Choi KH(2009)(61)             | A Nodular type of subcutaneous sarcoidosis (1)                             | The patient underwent marginal margin excision of the subcutaneous mass on the buttock, which involved the adjacent fascia on the operative field and refused steroid therapy. |
| 62 | case report  | Kang MJ(2009)(62)             | Cutaneous sarcoidosis presenting as multiple erythematous macules and patches (1) | Mild corticosteroids and 0.1% tacrolimus on the lesions |
| 63 | case report  | Ko JK(2009)(63)               | Neurosarcoïdosis (1)                                                       | Intravenous methylprednisolone |
| 64 | case report  | Park TS(2009)(64)             | Sarcoidosis with pancytopenia as resulting from bone marrow involvement (1) | Oral prednisolone |
| 65 | case report  | Chae DR(2008)(65)             | Sarcoidosis presenting as a nasal cavity mass (1)                          | Methotrexate, prednisolone |
| 66 | case report  | Hong YC(2008)(66)             | Scar sarcoidosis (1)                                                       | Topical steroid |
| 67 | case report  | Hong YS(2008)(67)             | Primary sarcoidosis of the nasal cavity (1)                               | Steroid therapy |
| 68 | case report  | Kang W(2008)(68)              | Sarcoidosis presenting as a rectal polyp (1)                               | Conservative treatment |
| no | Type of study | first author(year) (reference) | Subject (n) | therapy |
|----|---------------|---------------------------------|-------------|---------|
| 69 | case report   | Kim HK(2008)(69)                | Pseudoalveolar sarcoidosis with unilateral pulmonary infiltration (1) | The patient improved without any treatment. |
| 70 | case report   | Kim SJ(2008)(70)                | Thyroid cancer combined with pulmonary sarcoidosis (1) | The patient was treated with thyroid hormones and followed up. |
| 71 | case report   | You IC(2008)(71)                | Sarcoideosis presented as multiple conjunctival and nasal mucosal nodule (1) | Triamcinolone intralesional injection and oral prednisolone |
| 72 | case report   | Choi BY(2007)(72)               | Ankylosing spondylitis accompanying sarcoidosis (1) | Conservative treatment for sarcoidosis and etanercept for ankylosing spondylitis |
| 73 | case report   | Ji SG(2007)(73)                 | Pulmonary sarcoidosis which has similar finding of miliary tuberculosis (1) | Prednisolone |
| 74 | case report   | Jo KW(2007)(74)                 | Graves' disease coexistent with pulmonary sarcoidosis (1) | Prednisolone |
| 75 | case report   | Jung KS(2007)(75)               | Sarcoidosis with chylothorax (1) | Prednisolone, sandostatin |
| 76 | case report   | Kim KM(2007)(76)                | Sarcoidosis presenting with thyroiditis (1) | Steroid therapy |
| 77 | case report   | Kwok SK(2007)(77)               | Sarcoidosis presented tenosynovitis (1) | Oral prednisolone |
| 78 | case report   | Lee HJ(2007)(78)                | Breast sarcoidosis (1) | Corticosteroid |
| 79 | case report   | Lee JH(2007)(79)                | Ethmoidal sarcoidosis (1) | Systemic corticosteroid |
| 80 | case report   | Park BH(2007)(80)               | Pulmonary sarcoidosis combined with neurosarcoidosis (1) | Prednisolone |
| 81 | case report   | Chang HJ(2006)(81)              | Exacerbation of pulmonary sarcoidosis after the cessation of interferon and ribavirin therapy for chronic hepatitis C (1) | The patient's sarcoidosis improved spontaneously and he continues to be monitored regularly without steroid therapy. |
| no | Type of study | first author(year) (reference) | Subject (n) | therapy |
|----|--------------|--------------------------------|-------------|---------|
| 82 | case report  | Kim YJ(2006)(82)              | Scar sarcoidosis of the eyelid (1) | Intralesional triamcinolone injectioni |
| 83 | case report  | Do YS(2005)(83)              | Sarcoidosis presented with myofascitis (1) | The patient was given NSAID. |
| 84 | case report  | Lee BH(2005)(84)              | Sarcoidosis with cavitation and hepatic involvement (1) | Steroid treatment |
| 85 | case report  | Ko DA(2004)(85)              | Sarcoidosis, presented as recurrent eyelid masses (1) | Steroid therapy |
| 86 | case report  | Kim JP(2003)(86)              | Nodular type of muscular sarcoidosis (1) | Corticosteroid therapy |
| 87 | case report  | Jang J(2001)(87)              | Cardiac sarcoidosis (1) | Cardiac transplantation |
| 88 | case report  | Choi JC(2000)(88)              | Psoriasiform Sarcoidosis (1) | Intralesional injection of triamcinolone acetonide |
| 89 | case report  | Choi IK(1998)(89)             | Sarcoid dactylitis (1) | Prednisolone, hydroxychloroquine |
| 90 | case report  | Choi SH(1998)(90)             | Neurosarcoaidosis without systemic involvement (1) | Oral prednisolone |
| 91 | case report  | Ju MS(1998)(91)              | Sarcoidosis with cavitory node of the lung (1) | Steroid therapy |
| 92 | case report  | Shin SJ(1998)(92)             | Sarcoidosis involving skeletal muscle (1) | Prednisolone |
| 93 | case report  | Kim GS(1997)(93)             | Necrotizing sarcoid granulomatosis (1) | Because of spontaneously improved respiratory symptoms, the patients was not treated steroid therapy |
| 94 | case report  | Lee SJ(1997)(94)             | Sarcoidosis involving bone marrow, skin, uvea, joints and liver (1) | Prednisolone |
| 95 | case report  | Kim JW(1995)(95)             | Sarcoidosis with bone involvement (1) | Prednisolone |
| 96 | case report  | Park HC(1995)(96)             | Sarcoidosis with cardiac involvement (1) | Lidocaine, oral prednisolone |
| 97 | case report  | Cha MK(1994)(97)             | Systemic sarcoidosis with cutaneous and subcutaneous involvement (1) | Prednisolone |
| no. | Type of study | first author(year) (reference) | Subject (n)                                | therapy                      |
|-----|---------------|--------------------------------|-------------------------------------------|------------------------------|
| 98  | case report   | Uhm WS(1994)(98)               | Pulmonary sarcoidosis (2)                 | steroid treatment           |
| 99  | case report   | Lee TH(1993)(99)               | Ocular sarcoidosis (1)                    | corticosteroid therapy      |
| 100 | case report   | Kim YS(1991)(100)             | Sarcoidosis involving the spinal dura (1) | steroid treatment           |
| 101 | case report   | Han JK(1989)(101)             | Mediastinal and pulmonary sarcoidosis (1) | prednisolone                |
| 102 | case report   | Kim SJ(1989)(102)             | Sarcoidosis (5)                           | Of 5 patients, 4 patients were treated the steroid therapy and the one patient was not treated the steroid therapy. |
Reference

1. Kim MS, Park CK, Shin HJ, Seo HW, Chang J, Ahn S, et al. Review of Sarcoidosis in a Province of South Korea from 1996 to 2014. Tuberc Respir Dis. 2017;80(3):291-5.
2. Lee SY, Lee HG, Kim DS, Kim JG, Chung H, Yoon YH. Ocular sarcoidosis in a Korean population. J Korean Med Sci. 2009;24(3):413-9.
3. Kim TW, Chung H, Yu HG. Clinical Features in Korean Patients with Sarcoid Uveitis. J Korean Ophthalmol Soc. 2008;49(9):1483.
4. Lee CH, Son JW, Kong EJ. Cardiac Sarcoidosis Presenting as Complete Atrioventricular Block: Findings on PET/MRI. Korean Circ J. 2018;48(10):947-8.
5. Park H, Park JC, Cho JY, Yoon HJ, Kim KH, Ahn Y, et al. Recovery of High Degree Atrioventricular Block in a Patient with Cardiac Sarcoidosis by Corticosteroid Therapy. Chonnam Med J. 2018;54(1):74-5.
6. Choi SY, Cha WW, Song K, Choi MS. A Case of Sarcoidosis of the Nasal Septum. J Otorhinolaryngol-Head Neck Surg. 2017;60(5):248-51.
7. Kim TK, Kang SH, Moon HS, Sung JK, Jeong HY, Eun HS. Pulmonary Sarcoidosis That Developed During the Treatment of a Patient With Crohn Disease by Using Infliximab. Ann Coloproctol. 2017;33(2):74-7.
8. La YK, Kim HI, Baek MS, Baik KW, Cha YJ, Kim WJ. Isolated Leptomeningeal Neurosarcoidosis. J Korean Neurol Assoc. 2017;35(1):48-9.
9. Park SK, Hwang PH, Yun SK, Kim HU, Park J. Tumor Necrosis Factor Alpha Blocker-Induced Erythrodermic Sarcoidosis in with Juvenile Rheumatoid Arthritis: A Case Report and Review of the Literature. Ann Dermatol. 2017;29(1):74-8.
10. Kang JH, Ahn JH, Yu JE, Kim JE, Yim YR, Lee JW, et al. A Case of Sarcoidosis That Improved upon Discontinuation of Etanercept. J Rheum Dis.. 2016;23(3):187.
11. Kim EH, Lee SG, Kim KH, Seol YM, Park EK, Koo DW, et al. Discovery of Splenic Sarcoidosis Concurrent with the Diagnosis of Ovarian Cancer: A Case Report. J Rheum Dis. 2016;23(2):130.
12. Kim HJ, Park J, Kim JM, Lee YJ, Kang HR, Lee CH. Sarcoidosis Presenting with Multiple Lung Parenchymal Nodules. EMJ. 2016;39(2):61.
13. Kim M, Park MS. Spinal Cord Neurosarcoidosis after Cervical Compressive Myelopathy. J Korean Neurol Assoc. 2016;34(3):205-8.
14. Lee JW, Park J, Park SH, Lee J, Park JH, Kim JY. Sarcoidosis-associated Syndrome of Inappropriate Antidiuretic Hormone Secretion. J Korean Med Sci. 2016;91(3):296-9.
15. Sim JK, Lee SY, Shim JJ, Kang KH. Pulmonary Sarcoidosis Induced by Adalimumab: A Case Report and Literature Review. Yonsei Med J. 2016;57(1):272-3.
16. Cho NH, Song IW, Kwon SY, Cho HC. A Case of Papillary Thyroid Carcinoma Coexistent with Thyroid Sarcoidosis. J Korean Thyroid Assoc. 2015;8(1):121.
17. Hong SH, Kang EY, Woo OH, Yong HS, Oh YW, Shin BK, et al. A Pulmonary Sarcoidosis Manifesting as a Rare Atypical Pattern and Distribution. Tuberc Respir Dis. 2008;64(3):236-9.
18. Jeon JH, Seo JB, Hwang IR, Park HY, Kim JS, Park KG, et al. Case of Sarcoidosis-Related Hypercalcemia with Normal Serum 1,25(OH)2D. Korean Journal of Medicine. 2015;88(2):207. doi: 10.3904/kjm.2015.88.2.207.
19. Jeong DE, Kim MK, Koh SA, Lee KH, Choi JH, Hong YH, et al. Immune thrombocytopenia associated with sarcoidosis. Yeungnam Univ J Med. 2015;32(1):26. doi: 10.12701/yujm.2015.32.1.26.
20. Kim BY, Kim SR, Hwang J, Jin S-Y, Kim H-S. A Case of Gastrointestinal Sarcoidosis without Pulmonary Involvement. Korean J Med. 2015;89(1):127.
21. Ohn J, Byun SY, Kim IS, Park KC. Venous Leg Ulcer in a Sarcoidosis Patient: A Case Report. Ann Dermatol. 2015;27(6):744-7.
22. Park HS, Kim H, Lee JY, Jung SY, Han S, Park YB, et al. Hepatic Sarcoidosis in a Patient with Chronic Hepatitis B Virus Infection. J Rheum Dis. 2015;22(3):200.
23. Cho JW, Jung JW, Jung YK, Koh IS, Kim HK, Lee JY. Neurosarcoidosis after Uveitis. J Korean Neurol Assoc. 2014;32(4):337-8.
24. Kim DH, Cho WH, Cho KS, Cha SH. Solitary cavernous sinus neurosarcoidosis mimicking neurosyphilis. J Korean Neurosurg Soc. 2014;55(1):61-3.
25. Kim HS, Lee SY, Oh SC, Choi CW, Kim JS, Seo JH. Case Report of Pulmonary Sarcoidosis Suspected to be Pulmonary Metastasis in a Patient with Breast Cancer. Cancer Res Treat. 2014;46(3):317-21.
26. Kwon DH, Lee SH, Kim ES, Eoh W. Intramedullary sarcoidosis presenting with delayed spinal cord swelling after cervical laminoplasty for compressive cervical myelopathy. J Korean Neurosurg Soc. 2014;56(5):436-40.
27. Park JS, Kwak MS. A Case of Isolated Orbital Sarcoidosis. J Korean Ophthalmol Soc. 2014;55(10):1549.
28. Byun CW, Yang SN, Yoon JS, Kim SH. Lofgren's Syndrome-Acute Onset Sarcoidosis and Polyarthralgia: A Case Report. Ann Rehabil Med. 2013;37(2):295-9.
29. Cho KH, Shin JH, Park SH, Kim HS, Yang SH. A case of pulmonary sarcoidosis with endobronchial nodular involvement. Tuberc Respir Dis. 2013;74(6):274-9.
30. Han EJ, Jang YS, Lee IS, Lee JM, Kang S, Kim HS. Muscular sarcoidosis detected by F-18 FDG PET/CT in a hypercalcemic patient. J Korean Med Sci. 2013;28(9):1399-402.
31. Kim MH, Lee K, Kim KU, Park HK, Lee MK, Suh DS. Sarcoidosis mimicking cancer metastasis following chemotherapy for ovarian cancer. Cancer Res Treat. 2013;45(4):354-8.
32. Kwon YS, Jung HI, Kim HJ, Lee JW, Choi WI, Kim JY, et al. Isolated cervical lymph node sarcoidosis presenting in an asymptomatic neck mass: a case report. Tuberc Respir Dis (Seoul). 2013;75(3):116-9.
33. Lee JH, Lee JJ, Park K-S, Park S-H, Kim H-Y, Kwok S-K. Simultaneous Presentation of Ocular Sarcoidosis and Early Axial Spondyloarthritis in a Young Woman. J Rheum Dis. 2013;20(6):378.
34. Lee JK, Moon NJ. Orbital sarcoidosis presenting as diffuse swelling of the lower eyelid. Korean J Ophthalmol. 2013;27(1):52-4.
35. Jang JY, Bae YA, Hong HJ, Kwon KW. Sonographic Appearance of Dermal and Subcutaneous Sarcoidosis: A Case Report. J Korean Soc Ultrasound Med. 2012;31(4):251-5.
36. Kang SM, Baek JY, Hwangbo B, Kim HY, Lee GK, Lee HS. A case of capecitabine-induced sarcoidosis. Tuberc Respir Dis (Seoul). 2012;72(3):318-22.
37. Lee IS, Kim SB, Moon CS, Jung SM, Kim SY, Kim EY, et al. Sarcoidosis presenting with massive pleural effusion and elevated serum and pleural fluid carbohydrate antigen-125 levels. Tuberc Respir Dis (Seoul). 2012;73(6):320-4.
38. Lee JH, Lim YJ, Lee S, Joo KB, Choi YY, Park CK, et al. Early-onset childhood sarcoidosis with incidental multiple enchondromatosis. J Korean Med Sci. 2012;27(1):96-100.
39. Lee JM, Oh IY, Choi DJ. Cardiac sarcoidosis presenting with complete atrioventricular block and sustained monomorphous ventricular tachycardia. Korean Circ J. 2012;42(8):571-4.
40. Lee SJ, Kim EH, Kim YS, Song JE, Chung S-J, Lee CK, et al. A Case of Sarcoidosis Combined with Massive Ascites. J Rheum Dis. 2012;19(6):364.
41. Min KD, Hwang SH, Lee YS, Lee BI. Sarcoidosis Presenting as Knee Pain. J Korean Orthop Assoc. 2012;47(4):299.
42. Yoon H, Kang BJ, Kim WS, Kim DS, Song JW. A Case of POEMS Syndrome Associated with Sarcoidosis. Korean J Med. 2012;83(1):107.
43. Ahn SW, Kim KT, Youn YC, Kwon OS, Kim YB. Isolated spinal cord neurosarcoidosis diagnosed by cord biopsy and thalidomide trial. J Korean Med Sci. 2011;26(1):154-7.
44. Im MH, Woo JJ, An JK, Lee BH, Choi YS. Takayasu Arteritis Associated with Sarcoidosis: A Case Report. J Korean Soc Radiol. 2011;65(5):487-90.
45. Kim YB, Chung YG, Kim SJ, Kim SJ, Ahn HS, Joo HJ, et al. Extensive systemic sarcoidosis with testicular involvement mimicking metastatic testicular cancer. Korean J Urol. 2011;52(4):295-7.
46. Lee HJ, Yoon SY, Han JM, An JH, Lee JJ, Choi CM, et al. Sarcoidosis Occurred after Treatment of Tuberculous Lymphadenitis. Tuberc Respir Dis. 12
47. Lee SH, Kim S-I, Song JS, Kim TH, Sohn JW, Kim S-H, et al. Sarcoidosis Induced by Adalimumab in Rheumatoid Arthritis. Tuberc Respir Dis. 2011;70(5):433.
48. Lee YB, Lee JI, Park HJ, Cho BK, Oh ST. Interferon-alpha Induced Sarcoidosis with Cutaneous Involvement along the Lines of Venous Drainage. Ann Dermatol. 2011;23(2):239-41.
49. Park SY, Kim EK, Hwang DW, Lee KW, Paik SS, Jung KH, et al. A Case of Development of Sarcoidosis During Tumor Necrosis Factor-alpha Antagonist Therapy. J Rheum Dis. 2011;18(1):41-5.
50. Choi SC, Kim HJ, Kim CR, Byun JY, Lee DY, Lee JH, et al. A case of morpheaform sarcoidosis. Ann Dermatol. 2010;22(2):239-41.
51. Han JY, Cho MK, Kim HS. A case of sarcoidosis associated with acute tubular necrosis and pulmonary hemorrhage. Korean J Med. 2010;78(5):654-9.
52. Kim DC, Rim DH, Kim YT, Ko JY, Park CK, Park SS, et al. Systemic Sclerosis Coincidence with Sarcoidosis: A Case Report and Review of the Literature. J Korean Rheum Assoc. 2010;17(4):400.
53. Kim SH, Seo KM, Kim DK, Kang SH. Intramedullary Sarcoidosis of Cervical Spinal Cord Suspected as Intramedullary Tumor: A case report. J Korean Acad Rehabil Med. 2010;34(3):372-5.
54. Kim SH, Ahn SW, Park BS, Shin JW, Kim SM, Lee KW. Neurosarcoidosis Presenting as Spinal Nerve Root Pain of Trunk. J Korean Neurol Assoc. 2010;28(2):119-21.
55. Lee CH, Jung YS, Lee SH. Hydrocephalus as a Presenting Manifestation of Neurosarcoidosis: Easy to Misdiagnose as Tuberculosis. J Korean Neurosurg Soc. 2010;48(1):79-81.
56. Lee KH, Kim KO, Kim YJ, Lee JH, Son KP, Huh KR, et al. Systemic Sarcoidosis Associated with Early Gastric Cancer. Korean J Gastrointest Endosc. 2010;40(6):374-7.
57. Yang MY, Ryu YS, Ko HJ, Park SK, Park JS, Park CS, et al. A Case of Pulmonary Sarcoidosis with Elevated Carcinoembryonic Antigen (CEA). Tuberc Respir Dis. 2010;69(1):48.
58. Yun SE, Kim HO, Jeong YG, Lee KJ, Lee CM, Kim JH, et al. A Case of Diffuse Subcutaneous Sarcoidosis Presenting as Thickened Extremities. The J Korean Rheum Assoc. 2010;17(1):56.
59. Cho HJ, Jung SH, Yun TJ, Moon D. Heart Transplantation Performed in a Patient with Isolated Cardiac Sarcoidosis. Korean J Thorac Cardiovasc Surg. 2009;42(1):92-5.
60. Choi HH, Hong YA, Choi JK, Kim JS, Kim SJ, Kim SC, et al. A Case of Sarcoidosis That Was Initially Misdiagnosed as Nontuberculous Mycobacteria Pulmonary Disease. Tuberc Respir Dis. 2009;66(4):309.

61. Choi KH, Choi YS, Kim BS, Joo JE, Jung YY, Cho YK, et al. A Nodular Type of Subcutaneous Sarcoidosis: A Case Report. J Korean Soc Radiol. 2009;60(1):47-50.

62. Kang MJ, Kim HS, Kim HO, Park YM. Cutaneous Sarcoidosis Presenting as Multiple Erythematous Macules and Patches. Ann Dermatol. 2009;21(2):168-70.

63. Ko JK, Lee SW, Choi CM. Moyamoya-Like Vasculopathy in Neurosarcoidosis. J Korean Neurosurg Soc. 2009;45(1):50-2.

64. Park TS, Kim D-Y, Park S-J, Kim YR, Na SY, Park JW, et al. A Case of Sarcoidosis with Pancytopenia as Resulting from Bone Marrow Involvement. Tuberc Respir Dis. 2009;67(6):560.

65. Chae DR, Lim SU, Cho GJ, Lim JH, Ju JY, Kwon YS, et al. Sarcoidosis Initially Presenting as a Nasal Cavity Mass Misdiagnosed as Tuberculosis. Tuberc Respir Dis. 2008;65(2):121-4.

66. Hong YC, Na DJ, Han SH, Lee YD, Cho YS, Han MS. A case of scar sarcoidosis. Korean J Intern Med. 2008;23(4):213-5.

67. Hong YS, Choi HS, Lee SS, Lim SC. A Case of Primary Sarcoidosis of the Nasal Cavity. Korean J Otorhinolaryngol-Head Neck Surg. 2008;51(10):938-41.

68. Kang W, Kim BK, Kim MJ, Cheon JH, Lee YC, Kim WH, et al. A Case of Sarcoidosis Presenting as a Rectal Polyp. Korean J Gastrointest Endosc. 2008;36(4):238-41.

69. Kim HK, Ban HJ, Chi SY, Chae DR, Cho GJ, Lim JH, et al. A Case of Pseudoalveolar Sarcoidosis with Unilateral Pulmonary Infiltration. Tuberc Respir Dis. 2008;64(2):149-52.

70. Kim SJ, Lim TK, Kim C, Hwang YI, Park S, Jang SH, et al. A Case of Thyroid Cancer Combined with Pulmonary Sarcoidosis. Tuberc Respir Dis 2008;65(1):52-6.

71. You IC, Moon HJ, Mun GH, Im SC, Yoon KC. A Case of Sarcoidosis Presented as Multiple Conjunctival and Nasal Mucosal Nodule. J Korean Ophthalmol Soc. 2008;49(6):1000.

72. Choi BY, Park YB, Lee JH, Ryu HJ, Lee EY, Lee YJ, et al. A Case of Ankylosing Spondylitis Accompanying Sarcoidosis. J Korean Rheum Assoc. 2007;14(3):251-5.

73. Ji SG, Ban HJ, Lim JH, Cho GJ, Ju JY, Chae DR, et al. A Case of Pulmonary Sarcoidosis which hasSimilar Findings of Miliary Tuberculosis. Chonnam Med J. 2007;43(3):220-3.
74. Jo KW, Koh JH, Lee MY, Jung FM, Shin YG, Yong SJ, et al. A Case of Graves' Disease Coexistent with Pulmonary Sarcoidosis. Tuberc Respir Dis. 2007;62(5):417-520.

75. Jung KS, Moon JA, Yoon SH, Byun MK, Jung WY, Jung JH, et al. A Case of Successful Management of Sarcoidosis with Chylothorax Using Octreotide. Tuberc Respir Dis. 2007;62(2):119-24.

76. Kim KM, Ha YJ, Jeong KC, Kim YJ, Hahn CH, Lee SM, et al. A case of sarcoidosis presenting with thyroiditis. Korean J Med. 2007;73(3):981-4.

77. Kwok SK, Seo SH, Ju JH, Yoon CH, Park SH, Kim HY. Sarcoidosis Presenting as Tenosynovitis of Both Ankles. J Korean Rheum Assoc. 2007;14(3):307-9.

78. Lee HJ, Kim EK, Kim MJ, Oh KK, Kim SH. Breast Sarcoidosis Appearing as a Primary Manifestation of Sarcoidosis: A Case Report. J Korean Radiol Soc. 2007;56(6):609-13.

79. Lee JH, Kim NS, Cho JH, Lee YS. A Case of Ethmoidal Sarcoidosis. Korean J Otorhinolaryngol-Head Neck Surg. 2007;50(8):716-8.

80. Park BH, Park SC, Shin SY, Jeon HH, Jung KS, Jung WY, et al. A Case of Pulmonary Sarcoidosis Combined with Neur-osarcoidosis. Tuberc Respir Dis. 2007;62(6):549-53.

81. Chang HJ, Choi EH, Kim IJ, Sim YS, Lee JH, Kim TH, et al. Exacerbation of Sarcoidosis Following Interferon-alpha Therapy for Chronic Active Hepatitis C. Tuberc Respir Dis. 2006;61(3):285-8.

82. Kim YJ, Kim YD. A Case of Scar Sarcoidosis of The Eyelid. Korean J Ophthalmol. 2006;20(4):238-40.

83. Do YS, Lee JY, Kim HJ, Kim EH, Chai JY, Jeon CH, et al. A Case of Sarcoidosis Presented with Myofasciitis. J Korean Rheum Assoc. 2005;12(1):42-6.

84. Lee BH, Kim JM, Kim DW, Kim JH, Bang KT, Lee KY, et al. A Case of Sarcoidosis with Cavitation. Tuberc Respir Dis. 2005;59(5):546-50.

85. Ko DA, Kim BJ. Sarcoidosis, Presented as Recurrent Eyelid Masses. J Korean Ophthalmol Soc. 2004;45(9):1590-5.

86. Kim JP, Kim SH, Lee HG, Sung MS, Kim YS, Kim HM, et al. Muscle Mass in the Calf as a Presenting Symptom of Sarcoidosis. J Korean Rheum Assoc. 2003;10(1):66-70.

87. Jang J, Min K, Jung GC, Kim J, Lee I. Cardiac Sarcoidosis Treated by Cardiac Transplantation: A Case Report. Korean J Pathol. 2001;35(1):71-5.

88. Choi JC, Jang KA, Choi JH, Sung KJ, Moon KC, Koh JK. Psoriasiform Sarcoidosis. Ann Dermatol. 2000;12(4):303-5.

89. Choi IK, Lee SH, Lee SR, Kim JH, Kwon YH, Lee SY, et al. Sarcoid Dactylitis. Tuberc Respir Dis. 1998;45(6):1298-304.

90. Choi SH, Kim JE, Lee H, Lim JG, Yi SD, Park YC. A case of neurosarcoidosis without systemic involvement. J Korean Neurol Assoc. 1998;16(5):728-31.
91. Ju MS, Lee HK, Chang JH, Cheon SH, Kim YK, Yoon HS, et al. A Case of Sarcoidosis with Cavitary Nodule of the Lung. Tuberc Respir Dis. 1998;45(5):1098-102.
92. Shin SJ, Kim HK, Lee JM, Min JK, Lee SH, Hong YS, et al. A Case of Sarcoidosis Involving Skeletal Muscle. Korean J Med. 1998;54(6):849-55.
93. Kim GS, Lee SJ, Lee JC, Yoo CG, Kim YW, Han SK, et al. A Case of Necrotizing Sarcoid Granulomatosis. Korean J Med. 1997;53(4):574-9.
94. Lee SJ, Kim JY, Lee JC, Kim GS, Yoo CG, Kim YW, et al. A Case of Sarcoidosis Involving Bone Marrow, Skin, Uvea, Joints, Liver. Korean J Med. 1997;53(4):580-5.
95. Kim JW, Cho YJ, Baek JJ, Park KU, Chung Y. A case of sarcoidosis with bone involvement. Tuberc Respir Dis. 1995;42(3):407-12.
96. Park HC, Kim SK, Kim YS, Chang J, Chung KY, Shin DH, et al. Sarcoidosis with cardiac involvement. Yonsei Med J. 1995;36(6):538-45.
97. Cha MK, Kim TY, Cho BK, Houh W, Song JS. A Case of Sarcoidosis. Ann Dermatol. 1994;6(1):52-8.
98. Uhm WS, Lim CM, Kim WS, Kim DS, Kim WD. Familial Sarcoidosis, The First Report in Korea. Tuberc Respir Dis. 1994;41(6):644-50.
99. Lee TH, Kim YJ, Sin DH. Case Report: Ocular sarcoidosis. J Korean Ophthalmol Soc. 1993;34(7):687-91.
100. Kim YS, Yang KH, Kim BK, Kim SM. Sarcoidosis Involving the Spinal Dura. Korean J Pathol. 1991;25(2):158-63.
101. Han JK, Kim WH, Jung KS, Kwak JH, Kwon OJ, Kim KB, et al. Mediastinal & pulmonary sarcoidosis: report of one case and radiologic-pathologic correlation of lymph node enhancement pattern during the treatment. J Korean Radiol Soc. 1989;25(3):425-32.
102. Kim SJ, Han JK, Im JG, Han MC. Thoracic manifestations of sarcoidosis: CT findings. J Korean Radiol Soc. 1989 25(5):728-33.