# The manifestation of spinal tuberculosis and associated vertebral level at Windhoek Central Hospital, Namibia

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**Background.** Tuberculosis (TB) is a major public health concern, especially in developing countries such as Namibia, where spinal TB accounts for 50% of all skeletal TB cases.
**Objective.** To determine the clinical manifestations and most common identifiable radiological features of spinal TB, and to identify the most frequently affected vertebral level. This will aid in future diagnoses and prompt treatment regarding spinal TB cases in Namibia.
**Method.** A retrospective cross-sectional study design was adopted to review patient records of individuals diagnosed with spinal TB in 2019 at Windhoek Central Hospital (Namibia). Non-probability sampling was used, and patient demographics, clinical presentation and radiological features were recorded and analysed.
**Results.** Thirty patients (17 female and 13 male) were included in this study. Weight loss was the main clinical complaint (53%), while local tenderness (30%) was the most common physical examination finding. Eighteen of the 30 patients (60%) had varying degrees of neurological deficits. The most common imaging technique used was computed tomography (CT) (*n*=29, 97%), followed by magnetic resonance imaging (MRI) (3%). Intervertebral disk space/disk involvement was the most common radiological feature identified on imaging (57%), followed by abscess formation (50%). Vertebral lesions involved the lumbar (50%) and the thoracolumbar spine (23%). L1 and L2 were most commonly affected (48% and 44%, respectively), followed by T12 and L3 (32% each).
Conclusion. Early stage diagnosis of spinal TB is highly challenging. Patients are often misdiagnosed and/or mismanaged. Thus, it is essential to enhance screening techniques and educate healthcare professionals on common signs, symptoms and radiological features of spinal TB. This will allow prompt detection and help to prevent debilitating complications associated with the disease to manifest.
**Keywords.** Tuberculosis, spinal TB, extrapulmonary TB, Namibia, clinical features, radiological features, imaging, vertebral level.

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The complications of tuberculosis (TB), specifically spinal TB, are affecting developing countries, such as Namibia, on a large scale. It is a major cause of disability and poor patient satisfaction owing to a delayed diagnosis or inappropriate management of the disease.[1]

Spinal TB, also known as Pott's Disease, was first described by Dr Percivall Pott in 1779 and remains the most common skeletal site for TB involvement.[1] Approximately 15% of TB cases present as extra-pulmonary TB, with osteoarticular TB accounting for 11.3% of these cases, half of which involve the spine.[1]

A clinical epidemiological survey indicates that the incidence of spinal TB is the highest in developing countries, including Namibia. Spinal TB is often misdiagnosed and consequently mistreated, largely because most patients present with non-specific symptoms that can be misleading.[2] A study on the characteristics of spinal TB revealed that the most common initial symptoms are generalised, such as backache and local tenderness.[3] This makes the diagnosis of spinal tuberculosis a particularly challenging one. A study in Taiwan found that the median duration of symptoms before a confirmed diagnosis was 60 days (ranging from 3 - 720 days),[4] highlighting the considerable delay in diagnosis.

Additionally, various laboratory tests and imaging examinations may yield misleading negative results, particularly in the early stages of the disease.[2,5] This further delays the prompt diagnosis of spinal TB, potentially leading to the destruction of additional portions of the bone,

adjacent bones or joints,[6] and can progress to devastating sequelae. Neurological complications are among the most dreaded outcomes, typically developing gradually in TB. Early neurological signs often include clumsy gait, hyperreflexia, clonus and early motor deficits.[1] As the disease progresses, it can lead to posterior kyphosis (abnormal rounding of the upper back), nerve compression symptoms[5] and even paraplegia (an impairment in motor or sensory function of the lower extremities) or quadriplegia (an impairment in motor or sensory function of both the upper and lower extremities).[1] Spinal deformity and kyphosis are dreaded complications. The Frankel Scale for Spinal Cord Injury (SCI), introduced in 1969, is commonly used to classify neurological deficits into five grades.[7] The scale ranges from grade E (normal function) to grade A (complete motor and sensory deficits). The Frankel Scale is an easy and quick tool for categorising SCI. Hurtado *et al.*[1] noted that treatment of spinal TB in patients without remarkable deformities or neurological complications (pre-destructive stage) leads to healing in about 95% of cases. However, once the disease moves into the destructive stage and symptoms progress to neurological deficits, there is a high risk that patients may never recover neurological function.

Guidelines on the management of spinal TB are often extrapolated from trials on pulmonary disease.[1] The treatment of spinal TB involves the standard TB regimen, administered more frequently and often for an extended duration. Vitamin B6 is added, especially for patients at higher risk of neuropathy (dysfunction of one or more peripheral nerves, causing numbness or weakness). Directly Observed Therapy (DOTS) remains important for managing TB and ensuring TB medicine adherence. However, the duration of treatment in osseous TB can be unusually prolonged, sometimes extending up to a year or two.[1] This raises the challenge of drug resistance and defining a curative endpoint for spinal TB. Unlike pulmonary TB, determining the eradication of spinal disease is more complex owing to its extra-pulmonary sites.[1] Medical therapy remains the mainstay of treatment for spinal tuberculosis.[8,9] However, surgery might also be considered in some cases, such as unresponsiveness to chemotherapy, recurrence and static or worsening neural deficit.[10] Surgery is not only effective in debriding the lesion but also in eradicating TB foci, decompressing the spinal cord, re-establishing spinal stability and restoring normal spinal alignment.[5] A combination of medical therapy and surgery yields the best results in complicated cases.[9]

However, there are conflicting views on the theoretical and clinical information on the vertebral level most commonly affected by spinal TB. According to Li *et al.*,[11] the lumbar and lumbosacral vertebrae are the most affected vertebral levels, as these areas endure maximum spinal load and have a high range of motion. The lumbosacral segment is also a transitional area between mobile lumbar lordosis and fixed sacral kyphosis, theoretically making it more susceptible to damage from spinal TB. In contrast, various health practitioners reported that, based on their clinical experience, the thoracic vertebral level is more commonly affected.

Various imaging modalities, e.g., X-ray, computed tomography (CT) and magnetic resonance imaging (MRI), are useful for diagnosing spinal TB. MRI, in particular, is useful in revealing the severity of the disease and could be repeated to monitor the progress, though it is non-specific.[12]

Challenges and controversies persist regarding spinal TB, which remains a significant global issue, especially in lower-income countries such as Namibia.[13] Clinical and radiographic features of osseous TB can mimic a range of other pathologies, such as benign bone tumours, osteochondrosis and Kaposi sarcoma.[12] Therefore, it is particularly difficult to diagnose spinal TB. To help prevent the progression of the disease and the potentially irreversible complications, spinal TB should be diagnosed and treated promptly. Currently, to the best of our knowledge, no scientific data or studies on spinal TB have been conducted in Namibia.

The study aims to clarify which vertebral level is most commonly affected and to address the current gap in knowledge regarding the characteristic clinical and radiological features of spinal TB among patients in Namibia. The goal is to educate health professionals across the country to enhance the prompt diagnosis and treatment of spinal TB.

## Methods

The present study was approved by the Ethics Committee of the Ministry of Health and Social Services (MOHSS). It was a document-based, descriptive review of positive spinal TB cases, involving no direct interaction with patients. Consequently, informed consent was not required. Confidentiality and anonymity were maintained at all times through the use of pseudonyms, prompt transcription of raw data, separate storage of de-identified data from coding lists, the use of computer passwords and firewalls and restricted access to the data collected.

A retrospective cross-sectional study design was adopted, using non-probability sampling methods to examine the radiological features of spinal TB and identify the most commonly affected vertebral level among patients at Windhoek Central Hospital, in Namibia. The study sample included 30 patients from 2019, all of whom were referred to the spinal clinic at Windhoek Central Hospital and diagnosed with spinal TB (inclusion criteria). The data extracted included: age, sex, ethnicity, date of consultation/imaging (X-ray, CT, MRI) and, where available, clinical findings from patient records and Retroviral Disease (RVD) status.[14,15] The exclusion criteria encompass patients referred to the spinal clinic for reasons other than spinal TB, such as trauma-related injuries (spinal cord injuries and vertebral fractures), degenerative disorders, vertebral osteomyelitis, spinal stenosis, herniated discs, abscess and haematoma formations and tumours. Patients of all ages (from infancy to old age) were considered for inclusion.

Medical Imaging Namibia served as the data collection point for this study. A sample was selected from the archive, and the images (X-rays, CT scans and MRIs) were reviewed. The data collection process involved using a checklist to assess each confirmed TB X-ray, CT scan and MRI. The checklist was used to assess the following: site of lesion (i.e., cervical, thoracic, lumbar, thoracolumbar or sacral), radiological findings (intervertebral disk space/disk involvement, abscess, end plate injury, thecal sac indentation, spinal cord compromise/canal stenosis, cord oedema, calcification, reduced bone density, wedge collapse, compression fracture, vertebral body height reduction, kyphosis, scoliosis or bone fragmentation).

The data were captured in Microsoft Excel and stored on an encrypted device. Access was restricted to the primary investigator and supervisors, with data retention planned for a minimum of 10 years. Statistical analysis was performed using Microsoft Excel. The mean and standard deviation (SD) were determined for the age range of the participants. The analysis identified the most common clinical manifestations, radiological features and the spinal level most affected by spinal TB among patients in Namibia. Owing to the small sample size ($N$=30 patients), the analysis was

conducted manually. Results are presented in tables and graphs for better interpretation of the data.

## Results

### Patient characteristics

In the study, 17 females (56.7%) and 13 males (43.3%) aged 2 - 59 years were included, with a mean age of 36 (14.2) years. Diagnostic categorisation was as follows: confirmed TB (13%), probable TB (57%), possible TB (13%), not TB (0%) and unknown (17%) (Table 1).

Clinical presentations included fever, weight loss, night sweats, fatigue, back pain, radicular symptoms and Gibbus deformity. Imaging revealed bone or soft tissue destruction, intervertebral disk space/disk involvement, abscess formation, thecal sac indentation and spinal cord compromise/canal stenosis. The most common clinical complaint was weight loss (*n*=16, 53%), followed by fatigue (*n*=11, 37%), weakness (*n*=11, 37%), fever (*n*=10, 33%), back pain (*n*=9, 30%), night sweats (*n*=8, 27%) and tingling or numbness in the lower extremities (*n* = 8, 27%). At physical examination, tenderness and Gibbus deformity were the most common findings (*n*=9, 30% each), followed by impaired sensation (*n*=6, 20%), decreased motor skills (*n*=5, 17%) and kyphosis (*n*=2, 7%) (Table 2).

Neurological status was evaluated using the Frankel classification[7] (Table 3). Of the 30 patients, 18 (60%) had a neurological deficit: Frankel A in five patients (17%), Frankel B in one patient (3%), Frankel C in three patients (10%) and Frankel D in nine patients (30%) (Table 3). However, data on neurological function was incomplete for 12 patients (40%); nine had no information on history or physical examination and three had no information on physical examination alone. As a result, the neurological status of 12 of the 30 patients (40%) could not be classified according to the Frankel system.

### Imaging examination results

In the present study, the most commonly used imaging technique for evaluating spinal lesions was CT (97%), followed by MRI (3%). TB lesions were identified in the following locations: thoracic (*n*=1, 3%), lumbar (*n*=15, 50%), cervical/thoracic/lumbar (*n*=1, 3%), thoracolumbar (*n*=7, 23%), lumbosacral (*n*=1%) and unknown (*n*=5, 16%) (Table 4). The unknown cases were poorly documented with minimal or no information but were included because they met the inclusion criteria (referral to the TB spine clinic).

Data on specific vertebral level involvement (Fig. 1) from the 25 cases with sufficient information showed that 12 (48%) of the cases involved L1. The next commonly affected vertebral level was L2 (*n*=11, 44%), followed by T12 and L3 (*n*=8, 32% each). The lowest vertebral involvement was T8 (*n*=1, 4%) and L5 (*n*=3, 12%).

The most common radiological feature seen on imaging was intervertebral disk space/disk involvement (*n*=17, 57%), followed by abscess formation (*n*=15, 50%), spinal cord compression/stenosis (*n*=12, 40%), thecal sac indentation (*n*=8, 27%), end plate irregularity (*n* = 5, 17%), Gibbus deformity (*n* = 3, 10%), cord oedema (*n*=3, 10%), vertebral body height reduction (*n*=3, 10%), kyphosis (n=2, 7%), wedge collapse (*n*=1, 3%) and bone fragmentation (*n*=1, 3%) (Table 5).

## Discussion

Compared with other diseases, spinal TB is often misdiagnosed owing to its non-specific clinical manifestations and the limitations of imaging examinations. The study aimed to address this issue by identifying the common clinical and radiological manifestations of spinal TB and determining the vertebral level most commonly affected among patients at Windhoek Central Hospital, in Namibia.

In this study, the age group most affected was the 21 - 30-year-olds. This finding is similar to a study conducted by Wang *et al.*,[16] which also reported the highest number of patients in this age group. They attributed the increased risk of TB infection in this demographic to harsh living conditions, poor health awareness and greater mobility. The clinical presentation of spinal TB often varies and tends to be non-specific. Contrary to some studies,[16] back pain was not the most common presenting symptom in our study. Instead, weight loss was the most prevalent complaint, followed by more generalised symptoms, such as fatigue, weakness and fever. Back pain, night sweats and tingling or numbness in the lower limbs were much less common in this study. The

**Table 1. Algorithm for patient categorization into different categories of the composite reference standard (based on Wang[16])**

| CRS Category | AFB smear | Culture | Symptoms/ Signs | Radiology results | Histology/ cytology | Follow-up at 3 months |
|---|---|---|---|---|---|---|
| Confirmed TB | +/- | + | + | +/- | +/- | + |
| Probable TB | +/- | - | + | + | + | + |
| | +/- | - | + | + | - | + |
| | +/- | - | + | - | + | + |
| Possible TB | +/- | - | + | - | - | + |
| Not TB | - | - | + | - | - | + |
| Classification | | | ***n*** (%) | | | |
| Confirmed TB | | | 4 (13) | | | |
| Probable TB | | | 17 (57) | | | |
| Possible TB | | | 4 (13) | | | |
| Not TB | | | 0 (0) | | | |
| Unknown | | | 5 (17) | | | |

CRS = composite reference standard; AFB = acid-fast bacili; TB = tuberculosis.

discrepancy regarding back pain may be attributed to its subjective nature and varying pain tolerances among different ethnic groups.[17] Consistent with other studies,[5] local tenderness was the most common physical examination finding. The generalised nature of the signs and symptoms highlights the difficulty in diagnosing spinal TB patients and proves why it is often overlooked.

In our study, 60% of the patients had neurological damage according to the Frankel classification, which includes clinical features such as numbness, weakness and varying degrees of hypoesthesia (determines motor and sensory function). This high prevalence of neurological impairment can be attributed to the non-specific symptoms commonly presented by patients, leading to diagnoses at more advanced stages of disease, Consequently, the neurological damage caused by spinal TB is likely to be irreversible in many cases by the time of diagnosis.

**Table 2. Clinical symptoms and signs of 30 spinal TB patients**

| Characteristics | *n* (%) |
|---|---|
| Clinical symptoms | |
| Back pain | 9 (30) |
| Fever | 10 (33) |
| Weight loss | 16 (53) |
| Night sweats | 8 (27) |
| Fatigue | 11 (37) |
| Tingling or numbness sensation | 8 (27) |
| Weakness | 11 (37) |
| Clinical signs | |
| Gibbus deformity | 9 (30) |
| Kyphosis | 2 (7) |
| Tenderness | 9 (30) |
| Impaired sensation | 6 (20) |
| Decreased motor skills | 5 (17) |

Consistent with other studies,[3,16] the lumbar, thoracic and thoracolumbar vertebrae were the most commonly affected sites in our study, while the cervical and lumbosacral regions were less commonly involved. The thoracolumbar area is particularly susceptible to injury because of the transition from the rigid thoracic spine to the more flexible lumbar spine.[18] This anatomical transition might facilitate the seeding of TB bacteria.[3] TB bacteria spread haematogenously from a primary location such as the lungs to the vertebral body. The rich vascular plexus in the subchondral region of each vertebra further facilitates the spread of the TB bacteria.[3]

The specific vertebral levels affected in our study revealed that L1 (48%) was the most commonly involved, followed closely by L2 (44%), then L3 (32%) and T12 (32%). The cervical, sacral and upper thoracic vertebrae were the least affected. These results aligned with those from a study by Wang *et al.*,[16] which identified L1 and L2 as commonly affected. However, unlike our study, Wang *et al.*,[16] reported L3 as the most commonly affected vertebral level, followed closely by L4. Our study found L3 to be less commonly affected compared with their results. Additionally, while the cervical and upper thoracic regions were among the least affected in both studies, sacral lesions were found to be more common in their study. Despite these slight differences, both studies identified the same vertebral levels (L1 and L2) as the most commonly affected and the cervical and upper thoracic regions as the least affected.

Spinal TB can also be diagnosed by identifying specific radiological features on imaging. MRI and CT are the most useful tools for detecting spinal lesions. According to Sae-Jung *et al.*,[19] the typical features to be on the lookout for are vertebral endplate involvement, anterior vertebra body involvement and/or multiple vertebral body lesions. Consistent with these findings and other studies,[5] the most common radiological features observed in our study were various degrees of intervertebral disk space/disk involvement, followed closely by abscess formation. Abscess formation in the vertebrae, destruction of the intervertebral disc and destruction of the adjoining vertebral body are the typical characteristics of vertebral TB. Spinal TB generally begins with extensive

**Table 3. Frankel classification of patients with spinal TB (*N*=30)**

| Frankel classification | *n* (%) |
|---|---|
| A | 5 (17) |
| B | 1 (3) |
| C | 3 (10) |
| D | 9 (30) |
| E | 0 (0) |
| No/Insufficient data | 12 (40) |
| **Neurological grades of Frankel classification** | |
| A | Complete neurological injury: Complete motor and sensory loss below the lesion. |
| B | Incomplete: Preserved sensation only - no motor function detected below the level of the lesion; some sensory function below level of lesion preserved. |
| C | Incomplete: Preserved motor, non-functional – some voluntary motor function preserved below level of lesion, but too weak to serve any useful purpose; sensation may or may not be preserved. |
| D | Incomplete: Preserved motor, functional – functionally useful voluntary motor function below level of injury is preserved. |
| E | Normal motor function: Complete functional recovery (normal motor and sensory functions below level of lesion; abnormal reflexes may persist). |

intervertebral disc destruction, which is followed by damage to the vertebral body. This type of lesion will ultimately result in the narrowing or disappearance of the intervertebral space.[16] Therefore, the checklist used in our study can be highly beneficial for healthcare professionals, as it can help them quickly recognise common radiological features of spinal TB and consider the diagnosis in their differential assessments.

Special attention should also be directed towards record keeping. In our study, we observed that the record-keeping system for patients, specifically those with spinal TB, at Windhoek Central Hospital, in Namibia, needs improvement. The main limitations encountered involved difficulty accessing patient records, which were often poorly maintained, with illegible entries and missing information. Inconsistencies in the recorded data further complicated the data collection process. As a result, these issues made it challenging to draw accurate conclusions and apply the findings to the general population.

Abdelrahman and Abdelmageed[20] advocate for a simple and clear approach to record-keeping, emphasising that 'if it has not been documented, it has not been done'. They recommend writing legibly; including patient details, date and time; avoiding abbreviations; not altering entries or disguising additions; avoiding unnecessary comments; checking dictated letters and notes; checking reports and being familiar with local legal requirements regarding the Data Protection Act. Notably, Namibia currently lacks legislation that directly provides for data protection and has not established a data protection authority.

The clarity and accuracy of record keeping are of utmost importance for effective communication between healthcare professionals and patients. Record keeping is important for identifying specific patients, supporting the diagnosis, justifying the management options, documenting the course of the disease as well as promoting the continuity of care among healthcare providers. Ultimately, the maintenance of these records ensures that the needs of patients are met adequately.[20]

Another challenge is defining a curative endpoint for spinal TB. Unlike pulmonary TB, where repeated tissue biopsy and culture conversion are the gold standard, these methods are not practical for spinal TB due to its paucibacillary nature. Such procedures are invasive, time-consuming and yield poor results.[3] As a result, there still exists a gap in knowledge regarding the curative endpoint of spinal TB, which requires further investigation. Ensuring full eradication of the disease and preventing potential relapses would help health professionals.

**Table 4. The spinal segments associated with lesions**

| Vertebral area of lesion | *n* (%) |
|---|---|
| Cervical | 0 (0.0) |
| Thoracic | 1 (3.3) |
| Lumbar | 15 (50.0) |
| Cervical/thoracic/lumbar | 1 (3.3) |
| Thoracolumbar | 7 (23.3) |
| Lumbosacral | 1 (3.3) |
| Unknown | 5 (16.7) |

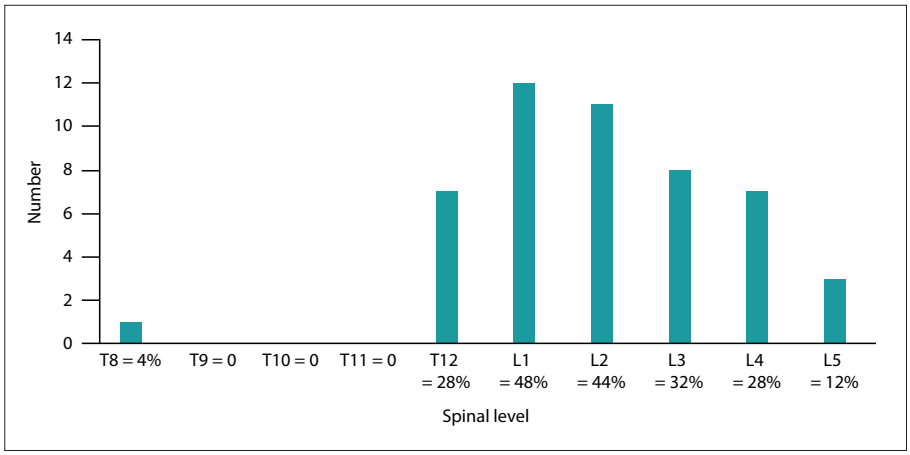


*Fig. 1. Frequency of specific vertebral level involvement.*

## Limitations

The study was only conducted at a single centre (Windhoek Central Hospital, Namibia), which limits the generalisability of the findings to patients from other parts of the country (including rural and urban areas) or even to patients from other hospitals in the same city (Windhoek). The study design, a cross-sectional study, also contributed to the limitations of the study. The timing of the snapshot is also not guaranteed to be representative of the entire Namibian population. The difficulty in achieving the required sample size of 120 may have affected the statistical power of the analysis. There were no registers with information specifically focusing on spinal TB. The obtained patient records used in this study were not all up to date, and history and physical findings were not properly documented for most of these patients. We also wanted to examine the paediatric and adult populations separately, but this was not feasible as not enough records could be obtained for each group.

## Conclusion

The most common symptoms included weight loss, fatigue, fever and night sweats, which differed from the frequently reported complaints of back pain in the literature. During clinical rotations, it was observed that back pain in itself is also often not taken up seriously and most patients are treated with non-steroidal anti-inflammatory drugs (NSAIDs) on an outpatient basis and might be referred to a physiotherapist or biokineticist for back muscle exercises and strengthening. Spinal TB is rarely considered as a differential diagnosis for initial presentations of back pain. Healthcare professionals should be on the lookout for additional clinical signs, such as Gibbus deformity, local tenderness and impaired sensation. Radiological features that should raise suspicion include intervertebral disk space/disk involvement, abscess formation, spinal cord compression/stenosis and thecal sac indentation. The lumbar and thoracolumbar regions were the most commonly affected vertebral levels in spinal TB. Improving screening techniques and educating healthcare professionals to recognise and not overlook the

**Table 5. Radiological features in patients with spinal TB (*N*=30)**

| Radiological feature | *n* (%) |
|---|---|
| Intervertebral disk space/disk involvement | 17 (57) |
| Gibbus deformity | 3 (10) |
| Abscess | 15 (50) |
| End plate irregularity | 5 (17) |
| Thecal sac indentation | 8 (27) |
| Spinal cord compression/stenosis | 12 (40) |
| Cord oedema | 3 (10) |
| Calcification | 0 (0) |
| Reduced bone density | 0 (0) |
| Wedge collapse | 1 (3) |
| Compression fracture | 0 (0) |
| Vertebral body height reduction | 3 (10) |
| Kyphosis | 2 (7) |
| Scoliosis | 0 (0) |
| Bone fragmentation | 1 (3) |
| No/insufficient data | 13 (43) |

common, generalised clinical manifestations and radiological features of spinal TB is crucial. A thorough history, exploring TB risk factors, complete physical examination and relevant medical imaging should be done where necessary. This study aims to serve as a guide for identifying specific clinical manifestations and radiological features to consider in practice, facilitating earlier detection, diagnosis and prompt treatment of spinal TB to prevent debilitating sequelae that can result from the disease.

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**Author contributions.** QW and AvdH developed the theoretical framework of the research. AvdH provided the data to be captured. RP collected and analysed the data. QW provided analysis tools and aided in the data analysis. QW and AvdH supervised the project. All authors discussed and interpreted the results. RP wrote the manuscript. All authors provided critical feedback and helped shape the research and final manuscript.

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