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PAPER

PHYSICAL ANTHROPOLOGY

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Schmorl's Nodes in an American Military Population: Frequency, Formation, and Etiology*,†

ABSTRACT: This research investigates the frequency of Schmorl's nodes in differing populations, with new data from a skeletal sample from the Central Identification Laboratory (CIL) at the Joint Prisoner of War/Missing in Action Accounting Command, while also reviewing the etiology of Schmorl's node formation. Processes implicated in Schmorl's node formation include trauma, old age, disease, intrinsic abnormalities, and biomechanical factors, and they correlate with Schmorl's node formation to varying degrees. A survey of research from the anthropology and medical literature revealed Schmorl's node population frequencies ranging from 8 to 80%. The current study consists of two samples, one derived from CIL case reports and one analyzing skeletal remains. The case report sample yielded a Schmorl's node frequency of 19.8%. The examined sample yielded a frequency of 73.7%. The disparate frequencies reported are likely due mainly to differences in completeness and observability. It is likely that trauma was a major factor in the formation of Schmorl's nodes in the CIL study.

KEYWORDS: forensic science, forensic anthropology, Schmorl's node, paleopathology, trauma, lesion, Central Identification Laboratory

Schmorl's nodes are encountered frequently in skeletal remains from both archaeological and forensic contexts. Despite a multitude of research on the subject, Schmorl's nodes are not entirely understood. Although how they form is known, why they form is a more contentious issue, with various processes proposed. This research investigates the frequency of Schmorl's nodes in differing populations, with new data from a skeletal sample from the Central Identification Laboratory (CIL) at the Joint Prisoner of War/Missing in Action Accounting Command (JPAC) in Hawai'i. Schmorl's node formation and views on their etiology are discussed.

Schmorl's Nodes: Background

Schmorl's nodes result from herniation of the *nucleus pulposus* of the intervertebral disk through the cartilaginous endplate and into the cancellous bone of the vertebral centrum (Fig. 1). This disk tissue leaves an excavated lesion in the body of the vertebra. Some researchers (1–3) term these lesions Schmorl's depressions, as they consider the herniated disk tissue itself to be the node. In common usage, however, the term "Schmorl's node" has come to signify the effect of the herniation, the depression left in the vertebral body (4). Schmorl's nodes also have been termed cartilaginous nodes or herniated disks, most often in the medical literature. The latter terminology, however, is not always strictly correct: a Schmorl's node is clearly the result of a herniated disk, but a herniated disk does not necessarily result in a Schmorl's node. The term "herniation" is used to describe disk material projecting out in any direction, not only superiorly or inferiorly into a vertebral body. As noted previously by Batts (5) and Jensen et al. (6), this has led to ambiguity in reported population frequencies of Schmorl's nodes.

Multiple processes have been put forth as the causative factor of Schmorl's node formation. These processes include trauma, old age, disease, or intrinsic factors. As will be seen below, Schmorl's node formation does not correlate well with at least one of the proposed processes. Other processes show high correlations with Schmorl's node formation; however, not every population expressing these same processes has a similarly high frequency of these lesions. At a minimum, it is generally agreed that Schmorl's nodes are produced by any process that weakens either the cartilaginous endplate or the vertebral body itself, which in turn facilitates the herniation of the *nucleus pulposus* (7,8).

Schmorl's nodes have been reported commonly in older individuals. It has been thought that the lesions may be a normal result of the aging process, often in association with or as a result of degenerative disk disease (7,9–12). Some studies have proposed that Schmorl's nodes predispose individuals to degenerative disk disease and cause its earlier onset (13,14). Conversely, additional studies have concluded that Schmorl's nodes do not play a significant role in the development of degenerative spinal disease (15,16).

Several studies have shown that there is no positive correlation between age and the frequency of Schmorl's nodes. Research by Hilton et al. (13) found that frequencies of Schmorl's nodes were similar between a group of individuals who were <50 years of age

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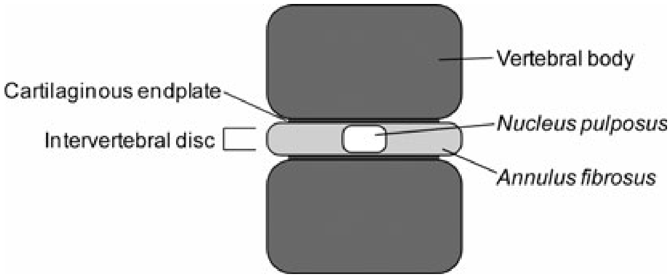

FIG. 1—*Illustration of vertebral segment.*

and a group of individuals who were >50 years of age. Similarly, Pfirrmann and Resnick (15) found that the frequency of Schmorl's nodes was similar between older (their study) and younger (Hamanishi et al.'s [17] study) populations. Pfirrmann and Resnick (15) looked at 100 vertebral columns using slab radiographs and found that 58% of individuals (mean age 68.2 years) had Schmorl's nodes. Conversely, Hamanishi et al.'s (17) study found a Schmorl's node frequency of 5% in the sixth decade of life as opposed to 57% in the second decade of life. Although these two studies show that frequencies of this lesion are similar in young and old populations, the reported frequencies of the lesions in the two older populations are significantly different. A study by Weiss (18) found no correlation with age. Additionally, Saluja et al. (19) found no significant relationship between age and the number of vertebrae exhibiting Schmorl's nodes.

Intrinsic abnormalities, or weak areas, either in the cartilaginous endplate or the subchondral bone of the vertebral body can lead to the formation of Schmorl's nodes. These weakened vertebrae are considered incapable of withstanding pressure caused by the *nucleus pulposus* (5). It has been speculated that weak areas may be left by the regression of the notochord or by the degeneration of vertebral blood vessels in the cartilaginous endplate. Saluja et al. (19) found that the majority of Schmorl's nodes in their study formed near the center and posterior center of the vertebral body, which corresponds to the location held by the notochord and by residual vascular channels. Weak areas also may be caused by several types of disease processes, particularly Scheuermann's disease, as well as Paget's disease, osteomalacia, hyperparathyroidism, neoplasm, and infection (7,8,20). Weak areas in the vertebrae and cartilaginous endplates may cause certain individuals to be susceptible to the formation of Schmorl's nodes through additional means, such as trauma.

Research by Üstündağ (16) suggests that Schmorl's node formation may be influenced by intrinsic biomechanical factors in association with trauma. The research purports that Schmorl's nodes are seen more often in areas of the vertebral column where the intervertebral disks are thin, where flexion and extension of the spine are limited, and where torsional forces are common (i.e., the thoracic region). The study concludes that Schmorl's nodes may result when thin intervertebral disks are not able to withstand trauma from torsional forces.

Trauma is generally considered one unambiguous cause of Schmorl's node formation (5,15,18,20). Resnick et al. (21) indicate that Schmorl's nodes may appear in acute injuries in which excessive axial loading of the spine occurs, as axial loading increases nuclear pressure. Wagner et al. (22) found that acute Schmorl's nodes form as a result of axial loading injuries (car accidents and ski jumping accidents) and noted that the lesions can appear months after the initial injury. Fahey et al. (23) examined the spines of 70 patients who had died in motor vehicle accidents and found nine acute Schmorl's nodes in seven individuals.

In addition to acute trauma, Schmorl's nodes may form from repetitive stresses. These lesions are associated with flexion of the vertebral column (especially from continual lifting of heavy objects), as well as generalized physical stress (24). Multiple studies have shown that adolescent and young adult athletes with high demands on their backs (such as gymnasts, wrestlers, tennis players, etc.) have a high incidence of Schmorl's nodes (25–28). A study by Weiss (18) demonstrated that a population with continued excessive demands on their backs had significantly more Schmorl's nodes than a population that did not participate in similar arduous activities (61% compared with 18.5%). Weiss does caution, however, that the lesions may be either from repetitive actions or from acute injuries.

Materials and Methods

The current study considers skeletal remains from the JPAC-CIL. The sample is comprised of U.S. servicemembers (the majority of whom are young, White males) who served during World War II, the Korean War, and the Vietnam War, with additional servicemembers from the American Civil War and World War I. The remains derive from JPAC recoveries of battlefield losses and aircraft crashes, cemetery exhumations, and repatriations from foreign and domestic citizens and governments.

The study examined two samples: a broader investigation of instances of this pathological condition described in CIL case reports and a more specific analysis that examined intact skeletal remains. The examination of skeletal remains allowed direct observation of complete or nearly complete vertebral columns. Owing to the nature of the remains received at the CIL (mostly individuals who have died decades ago and often have been interred in acidic soils), few sets of skeletal remains are complete. The analysis of case reports allowed for a larger sample size, but no direct observation was possible.

In both samples, the extant spinal column, from the inferior surface of cervical (C) vertebra 2 to the superior surface of sacral (S) vertebra 1, was examined. The first cervical vertebra, the superior surface of C2, and the sacral vertebrae inferior to the superior surface of S1 were not considered. C1 and the superior surface of C2 were not examined because of their morphology, while the sacrum inferior to the superior surface of S1 was not examined as the sacra were generally in an articulated state and the surfaces of these vertebrae could not be viewed.

Examined Sample

A total of 38 individual sets of skeletal remains with complete or nearly complete vertebral columns were directly analyzed for the presence of Schmorl's nodes. Vertebrae were assessed for observability and the presence of Schmorl's nodes. An observable vertebra had the superior, inferior, or both surfaces present for analysis. Likewise, a vertebra was considered to have a Schmorl's node present if the superior, inferior, or both surfaces contained a lesion. No severity scale was used to assess the lesions; sizes ranging from barely discernable to large were considered equally. In each case, it was noted which vertebrae were present, which vertebrae possessed Schmorl's nodes, and which surface or surfaces the lesions occupied. Frequencies were then calculated.

The time period of military service (i.e., Vietnam War, World War II, etc.) is known for all 38 individuals: 18 of the individuals died during the Korean War, 14 died during World War II, three died during World War I, two died during the American Civil War, and one died during the Vietnam War.

Case Report Sample

A total of 534 case reports were examined initially. This included 468 single individual reports and 66 commingled group remains reports. Unless duplicated vertebral elements were present or vertebrae could be segregated by size, each group remains case was counted minimally as one individual. The original sample size of 534 case reports was reduced to 172 cases that had at least one vertebra present. The total number of observable vertebrae for each individual, however, was unknown. Consequently, this sample provides a minimum estimate for the number of individuals presenting with Schmorl's nodes.

Where possible, the presence of Schmorl's nodes, which vertebrae they were present on, and which surface (superior or inferior) they were on were noted. Not all of this information could be determined in each case, however, because of inter-observer variations in reporting, and thus, percentages could not be determined.

Results

Examined Sample

A total of 28 of the 38 individuals with complete or nearly complete spinal columns (73.7%) exhibited at least one vertebra containing a Schmorl's node. The lesions ranged from barely discernable indents to large, deep depressions. They also came in several shapes, including narrow channels (both horizontal and vertical), crescents, circles, and amoeboid shapes. Figure 2 depicts several typical Schmorl's nodes observed in the CIL collection. The majority of individuals (89.3%) were affected with more than one node. These lesions were often found on multiple consecutive vertebral surfaces. The longest string of Schmorl's nodes consisted of 20 surfaces of 11 vertebrae (from the lower surface of the fifth thoracic [T] vertebra to the upper surface of the third lumbar [L] vertebra).

Of 740 observable individual vertebrae, 141 or 19.1% had lesions on either or both vertebral surfaces. A total of 202 distinct Schmorl's nodes were documented. The frequency of lesions seen on inferior vertebral surfaces was higher than that seen on superior vertebral surfaces (16.7% compared with 12.8%).

Schmorl's nodes were documented in the vertebral column from C6 to S1 (Figs 3 and 4). Superior to the level of T5, Schmorl's

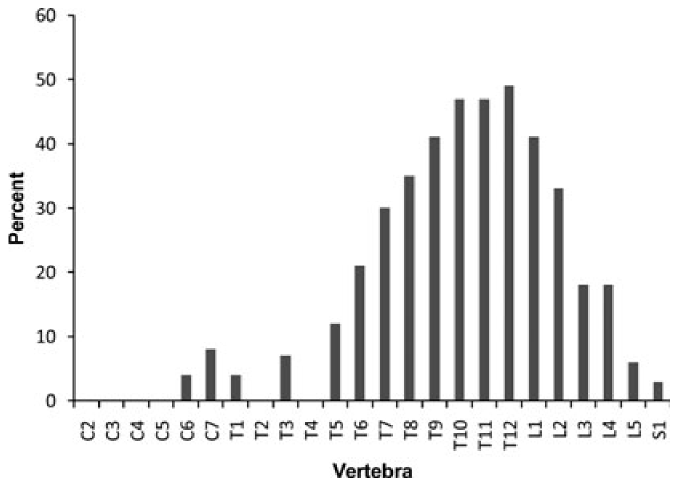

FIG. 3—*Frequency of Schmorl's nodes by vertebral element in the Central Identification Laboratory examined sample.*

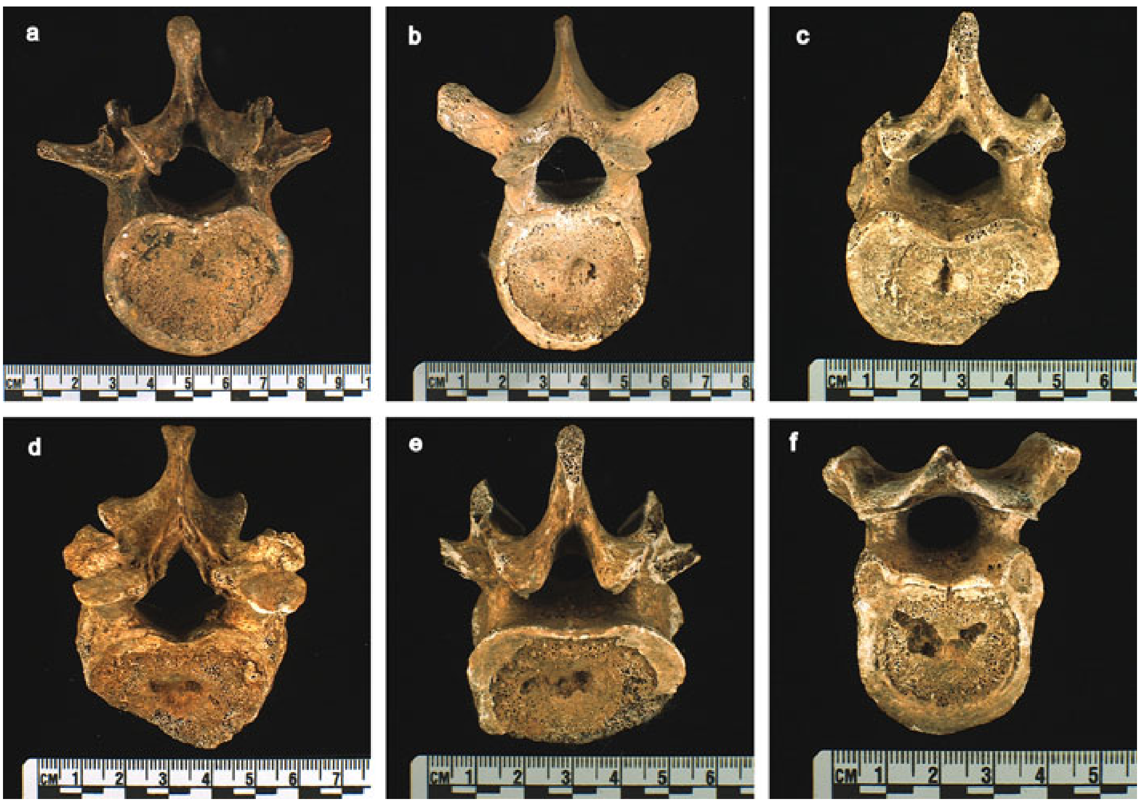

FIG. 2—*Typical forms and sizes of Schmorl's nodes observed in the Central Identification Laboratory examined sample: (a) inferior surface of L1; (b) superior surface of T9; (c) inferior surface of T12; (d) superior surface of T12; (e) inferior surface of L2; and (f) inferior surface of T9.*

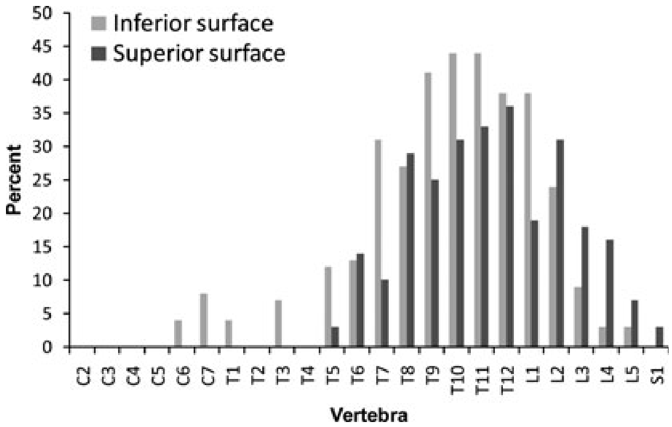

FIG. 4—*Frequency of Schmorl's nodes by vertebral surface in the Central Identification Laboratory examined sample.*

nodes were rare. Lesions were not found on either T2 or T4. These lesions were also rare in L5 and S1. A small number of Schmorl's nodes on cervical vertebrae were detected, which has been noted only infrequently by other researchers (4). The most frequently affected vertebra was T12, followed closely by T10 and T11.

In cases where the skeletal remains were positively identified by the CIL, it was possible to obtain biographical data and military personnel information. Of the 28 individuals with Schmorl's nodes, 16 have been identified and have this information available. All individuals are younger adult males. Fifteen of the men are White and one is Native American. Their mean age at death is 23 years, with a range of 18–28 years. It is noted that ages were not rounded to the nearest year but denote the latest full calendar year achieved. Their mean stature is 70.3 inches, with a range of 68.0–72.5 inches. Eight of the men died during World War II, seven died during the Korean War, and one died during World War I. Nine men were infantry, and seven were aircrew personnel.

Case Report Sample

Thirty-four of the 172 sets of remains with partial or complete spinal columns (19.8%) were reported to have at least one vertebra affected by a Schmorl's node. Four of these sets of remains are group remains cases. A minimum of 147 vertebrae with Schmorl's nodes were documented. The majority of individuals (31 or 91%) had multiple Schmorl's nodes. The highest incidence of Schmorl's nodes occurred on T10 and T11. It should be noted that not every case report listed which vertebrae or spinal region upon which the lesions were found. For instance, 31 Schmorl's nodes were identified as occurring in the thoracic region only, and 18 Schmorl's nodes were identified as in the lumbar region only.

Of the 34 individuals in the case report sample with Schmorl's nodes, 27 of them have been positively identified by the CIL and have biographical data and military personnel information available. Biographical data were not available for three individuals or the four group remains cases. All 27 identified individuals are White males and have a mean age at death of 25 years. The youngest individual in this sample to display a Schmorl's node was 18 years of age at the time of death. The oldest individual with this lesion was 41 years old, with the two next oldest individuals aged 31 years. The men's mean stature is 69.9 inches, with a range of 65.0–74.0 inches. Seventeen of the men died during World War II, seven died during the Korean War, two died during the Vietnam War, and one died during World War I. Sixteen men were aircrew personnel, ten men were infantry, and one man was ship crew.

Discussion

Schmorl's Node Frequency Differences

Research into the frequency of Schmorl's nodes in a military sample from the JPAC-CIL revealed that 19.8% (minimally) of skeletal remains documented in CIL case reports and 73.7% of individual sets of skeletal remains examined by the author were affected with Schmorl's nodes. The disparate frequencies reported for the CIL samples appear to be largely the result of differences in completeness and observability of the vertebrae. In the examined sample, only cases with complete or nearly complete vertebral columns and vertebrae in good/observable condition were selected for analysis. The vertebral columns of the military individuals represented in the case report sample were not often complete, with many cases containing only a few vertebrae. Of the 172 case reports examined, 17 of them had only a single vertebra present for analysis. Additionally, much of the skeletal material received at the CIL is damaged, eroded, and incomplete; it is unknown how many case reports contained vertebrae that were not observable because of poor preservation. It is likely also that recording of Schmorl's nodes varied among the case reports. These conditions assuredly have depressed the frequency of Schmorl's nodes observed in the case report sample.

Comparatively, Schmorl's nodes have been reported to affect anywhere between 8 and 80% of a given population (Table 1). This wide span of frequencies may be due to the different causes of Schmorl's nodes, the condition and observability of the vertebrae, the section of the vertebral column examined, and/or the method of detecting the lesions. Certain population groups also may be more affected by trauma, disease, or intrinsic factors than other groups.

Most researchers did not examine the entire vertebral column from C1 (or C2) to S1. Some studies (5,6,29,31) even have focused solely on the lumbar region of the spine. This is noteworthy, as Schmorl's nodes have been shown to be most prevalent in the lower thoracic region (7,13,14,16, this study). Additionally, as shown in the present study, Schmorl's nodes can be seen in the cervical vertebrae, as least as superior as C6. Limiting observation to a select region obviously leads to a lowered frequency of Schmorl's nodes.

The method used to detect the lesions also varied among the studies. It has been reported that diagnosing Schmorl's nodes using standard radiographs is difficult and that more lesions are detected using slab radiographs, magnetic resonance imaging (MRI), and direct examination of the bone itself (13–15,17,32,33). It is likely also that there are differences in observability of Schmorl's nodes among slab radiographs, MRI, and examination of skeletal remains. This may explain some of the differences seen in Schmorl's node frequency.

Several studies reported frequencies of Schmorl's nodes that seem unexpected when compared to the other reported population frequencies. For example, a study on an African American plantation slave population from South Carolina (31) (presumably a population involved in strenuous physical labor) lists a frequency that is considerably lower than many reported populations, including some modern populations that were not reported to have participated in strenuous labor (refer to Table 1). However, the author of the study suggests that the population could be comprised mainly of household slaves, rather than slaves from the general plantation population. Additionally, bone preservation is listed as varying from poor to very good and a Schmorl's node is defined as a lesion of the lumbar vertebrae. These factors may explain why the Schmorl's node frequency is lower than might have been expected when compared to other populations.

TABLE 1—*Reported population frequencies of Schmorl's nodes.*

Population (Reference)	Frequency	Age	Spinal Region	Method of Observation
Modern Israeli military parachuting instructors (29)	8.1% (6/74)	22–54, mean = 33	L1–L5	Radiographs
Patients with lumbar symptoms, Japan, modern (17)	9% (10/106)			MRI
Romano-British population (30)	9% of females; 12% of males		T4–L5	Direct examination
Motor vehicle accident victims, Australia, modern (23)	10% (7/70)	6–91	T1–L5	Direct examination and radiographs
Patients with chronic back pain, U.S., modern (4)	11.3% (33/291)	23–62, mean = 42.7	C1–S1	MRI
Urban slave cemetery (Black, White, and mixed Black and White individuals), U.S., *c*. 1720–1810 (3)	15.4% (4/26)	*c*. 15–59		Direct examination
British Columbian Amerinds, hard but not ''back-breaking'' labor, 3500–1500 BP (18)	18.5% (10/54)	18–69	T1–L5	Direct examination
Asymptomatic patients, Japan, modern (17)	19% (76/400)			MRI
Asymptomatic patients, U.S., modern (6)	19% (19/98)	20–80, mean = 42.3	L1–S1	MRI
Cadavers, U.S., early 20th century (5)	20% (10/50)		L1–L5	Direct examination
Modern British female twins (14)	30%	Mean = 53	T9–L5	MRI
16th–18th century church and village cemetery, Austria (16)	31.4% (97/309)	*c*. 20–46+	T1–S1	Direct examination
Cadavers, Germany, modern (8)	38%			Direct examination
Symptomatic patients, Germany, modern (32)	38% (142/372)		T1–L5	MRI
African American plantation slave cemetery, U.S., *c*. 1840–1870 (31)	39% (11/28)	*c*. 21–65	L1–L5	Radiographs/direct examination
War of 1812 soldiers, U.S. (34)	48% (13/27)			Direct examination
Socially stratified urban society, buried with grave goods, Italy, 5th–3rd century BC (36)	48.5%	*c*. 20–60+		Direct examination
St. Bride's Church crypt, London, 18th–19th century (19)	49% (26/53)	21–71	T8–S1	Direct examination
Routine autopsy cadavers, U.S., modern (15)	58% (58/100)	43–93, mean = 68.2	T1–L5	Slab radiographs
English POWs; farming, military, and prisoner labor; 200 BP (18)	61% (14/23)	18–69	T1–L5	Direct examination
Carmelite Friary cemetery, Aberdeen, 13th–16th century (19)	71% (17/24)	19–>45	T8–S1	Direct examination
Cadavers, U.K., modern (13)	76% (38/50)	13–96, mean = 50	T9–S1	Slab radiographs
Socially stratified urban society, no grave goods, Italy, 5th–3rd century BC (36)	76.9%	*c*. 20–60+		Direct examination
Cadavers, Finland, modern (33)	79% (19/24)		T10–L1	Radiograph, discograph, and direct examination
Battlefield victims, England, AD 1461 (35)	80% (24/30)	16–46+, mean = 30	T5–S1	Direct examination

BP, before present; MRI, magnetic resonance imaging; POWs, prisoners of war.

A study of a slave population from New Orleans (3) exhibited a very low frequency of Schmorl's nodes. This group was comprised of urban slaves, which are thought not to have participated in as strenuous of physical labor as other slave populations. The study also reports that the number of observable vertebrae was quite low—less than one-third of all thoracic vertebrae and less than one-half of all lumbar vertebrae were available for analysis.

Of five studies involving military populations (18,29,34,35, this study), four of them exhibit relatively high frequencies of Schmorl's nodes, as expected. The fifth population, comprised of modern Israeli military parachuting instructors (29), exhibits a very low frequency of Schmorl's nodes—indeed the lowest frequency of all populations presented in Table 1. This unexpected result likely is due, at least in part, to the observation of a limited region of the vertebral column, as well as the use of radiographs to detect the lesions.

Several studies listed in Table 1 also reported Schmorl's node frequencies that were expected. Two studies (18,36) that compared two populations each with documented differences in activity demonstrated significant differences in frequencies of Schmorl's nodes. Most of the modern, live patient group studies (4,6,14,17,32) exhibited low frequencies of Schmorl's nodes. The highest frequency reported for this type of group is 38%. The relatively low frequencies reported for these populations seem sensible, as the groups are comprised of individuals taken from the general (modern) population.

Schmorl's Node Location

The present study indicated that the highest concentration of Schmorl's nodes occurred on vertebra T12 (followed closely by T10 and T11) in the examined sample and on T10 and T11 in the case report sample. It is noted, however, that in the case report sample, T10 and T11 had the highest count of Schmorl's nodes and not the highest frequency, since the total number of observable vertebrae could not be determined. This finding is consistent with most studies on Schmorl's nodes, which have shown that the lesions are mainly concentrated in the lower thoracic and to a lesser degree, the upper lumbar region, of the spine. This distribution pattern may be related to biomechanical factors of the vertebral column (13). The lower thoracic region has limited mobility, thin intervertebral disks, and elevated potential for damage because of torsional stresses, which may render this area prone to Schmorl's nodes (13).

Several studies have reported that Schmorl's nodes are found more commonly on the inferior surfaces of vertebrae rather than on the superior surfaces (7,13–15). This also was noted in the present study of examined skeletal remains. Both CIL samples showed that nearly all individuals had Schmorl's nodes present on multiple surfaces/vertebrae. Other research has also shown that individuals commonly have multiple vertebrae affected by Schmorl's nodes (13,15); however, this information was not available in many studies.

Racial Distribution

The high number of White individuals with Schmorl's nodes in the present study (all 27 identified individuals from the case report sample and 15 of 16 identified individuals from the examined sample) can be attributed to sample size. The number of White individuals in the U.S. military during the time periods under study far exceeded the number of non-White individuals.

Military Activity

Trauma due to common military activities may be a major factor in the formation and high frequency of Schmorl's nodes observed in the CIL samples. Some possible stress-inducing military activities include continual lifting of heavy objects (such as weapons and machinery), carrying heavy packs on the back, hiking, digging trenches, and parachuting. The trauma may occur as both rapid-loading events on the axial skeleton and repeated stress injuries because of hard physical labor over time.

Several other studies involving military populations have reported relatively high frequencies of Schmorl's nodes. Coughlan and Holst (35) concluded that the high percentage of Schmorl's nodes in individuals from the Battle of Towton, AD 1461, was likely a result of increased physical stress and axial loading from military activities. Bar-Dayan et al. (29) demonstrated that Israeli military parachutists displayed a small percentage of Schmorl's nodes in the lumbar region. It is likely that if the thoracic region had been examined also, the percentage of individuals with Schmorl's nodes would have increased appreciably. It is logical to assume then that the stress placed on the spine during parachuting might explain the presence of some of these lesions in U.S. military aircrew personnel. Other researchers (18,37,38) have shown that populations experiencing demanding physical stress, such as lifting and carrying heavy loads and activities involving continuous movement and flexion of the spine (to include sustaining acute trauma), have higher frequencies of Schmorl's nodes.

No meaningful assessments of frequencies of this lesion by military duty (for instance aircrew vs. infantry) or time period (i.e., Vietnam War-era vs. World War II-era) can be made due to the small sample sizes of these groups and the mixed results of the case report sample compared with the examined sample. From the results, it appears that individuals from the Korean War and World War II exhibit higher frequencies of Schmorl's nodes than individuals from the Vietnam War, World War I, and the American Civil War. However, this can be explained by the small sample sizes of the last three groups. In the examined sample, only one individual from the Vietnam War, two from the American Civil War, and three from World War I were examined. Individuals from the Vietnam War, the American Civil War, and World War I were also underrepresented in the case report sample. It is certainly possible that the time period and the specific military duties of an individual do have an effect on the formation of Schmorl's nodes, as diverse physical stresses likely are acting on each group.

Conclusions

The present study has shown that Schmorl's nodes are quite prevalent in the CIL military sample when the skeletal remains had observable and complete or nearly complete spinal columns. In contrast, incomplete and poorly preserved vertebrae drastically reduce the number of Schmorl's nodes reported. It is likely that trauma induced by military activities, including both prolonged heavy strain and axial loading of the vertebral column, is a major factor in the formation of Schmorl's nodes in this population.

Schmorl's node population frequencies vary widely. A variety of factors appears to influence the reported frequency of these lesions in a given population. These can include observer differences, such as method of observing the lesions, the spinal region examined, the completeness and condition of the vertebrae, and the different processes involved in Schmorl's node formation. The various processes show differing levels of correlation with Schmorl's node formation. Age was shown to correlate poorly with lesion formation, with studies revealing high frequencies in both young and old populations. Both repetitive stress and acute trauma have been named by multiple studies as causes of Schmorl's node formation. Intrinsic weak areas and biomechanical factors also appear to be causes of Schmorl's node formation.

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