

KYPHOSIS JUVENILIS SCHEUERMANN

—AN OCCUPATIONAL DISORDER

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Since Scheuermann's original reports on kyphosis juvenilis appeared in 1920 and during the years that followed from the Cripples Hospital and Home in Copenhagen, the disorder has been discussed to some extent in Danish medical literature, whilst communications on the subject from abroad have been rather scanty. Remarkable contributions have, however, been afforded by Schmorl and his pupils, and by Brocher (1946); and, of course, mention is made of the disorder in the current text-books on radiology.

According to Scheuermann's view, kyphosis juvenilis is a disease *sui generis* which occurs in young, not full-grown individuals, in particular after heavy weight-bearing, appearing in the form of a kyphosis which soon becomes fixed, most frequently in the lower thoracic column. Roentgen examination reveals irregularities around the marginal crest of one or a few vertebrae, wedge-shaped vertebral bodies and irregular waving of their articular surfaces. According to Scheuermann's original theory these findings represent sequelae of an aseptic osteochondritis in the marginal crest and the cartilaginous layer between the latter and the diaphysis of the vertebra, similar to Legg-Calvé-Perthes' disease of the hip.

The affection is of quite common occurrence, but no numerical statement of its frequency in this country has been given. It appears from Hinricsson's reports on examinations of army recruits that its incidence was 8.2 % among nearly 4,500 men of conscription age in Sweden. Unfortunately, Hinricsson's work has been published only in the form of a very abridged report and consequently evades a more detailed evaluation.

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With regard to the sex-incidence, it appears from Hølund's work from the Orthopedic Hospital in Aarhus (Jutland) that among 220 Scheuermann-patients 72 % were males and 28 % were females, and a summary statement of the years 1945 and 1946 from the Orthopedic Hospital in Copenhagen showed exactly twice as many males as females. To this must be added that the disorder is generally far less pronounced in females than in males. Thus it is chiefly a disease affecting the male sex.

The etiology must be said to be still unknown. A selective or general impairment of the osseous system on the basis of hormonal disturbances, insufficiency of diet or vascular disturbances have been suggested but there are no convincing arguments in support of any of these views. In the Swedish material referred to above, and in the material to be dealt with here, the attention was directed in particular to the possible simultaneous occurrence of rachitic symptoms, but no such coincidence could be demonstrated.

The pathogenetic problems have been dealt with in particular by roentgenologists and pathologists, but naturally the latter have almost exclusively had to examine old inveterate cases. Schmorl and his pupils believe that they are able to demonstrate that the underlying cause of all cases of kyphosis juvenilis is a nucleus prolapse. This was contradicted by Scheuermann who maintained that prolapse is not observed in about 40 per cent., but is, on the other hand, very frequently seen without simultaneous kyphosis juvenilis; moreover he pointed out that prolapses do not afford any explanation of the marked roentgenologic changes around the marginal crest. Wissing rather concurs with Schmorl's view, maintaining on the basis of a very large roentgen material that affection of the disc can be demonstrated in nearly 100 % of the cases, and from a series of roentgenologic and clinical studies Overgård draws the conclusion that the transition between cases of pure nucleus prolaps and kyphosis juvenilis Scheuermann is quite fluid. The same view is expressed in Wagner's reference to aseptic necroses of the bones in which he said: "... nucleus prolapse is sometimes the only manifestation of Scheuermann's disease".

In Brocher's excellent monograph on Scheuermann's disease, which was published soon after the examinations dealt with here had been concluded, the pathogenesis is described in rather full detail. It is pointed out that Scheuermann has already shown that the disorder only occurs in man and that it is undoubtedly correct to associate this fact with the erect posture. Further, that owing to the static conditions any weight-bearing in the erect posture—and in particular when the individual is stooping—will cause a compression of the anterior

parts of the vertebral bodies when there is a sufficiently pronounced disproportion between the load and the strength of the corpus, and that this tendency will be particularly great just in the case of those vertebrae which, as experience shows, are most frequently affected in Scheuermann's disease. As a predisposing factor Brocher stresses that the tissue involved is always *growing* tissue—as is known, the disease always develops before the ossification of the spine is completed. In this connexion Mau's interesting experiments are pointed out, from which it distinctly appears that it is possible to produce wedge-shaped caudal vertebrae in young rats when the tail is fixed in a highly curved position during the growth of the subject.

Among other predisposing factors the author states that with respect to its inner structure the individual vertebral body is far weaker in its ventral than in its dorsal parts, that the epiphyseal structures of the vertebrae are of disproportionately small dimensions and that there are weak points in the end-plates where the chorda dorsalis has been localized, where the nutrient vessels pass through, and also in the small but rather widespread areas of degeneration demonstrated by Brocher and others which, like the vascular passages, are to be found chiefly in the ventral parts. Lastly, the author briefly mentions defective carriage and constitutional, hereditary and endocrine factors as possible pathogenetic elements.

Some of these pathogenetic problems have been taken up on a purely clinical basis in the present series of examinations. The main object has been to examine the importance of the trauma caused by work. Most of the investigators who have dealt with the disease—first of all Scheuermann himself—have realized that it plays a decisive role, but no actual statistical statement exists with special reference to the conditions of work of the patients *at the onset of the disease*. Moreover it was the purpose of the examination to find out the importance of the hereditary factors and secondly—to a lesser degree—the possible connexion with defective carriage and rachitis.

I have attempted to get an idea of the frequency of the disease by going over the examination reports on Danish army recruits during the 18 years from 1922 to 1939, when the percentage of rejection was fairly constant around 35. Scheuermann's disease comes under the rejection terms C., s., e. which comprise disorders of the back, the thorax and the pelvis. This group is not itemized in the reports on examinations of army recruits, but according to my experience of these examinations it would not be very wrong to estimate about half the number of the disorders in this group to be cases of Scheuermann's disease, perhaps slightly more in the rural districts and slightly less

in Copenhagen. With its hospitals and other institutions for diseased persons, and its various special colleges, the capital has absorbed from the rest of the country a number of young persons with diseases of the back of another nature.

The statement includes about 581,000 men at conscription age, i.e. about 20 years. I just want to stress a few details of interest in connexion with these large figures. It appears that at the yearly examinations of army recruits they deal with an average number of well over 32,000 men all over the country; on an average, 1520 or 4.7 %, are rejected, and 1402, or 4.3 %, are put in the category "qualified fitness" because of affections of the back, the thorax or the pelvis. Thus a total of nearly 3000 men (i.e. 9.0 %) are classified under the heading of one of these affections every year. If, as mentioned above, we consider about half the number of these cases to be represented by Scheuermann's disease, this means that between 4 % and 5 % of all adult Danish men suffer more or less from this disease. This must even be considered a minimum figure, as the mildest cases of Scheuermann's disease generally pass the recruit examination without any comments.

With regard to the distribution between rural and urban districts, an approximate idea can be conveyed by a detailed statement concerning the recruit examinations mentioned above, with reference to the distribution of the said affections of the back, the thorax and the pelvis in the various conscription circuits. The seven conscription circuits have been plotted on the map of Denmark reproduced here, and the figures in parenthesis state rejections per thousand for these disorders. It will appear that in the first circuit, which comprises Copenhagen and North Zealand, this figure amounts to one-fourth of the figures in the purer rural districts, such as Zealand outside Copenhagen and Jutland.

The difference between country and town becomes still more conspicuous when we proceed to a direct clinical examination in, respectively, a rural and an urban circuit. In this manner I examined 1,500 men at the examination of army recruits in Copenhagen, and 750 men in the second circuit (Central and South Zealand) at the summer examination in 1946. All these young men at conscription age were examined with a special view to Scheuermann's disease, and I managed to get X-rays of all suspected cases. In this manner 24 cases—or 3.2 %—were ascertained beyond doubt in the rural district, this being a minimum figure because there is a number of persons from provincial towns in the material, and because only absolutely safe cases with unquestionable roentgenologic findings have been included. In

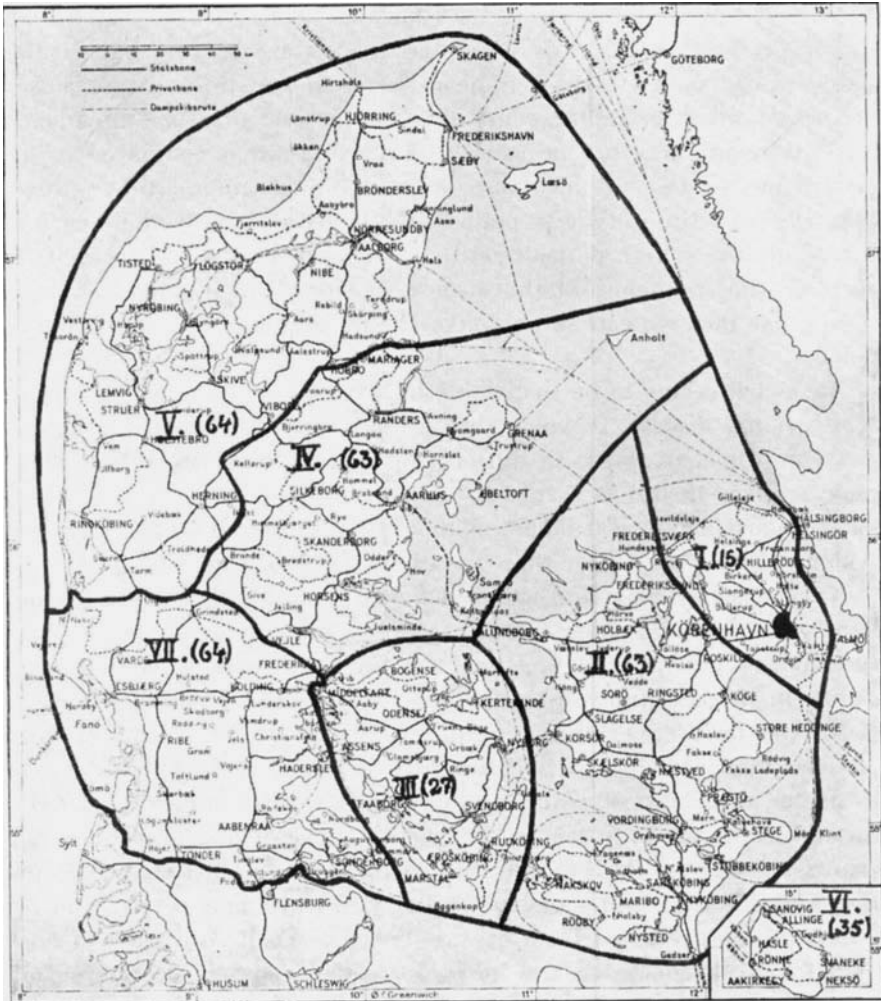


Fig. 1.

Rejections per thousand for disorders of the back, the thorax or the pelvis.

Average values for the years 1922 to 1939.

- | | |
|---------------------------------------|---------------------------|
| I: 15 (Copenhagen and North Zealand). | IV: 63 (Central Jutland). |
| II: 63 (rest of Zealand). | V: 64 (North Jutland). |
| III: 27 (Funen). | VI: 35 (Bornholm). |
| | VII: 64 (South Jutland). |

Copenhagen the corresponding figure was 6 cases or 0.4 %, i.e. 8 times as many in the country as in the town.

The apparent discrepancy between the ratio found in this manner and the one demonstrated on the map, where it is 1:4, can be readily explained by the fact that, as already mentioned, the first circuit is

no purely urban circuit but in addition to Copenhagen comprises North Zealand. When this correction is made, we find exactly the same result as was found in the practical examinations, namely *eight Scheuermann cases in the country for every one case in Copenhagen*.

This result may not be exactly surprising when compared to our experience so far—it may thus be mentioned among other things that 66 % of Hølund's 158 male patients were employed in agriculture—but the material dealt with is so large and the disproportion between the frequency of the disease in rural and in urban districts is so great that we can safely leave chance findings out of consideration.

In fact it seems to be justifiable to term *Scheuermann's disease an occupational disease*, if we establish a causal connexion with the special conditions of work in agriculture where the boys, often before their tenth year and as a rule at the age of about 14 or 15 years, have to take part in physical labour which is far harder than their osseous system, and in particular their vertebral column, can cope with.

Of course we also find cases of Scheuermann's disease in occupations other than farming—as there are others involving hard physical labour—but, as will appear from the statement, it is the young people in the country who contribute the great majority of the cases.

In the detailed examination of my series of Scheuermann cases the case histories showed that the great majority of patients had been subjected to a kind of trauma caused by work. 18 out of 24 patients the nature of whose work I managed to find out *at the onset of the disorder* were employed in agriculture, 5 in rather hard physical work of another nature (messengers, a dairy worker and a machine apprentice), only one performing no physical work. In this last-mentioned case the disorder may have been of hereditary determination, as his mother's spine presented quite analogous roentgenologic changes and a maternal uncle had "exactly the same sort of back" (which, unfortunately, could not be verified, as he was abroad).

My material displays a very considerable accumulation of cases of familial occurrence, but in the majority of these cases it *may* be a so-called "pseudoheredity", determined solely by the common surroundings of work. The same can presumably be said about Hinricsson's material, in which it is stated that heredity could be demonstrated in nearly 40 % of the cases. The familial occurrence can, of course, only be attributed to a possible hereditary predisposition when there is no history of adequate traumata. In two or three cases (including the one mentioned above) I believe, however, that I have seen examples of genuine heredity; unquestionable cases of Scheuermann's

disease were demonstrated, for instance, in a mother and her son, or in a father and his son, whilst no adequate traumata due to work could be demonstrated in any of them.

Among the pathogenetic factors it is moreover worth considering the importance of a hyperlordosis of the lumbar column, because the resulting compensatory kyphosis of the thoracic column will give rise to a loading of the thoracic vertebrae in extreme positions, which may well be imagined to be a contributory cause of the deformity. I have asked all my Scheuermann patients whether they were sway-backed in their childhood, but just a few answered in the affirmative. One of them, however, was able to inform me that he suffered from orthostatic albuminuria. However, this low percentage of positive answers cannot be considered a refutation, for in a series of this nature patients are non-introspective to a rare degree, and a few of them had not even realized that they were round-backed.

The old-fashioned Danish type of N.C.O. with his straight back may perhaps be considered as supporting the assumption of the prophylactic importance of good carriage. These men came from the "Army Apprentice School", now abolished, to which they were admitted in their fourteenth year, and the work they performed in the course of their training has hardly been less strenuous than that carried out by the young farm-hands; but—every tendency to defective carriage was effectively counteracted by means of energetic physical training.

It may be said by way of conclusion that there seem to be two, perhaps three, factors which are separately or jointly of importance to the development of Scheuermann's disease: first, hard physical labour before 16, 17, or 18 years; secondly, a hereditary predisposition and, lastly,—more hypothetically—defective carriage, in particular, sway-back.

The lines on which we have to work in our prophylactic endeavours are thus laid down. The most important are:—a ban on too hard physical labour for the very young, especially in agriculture; occupational advice in case of a familial hereditary taint, when our knowledge of the hereditary conditions has increased to some extent; and finally, the encouragement of carriage-correcting physical training to strengthen the backs of the very young.

SUMMARY

On the basis of reports from the Danish army recruit examinations, comprising about 581,000 men, the writer estimates the frequency of

Scheuermann's disease among Danish males to be from 4 % to 5 %; the disorder is found to be eight times as frequent in the country as in the capital. The same ratio between rural and urban districts is demonstrated by a clinical examination of 2,250 males at conscription age, supplemented by roentgenologic examination of all suspected cases.

In 23 out of 24 cases trauma caused by the patient's work could be demonstrated at the onset of the disorder, 18 of these cases being employed in agricultural work and 5 in other hard physical labour. Only one did not perform physical labour. This case seemed to be of hereditary determination. The extremely common familial occurrence may in the majority of the cases be due to "pseudoheredity", determined by the common surroundings of work.

No accumulation of rachitic signs was demonstrated among the patients with Scheuermann's disease. The contingent importance of defective carriage, in particular, sway-back, as a predisposing factor is accounted for.

Conclusion: The principal cause of kyphosis juvenilis Scheuermann is hard physical labour during the youthful years. A hereditary predisposition can be demonstrated in a few cases. It is probable that defective carriage may be a predisposing factor.

Prophylactic measures should aim at: (1) avoidance of overloading the backs of young people, (2) occupational advice in case of hereditary predisposition, and (3) active work counteracting defective carriage by means of harmonizing physical exercises which strengthen the back.

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RESUME

L'étude des rapports du Conseil de Révision de l'Armée danoise, portant sur 581,000 hommes, fait ressortir que l'on trouve le maladie de Scheuermann chez 4 et 5 % des jeunes gens danois. Cette maladie est huit fois plus fréquente dans les districts ruraux que dans la capitale. On a constaté le même rapport entre la ville et la campagne en

procédant à l'examen clinique de 2250 soldats, avec radiographies dans tous les cas suspects.

Pour 24 cas, on a pu établir la date du trauma du travail ayant suscité la maladie chez 23; parmi ceux-ci, 18 étaient occupés à des travaux agricoles et 5 à un dur travail physique. Un seul n'était pas un travailleur manuel, mais ce cas semblait être conditionné héréditairement. La manifestation familiale, qui est par ailleurs extrêmement fréquente, est due dans la plupart des cas à une fausse hérédité, imputable à la similitude de travail du milieu commun.

On n'a pas trouvé de signe de rachitisme parmi ceux qui souffraient de la maladie de Scheuermann. La signification possible des attitudes vicieuses, notamment des positions de lordose comme facteurs prédisposants, est analysée.

Conclusion : Un dur travail physique dans les jeunes années est la cause essentielle de la cyphose juvénile de Scheuermann. Dans certains cas, on constate toutefois qu'il peut y avoir des dispositions héréditaires. Il est probable que les attitudes vicieuses peuvent prédisposer à la maladie.

Les mesures prophylactiques doivent viser : 1) à éviter une surcharge du dos chez les adolescents, 2) à corriger les attitudes professionnelles défectueuses chez ceux ayant des dispositions héréditaires, 3) à corriger activement les attitudes vicieuses au moyen d'exercices physiques développant harmonieusement le dos et le fortifiant.

ZUSAMMENFASSUNG

Auf Grund einer Durchsicht von Aushebungsberichten des dänischen Heeres, die ca. 581,000 Mann umfassten, wird die Häufigkeit des Mb. Scheuermann unter dänischen Männern auf zwischen 4 und 5 % geschätzt, und das Leiden kommt achtmal so häufig auf dem Lande vor wie in der Hauptstadt. Das gleiche Verhältnis zwischen der Häufigkeit auf dem Lande und in der Stadt wird bei einer klinischen Untersuchung von 2250 Heeresdienstpflichtigen nachgewiesen, die in allen Fällen von Verdacht durch eine Röntgenuntersuchung ergänzt wurde.

Unter 24 Fällen konnte bei 23 ein Arbeitstrauma zur Zeit der Entstehung des Leidens nachgewiesen werden, hiervon 18 bei Landarbeit und 5 bei anderer schwerer Körperarbeit. Nur einer hatte keine körperliche Arbeit gehabt. Dieser Fall scheint erblich bedingt zu sein. Das im übrigen ausserordentlich gewöhnliche familiäre Auftreten kann in der Mehrzahl der Fälle auf „falscher Vererbung“ beruhen, die durch das gemeinsame Arbeitsmilieu bedingt ist.

Es konnte keine Häufung von rachitischen Zeichen unter den Scheuermannpatienten festgestellt werden. Die eventuelle Bedeutung von Haltungsfehlern, insbesondere des hohlen Kreuzes, als disponierender Faktor wird motiviert.

Konklusion: Die überwiegende Ursache der Entstehung der Kyphosis juvenilis Scheuermann ist harte körperliche Arbeit in der Jugend. In einzelnen Fällen lässt sich eine erbliche Anlage nachweisen. Es ist wahrscheinlich, dass Haltungsfehler ein disponierender Faktor sein können.

Prophylaktische Massnahmen müssen abzielen auf: 1) Vermeidung einer Überbelastung des Rückens der Jugendlichen, 2) Berufsberatung im Falle einer erblichen Anlage und 3) aktive Arbeit zum Ausgleich von Haltungsfehlern durch harmonisierende, rückenstärkende gymnastische Übungen.

BIBLIOGRAPHY

- Brocher, J. E. W.:* Die Scheuermannsche Krankheit, Basel, 1946 (with bibliography).
Hølund, T.: Ugeskrift f. Læger. 1943-105-389.
Hinricsson, H.: Nord. Med. 1943-20-2456.
Junghans, H.: Röntgenpraxis. 1932-4-97.
Overgård, K.: Hosp. tid. 1938-4-102. Nord. Med. 1940-5-593. Klinisk Årbog. 1942. 31.
Scheuermann, H.: Ugeskr. f. Læger. 1920-82-385. 1927-89-663. Fortschr. Röntgenstr. 1931-44-233. Hosp. tid. 1933-76-1. Acta Ortopæd. Scand. 1934-5-161.
Schmorl, G.: Fortschr. Röntgenstr. 1930-41-359. Arch. Klin. Chir. 1933. 172-240.
Schmorl & Junghans: Die gesunde und kranke Wirbelsäule im Röntgenbild, Leipzig, 1932.
Wagner, A.: Klinisk Aarbog 1939. 1.
Wissing, O.: Nord. Med., 1939-2-1384.