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Anthropometry and clinical features of Kashin-Beck disease in central Tibet

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Abstract We compared two different populations living in central Tibet with the purpose of establishing standard values for different anthropometric parameters in a rural population. Later on, these values were used as references for a similar study on a KBD population. One group (KBD) (*n*=1246) came from the endemic areas, and the other group, serving as the control population (*n*=815), came from non-endemic areas. Both groups included children and adults and were of the Mongoloid type; they were farmers or semi-nomads. Height, weight, segment length, joint perimeter, joint diameter, joint movement were recorded. Also more subjective information such as general feeling of tiredness, rapid fatigue at work, work limitation, joint pain, muscle weakness, muscular atrophy, dwarfism, flatfoot, and waddling gate was also collected. Those variables were compared between the two groups.

Résumé En vue d'établir des valeurs standards (normes) pour différents paramètres anthropométriques pour une population rurale non endémique nous avons comparé 2 populations différentes au Tibet Central: un groupe contrôle (*n*=815), issu de régions non-endémiques et un groupe avec la maladie de Kashin Beck (KBD) (*n*=1246), issu de régions endémiques. Une fois ces valeurs standards établies, celles-ci ont servi de référence pour une étude similaire sur une population KBD. Les 2 groupes étudiés incluent des enfants et des adultes. Ils appartiennent physiquement au type mongol. Ce sont tous des fermiers ou des semi-nomades. La taille, le poids, les longueurs de segments de membres, le périmètre et le diamètre articulaires, la mobilité ont été mesurées. Des informations plus subjectives telles qu'un sentiment général de fatigue, une fatigabilité rapide à l'effort, la limitation du travail, la douleur et la déformation articulaires, la faiblesse et l'atrophie musculaires, le nanisme, les pieds plats et la boiterie ont également été récoltés. Ces données ont été comparées entre les 2 groupes.

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Introduction

There are only a few articles that report on Tibetan anthropology. Most are related to growth patterns at that altitude, and few include descriptive anthropology.

Populations living at high altitudes do not follow the same pattern of human growth and development as populations living at sea level. Different populations respond differently, depending upon their genetic background and ethnic group. In Tibet 96% of the indigenous population belongs to the same ethnic group [1].

Traditional anthropologists classify the yellow ethnic group into four sub-groups: the Mongols, the Centro-Mongols (North Chinese), the South-Mongols (South Chinese, Tha, Vietnamese) and the Indonesians. For some anthropologists, the Tibetan ethnic group has a distinct middle position between Centro-Mongols and South-Mongols, which is not due to crossbreeding.

Although the population is homogeneous, some physical variations lead to two different physical groups: the Mongoloid type, with Mongoloid faces, small size, round head, yellow-brown colored skin – this group lives mainly in southern and central Tibet – and the red skin type, taller, with a prominent nose, longer head who live mainly in the north of Tibet.

Most Tibetans have a very robust skeleton with a strong musculature. They have a slow rate of development of stature and a late and poorly defined adolescent growth spurt [1]. Kashin-Beck disease (KBD) affects the shape and the function of the limb joints, the length of the long bones and, in more advanced cases, the growth pattern. Therefore, a specific anthropometric description is of interest to complete the clinical features of the disease.

The objectives of this study were primarily to establish standard values for different anthropometric parameters in a rural population of central Tibet. Then, these standard values were used as reference points for a study of a population affected with KBD. Thus, the most representative parameters of the disease can be confirmed and the previously described clinical picture [3] can be completed.

Subjects and methods

The study includes two different populations, all farmers or semi-nomads. They live in similar environments with the same living conditions and habits. The population ranges from 5 years to over 50 years in age and all of them are of the Mongoloid type.

The *KBD group* (n=1246), from the endemic areas, lives in 8 different counties of Lhasa, Lhoca and Shigatse prefectures. The *control group* (n=815), from the non-endemic areas, lives in the large county of Shigatse prefecture.

The parameters recorded are listed in Table 1. They are expressed as continuous variables. Only the right side of each subject was measured. For each continuous variable, an analysis of variance was performed with the combination of sex and disease variable as a grouping factor (4 levels), the age as covariate, and the interaction between the two. Other more subjective information was also collected: general feeling of tiredness; rapid fatigue at work; work limitation; joint pain; joint deformity; muscle weakness; muscular atrophy; dwarfism; pes planus; and waddling gate. They are expressed as binary variables. For each binary variable, a logistic regression was performed on the combination of sex and disease variables (categorical variable at 4 levels), the age (continuous variable) and their interaction. All measuring and collection of information was done by two Western physical therapists.

As the geographical areas of the control group and the KBD group were different, the authors wanted to verify whether there was any significant difference between the mean values of measurement in the three prefectures. Lhasa and Lhoca prefectures were categorized as the first group and Shigatse as the second group (the control group was chosen only in Shigatse prefecture). The mean values of the 36 continuous variables were also compared between these groups with analyses of variance with one intergroup factor the prefecture groups (2 levels), one covariate (the age) and their interaction.

Data entry and statistical analyses were carried out with the EPIINFO (version 6) and the SPSS (version 8.0) software packages.

Table 1 Anthropometric parameters measured for a control (n=815) and for a KBD (n=1246) population in central Tibet

Parameters	Tool of measure	Tool precision
Height	Height gauge	0.5 cm
Weight	Scale	0.5 kg
Segment length	Measuring tape	0.5 cm
Joint perimeter	Measuring tape	0.5 cm
Joint diameter	Calliper	0.5 cm
Joint range of motion	Goniometer	5 degrees

Results

The age distributions in the prefecture groups (Lhasa/Lhoca compared with Shigatze) were different (P<0.001) (Fig. 1). Therefore it is impossible to extract a possible prefecture difference, if any, as it was confounded with the age distribution difference. Age distribution was therefore taken into account and our conclusions are general and do not depend on a single prefecture. The age distribution between the KBD population and the control population (Fig. 2) showed a higher number of subjects age 5 and 15 years in the KBD group. This was due to the fact that we had a large KBD population aged from 5 to 15 already enrolled from previous studies. In the con-

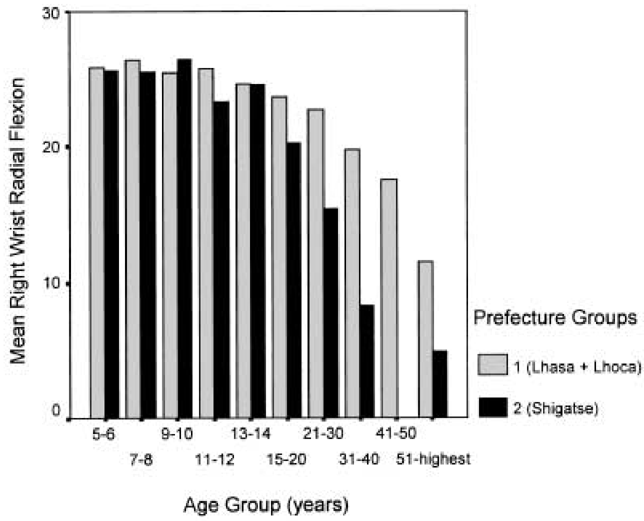

Fig. 1 Different age distribution (KBD-group) in Lhasa/Lhoca prefectures and Shigatse prefecture for the variable “wrist radial flexion”, Tibet Autonomous Region

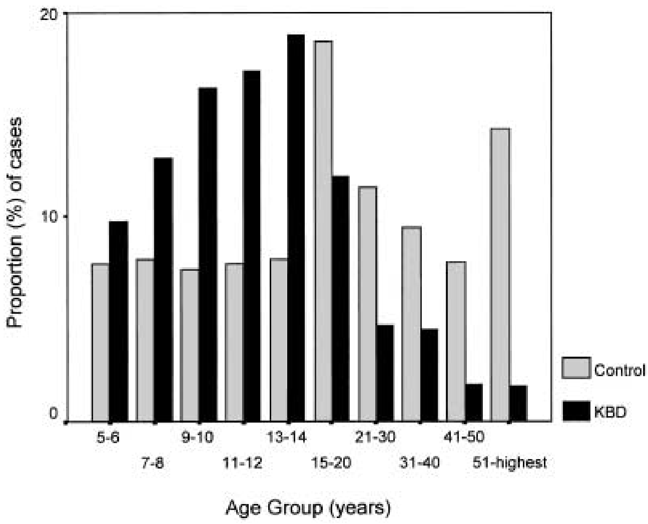

Fig. 2 Age distribution in the control group (n=815) and the KBD group (n=1246) in Lhasa, Lhoca and Shigatse prefectures, Tibet Autonomous Region

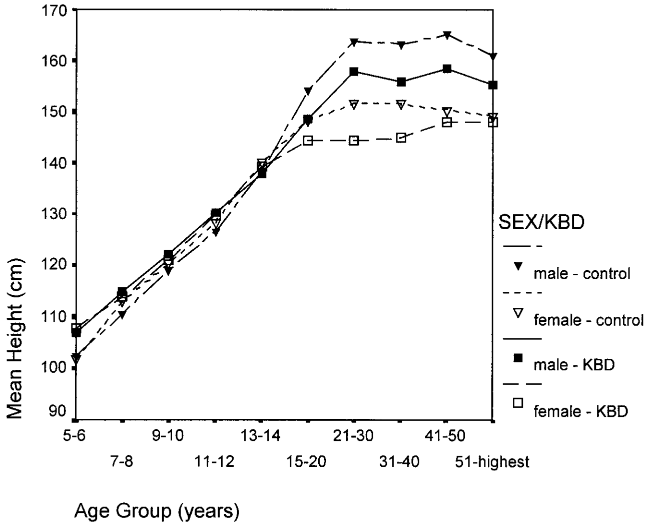

Fig. 3 Mean height by age group and by sex for control subjects and KBD patients in Lhasa, Lhoca and Shigatse prefectures, Tibet Autonomous Region

trol group, the older age groups were relatively more numerous. The sex distribution showed a higher proportion of men than women both by age group (P=0.001) and by KBD/control group (P=0.006).

The means of height, arm and forearm length, thigh and leg length and the weight were different according to age and sex, and also whether the subject had the disease or not. The difference between the 4 groups (KBD/non-KBD and male/female) is more obvious when the subjects are older than 15 years. The evolution with age for all the above-mentioned variables is similar to the height evolution (Fig. 3). The means of joint perimeter and joint diameter of each joint are highly significantly different between each group (sex, KBD/non-KBD). Their evolution with age gives graphs similar to those obtained for the height.

Concerning the mobility of joints, we have chosen the elbow joint to illustrate the results (Fig. 4). The elbow joint is representative of all other joints. All motions depend on the age and show a significant interaction of age

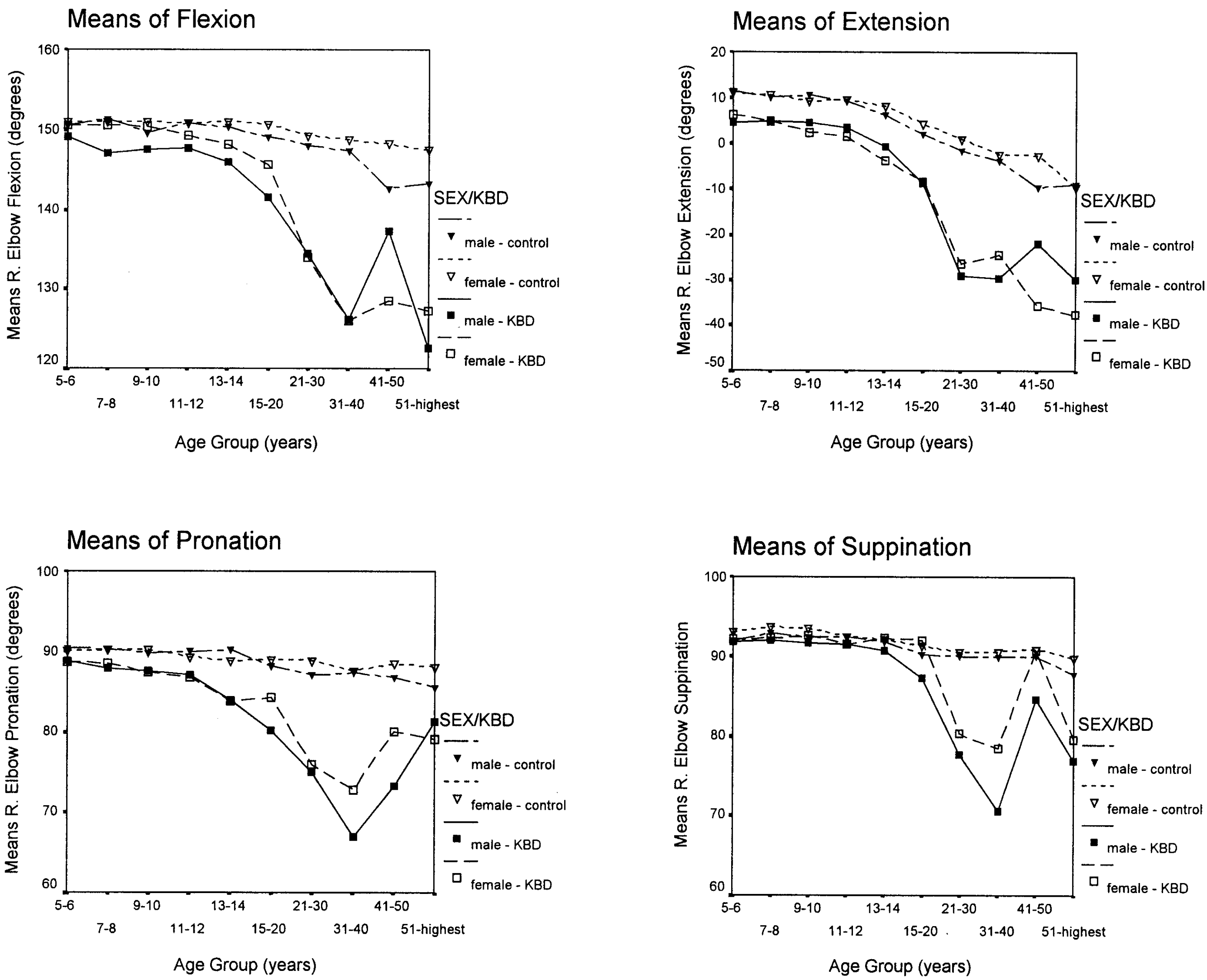

Fig. 4 Elbow motion (mean) (right elbow) by age group and by sex for control subjects and KBD patients in Lhasa, Lhoca and Shigatse prefectures, Tibet Autonomous Region

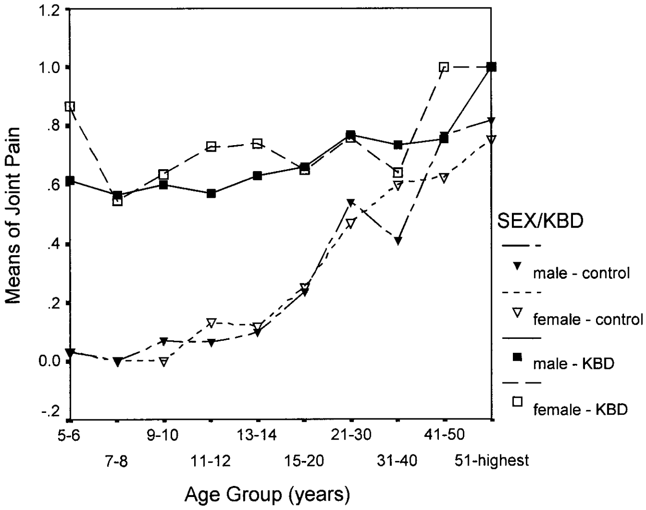

Fig. 5 Mean values of joint pain score (together) by age group and by sex for control subjects and KBD patients in Lhasa, Lhoca and Shigatse prefectures, Tibet Autonomous Region

with the group (sex and KBD). Any range of motion decreases with age and when the KBD affects the patient. The mobility in women is slightly more limited than in men. In the case of KBD the limitations in mobility start to be substantial in the 30s for both sexes.

The development of joint pain is mainly dependent on the age. The older the subject, the higher their pain score even if they are not suffering from KBD (Fig. 5). This very likely corresponds to arthritis pain and rheumatism, which is normal under such harsh living conditions. The weight-bearing joints are the most frequently affected.

Most of the variables estimated as secondary signs of KBD [3]. do not depend on age, sex or KBD/non-KBD group. The evolution of these variables with age does not depend on sex or disease. These variables are accessory symptoms of KBD and not major or characteristic signs of the disease.

Discussion

The sample of the KBD population comes from three different prefectures, covering quite a large geographical area. However, the control population comes from a smaller area in only one prefecture. In the field, the authors were confronted several times with the situation that the local health authorities were unaware of whether the areas were endemic for KBD. It seems that they underestimated the number of KBD cases, probably because they did not know how to make a correct clinical diagnosis.

As in the control group, the older age group is relatively more numerous, which probably affects the mean value of some variables such as joint pain and joint mobility. In this analysis, each variable was associated with age, sex and whether the subject had the disease (construction of a variable male/female and KBD/non-KBD). The interaction between them was also considered.

The different measures of limb length, joint diameter and joint perimeter will be useful in cases with a clinical diagnosis of KBD as well as the measures of range of motion of different joints.

Pain is a variable likely to be valid for children (after exclusion of a traumatic episode) but it is not useful in elderly adults. Age then becomes a confounding factor. Several other diseases, most of them due to ageing, such as osteoarthritis, polyarthritis will also cause pain. Due to its subjectivity, this variable must be taken with caution.

The same remark applies when appreciating joint deformities as they are very subjective to the eye of the examiner. Contrary measures of joint diameters and perimeters are objective. However, it is probably not necessary to measure both variables because the two measures are linked, and choosing one should be sufficient.

The limitation of mobility for people suffering from KBD and aged 25–30 years shows the important socioeconomic impact of this disease, especially when one appreciates that most are farmers and their activities are mostly manual.

The distribution of secondary clinical signs shows that some of them reflect the lack of mobility such as muscular atrophy and weakness. However, others could indicate a subsequent nutritional problem such as a general feeling of tiredness and a rapid fatigue while working. Etiological research suggests a lack of trace elements (iodine, selenium, vitamins C and E) in the diet of KBD patients as a risk factor, which could interfere with these results [2, 4, 5, 6].

Eventually, this anthropometric description and comparison between a control and a KBD population aims to refine the clinical diagnosis of KBD and should be a new tool for all health professionals working with KBD populations. This tool must be practical, reliable and easy to apply and to teach. Development of a model describing the most significant variables used for a clinical diagnosis of the KBD is in progress.

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