

ANTHROPOLOGIE \* XXXII/3 \* 1994

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# SOMATOMETRY OF RHESUS MACAQUES – SOMATIC DEVELOPMENT UP TO 24 MONTHS

ABSTRACT: The research project "Complex study of postnatal ontogeny of higher primates - basic adaptive process, social structure, and sexual dimorphism" is the first part of the longitudinal study of primate ontogeny. It is a pilot study directed primarily at the study of 141 individuals of the species Macaca mulatta from the breeding centre VÚFB Konárovice in the Czech Republic. Preliminary results of the ontogeny of selected somatic parameters are presented. The data analysed in this study have two sources: 1) Semi-longitudinal study that was conducted from 1984 up to the fall of 1993. This study includes 203 individuals (102 males and 101 females). Body mass, sitting height and four basic measurements of head were measured. 2) Longitudinal study of the grant project, which currently includes 70 regularly-examined individuals subdivided into three age groups. Full set of 48 measurements is taken for each individual. The measuring itself is based on standard anthropometric procedures (Martin and Saller 1957); some measurements were modified. 48 metrical traits are measured: body mass, body height, sitting height, 9 dimensions of head, 15 traits on upper limb, 12 on lower limb, and 9 on the trunk. Modified somatometry of macaques has great value for the description of their growth and sexual differentiation. The sample measured proves the methods to be reliably precise. Some specific measurements like body height appear to be very important for comparative studies of the ontogeny of body size and proportions in man and non-human primates. The preliminary results for five measurements are discussed. Sexual dimorphism has some specific features in the examined group. The body mass, head and chest circumference are significantly higher in males up to the 16th month, while the body height and sitting height are not significantly different in males and females. Values for all parameters are higher in females at two years of age.

KEY WORDS: Macaca mulatta - Somatometry - Growth - Pilot Longitudinal Study.

#### INTRODUCTION

The research project "Complex study of postnatal ontogeny of higher primates – basic adaptive proceses, social structure, and sexual dimorphism" co-ordinated by Václav Vančata (Grant Agency of the Czech Republic – grant project No. 206/93/1029) is the first part of the longitudinal study of higher primate ontogeny that should yield representative data on primate ontogeny. It is a pilot study directed primarily at the study of 141 individuals of the species Macaca mulatta from the breeding centre VÚFB Konárovice in the Czech Republic.

The project consists of four research studies. The study "Growth and somatic development of rhesus macaques" co-ordinated by Helena Zlámalová is based on the use of modified somatometrical methods widely used in anthropology. This paper deals with the postnatal ontogeny of Macaca mulatta up to 24 months. Preliminary results of the ontogeny of selected somatic parameters are presented. However, the main goal of this paper is to demonstrate the methods, their use in practice and the future prospects of somatometry in research on primate ontogeny.

#### MATERIAL

The main subject of the study is the captive group of Macaca mulatta living in the Primate Centre of the Research Institute of Pharmacy and Biochemistry in Konárovice (Jebavý and Jebavý 1993). At present there is a group of 141 macaques subdivided into 8 groups with semi-natural (aged) multimale social structure. All animals have been captive-born for several generations. New groups are created after weaning in approx. the 4-8 month of life. Up to 10 % of the new-borns are formula-fed but the great majority are breast-fed. 317 animals have been studied (152 males and 165 females) since 1981. The data up to 1984 were not complete, and only body mass was recorded. Therefore only the individuals examined since the year 1984 have been included into this study. The data analysed in this study have two sources:

- Semi-longitudinal study that was conducted from 1984 up to the fall of 1993. This study includes 203 individuals (102 males and 101 females). Body mass, sitting height and four basic measurements of head were measured. Altogether 938 measurings were made.
- New longitudinal study of the grant project, co-ordinated by H. Zlámalová (somatometry and growth) and V. Vančata (sexual dimorphism, database and

data processing) included in 1994 70 regularly examined individuals subdivided into three age groups. Full set of 48 measurements is taken for each individual.

A) Group of 21 individuals born in 1991 and 1992 (15 females and 6 males). These animals were measured monthly and later (since May 1994) at two month intervals. With one exception the individuals from this group were measured earlier, so at least five series of measurements for each individual can be analysed.

B) Group of 24 individuals (10 males, 14 females) born in 1993. With the exception of four formulafed animals, the group is measured regularly in two week intervals after weaning in November, i. e. after the 4-8 month of life. Since May 1994 they have been measured regularly in one month interval.

C) Group of 26 individuals born in 1994. Two formula-fed males have been examined regularly in one or two week intervals since their birth. The rest of the group is examined occasionally. Regular research on them will start after weaning.



FIGURE 1. Oniogeny of body mass of Macaca mulatta – semilongitudinal study 1984–1994 and comparison of results with other studies. 198

#### METHODS

The measuring itself is based on standard anthropometric procedures (Martin and Saller 1957); some measurements were modified. Standardisation of the position of body and individual segments was the first and main task of the use of somatometry methods in primates. Two technical workers are needed to keep the monkey in standard position and fixing it in place. 48 metrical traits are measured: body mass, body height, sitting height, 9 dimensions of head, 15 traits on upper limb, 12 on lower limb, and 9 on the trunk.

#### Head measurements

All 12 measurements of head must be made with the standard fixation of head (neck fixed by hands) and the trunk must be in the vertical position. Head circumference is measured horizontally through glabella, i. e. in the most prominent place above the origin of the nose.

### Body height and sitting height

Height measurements, that is body height and sitting height, are conducted by using a specially







FIGURE 3. Ontogeny of sitting height of Macaca mulatta – semilongitudinal study 1984–1994.

constructed monkeymeter (analogous to an anthropometer) with 5 mm precision. In the case of body height the monkey is fixed from the ventral side at six points: under the neck, in the abdominal region, in the knee region and in the ankle region. The knees must be pressed to the table to achieve maximal leg extension. Fixing at the ankle region ensures that monkey will stay with foot in a full contact. This position is unnatural for macaques, but it is the only way how to measure this linear dimension of the body that is comparable to that of man. We tried to measure the overall body length in lying position, but this was extraordinary complicated and very imprecise. A well coordinated team can take this measurement in a few seconds with quite good precision. Sitting height is the distance between ischial callosities and the most upper part of the head (vertex). Sitting with extended legs is not fully natural. For the precision of measurements it is necessary to take care that the occipital region, shoulder-blades and gluteal region are in full contact with the table.

#### Trunk measurement

Length, breadth and circumferential measurements are measured on the trunk. Chest circumference is measured at the level of the nipples with slightly abducted limbs. We also measure the shape, crosssection and sagittal and transversal dimension of the chest. The shape and cross-section are measured by a kirtometer. This set of measurements will be analysed in a special study.

#### General comments

Modified somatometry of macaques seems to have great value for the description of their growth and sexual differentiation. The sample measured up to 30 months of age proves the methods to be reliably precise. Some specific measurements like body height appear to be very important for comparative studies of the ontogeny of body size and proportions in man



FIGURE 4. Ontogeny of chest circumference of Macaca mulatta - longitudinal study 1993-1994.

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and non-human primates. The period of measurment seems to be sufficient and representative.

# PRELIMINARY RESULTS

Body mass increases basically linearly, AS can be seen from the Figure 1. It is on average 450 g for males and 430 g for females in the first two weeks, 1300 g for males and 1140 g for females at 6 months of age, 1885 g in males and 1730 in females at one year of age. Body mass is about 2650 g in males and 2400 g in females at 18 months of age and it reaches 2800 g (2535 g in longitudinal sample) in males and 2920 (2823 g in longitudinal sample) in females at 24 months. It increases up to 3818 g in males and to 3413 g in females at 30 months. There are significant differences between the longitudinal sample and semilongitudinal sample at two years of age.

Body height is about 450 mm at six months, 530 mm at one year and about 660 mm for males and 620 mm for females at two years of age. Sexual differences are not significant, with the exception of 24-month-old individuals. Changes of body height are linear.

Sitting height is 160 mm at one month of age, 290 mm at six months, 330 mm at one year of age, 385 at 18 months. It is about 365 in males and 393 mm in females at two years of age. Sexual differences are not significant, with the exception of the two year-category, where the sitting height is significantly higher in females. Developmental changes of sitting height are probably not linear.

Head circumference is 230 mm in males and 222 mm in females at six months, 238 mm in males and 231 mm in females at one year of age and 246 mm in males and 250 mm in females at two years of age. Head circumference does not increase linearly and there is a high sexual dimorphism in this feature.

Chest circumference is 230 mm in males and 216 mm in females at six months, 248 mm in males and 240 mm in females at one year of age and 266 mm in males and 272 mm in females at two years of age. Chest circumference increases with age approximately linearly. There is a high sexual dimorphism in chest circumference, with the exception of two-years group, where the degree of sexual dimorphism decreases but the value is higher for females than for males.

Sexual dimorphism has some specific features in the examined group. The body mass, head and chest circumference are significantly higher in males up to the 16th month, while the body height and sitting height are not significantly different in males and females. This means that there are allometrical differences in the ontogeny of body size in the sexes at this period. Values for all examined parameters are higher in females at two years of age, while a trend toward increasing all body parameters, i. e. a tendency to size sexual dimorphism, appears in males during the third/four year of life.

# **DISCUSSION AND CONCLUSIONS**

In comparison with the other comparable examined groups of Macaca mulatta, the group from Konárovice is the most gracile, with a medium degree sexual dimorphism. According to data presented by VanWagenen and Catchpole (1956) their population was more heavy but with a lower degree of sexual dimorphism. Females from the Gavan and Hutchinson (1973) sample are comparable in body mass but males are significantly more heavy. The sexual dimorphism is a very marked one. This could be caused by differences in feeding regimen, the formation of a social structure, climate and the origin of individual group. A much deeper analysis of various factors and more data from the Konárovice group will be necessary for understanding of these differences.

## ACKNOWLEDGEMENT

This research has been supported by the Grant Agency of the Czech republic – grant project No. 206/93/1029.

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