GENETICS OF GROWTH TRAITS IN BOLIVIAN LLAMAS

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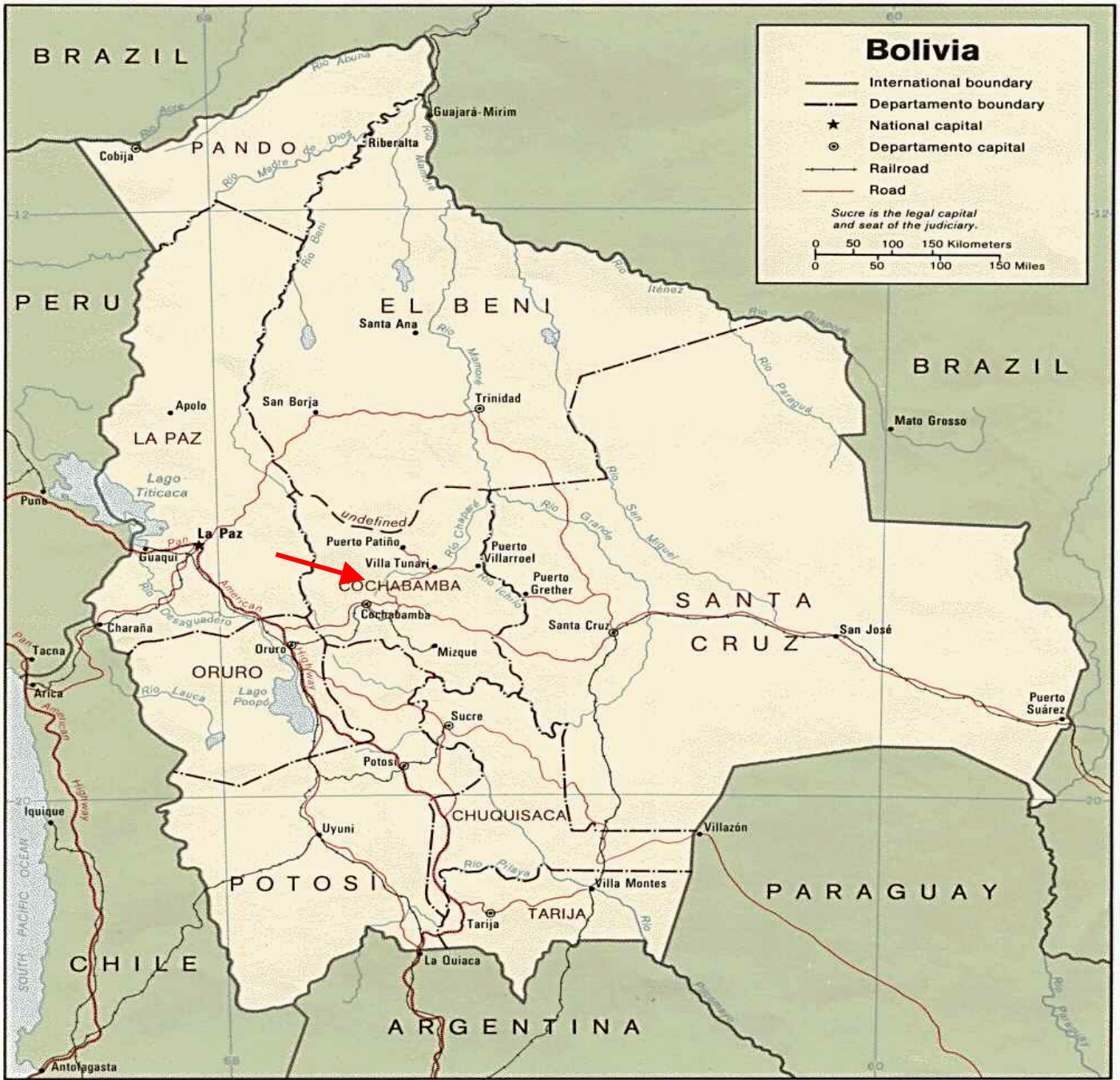


Base 800454 1-86

Material

2 types of llama

769 males 2568 females 51 males 330 females

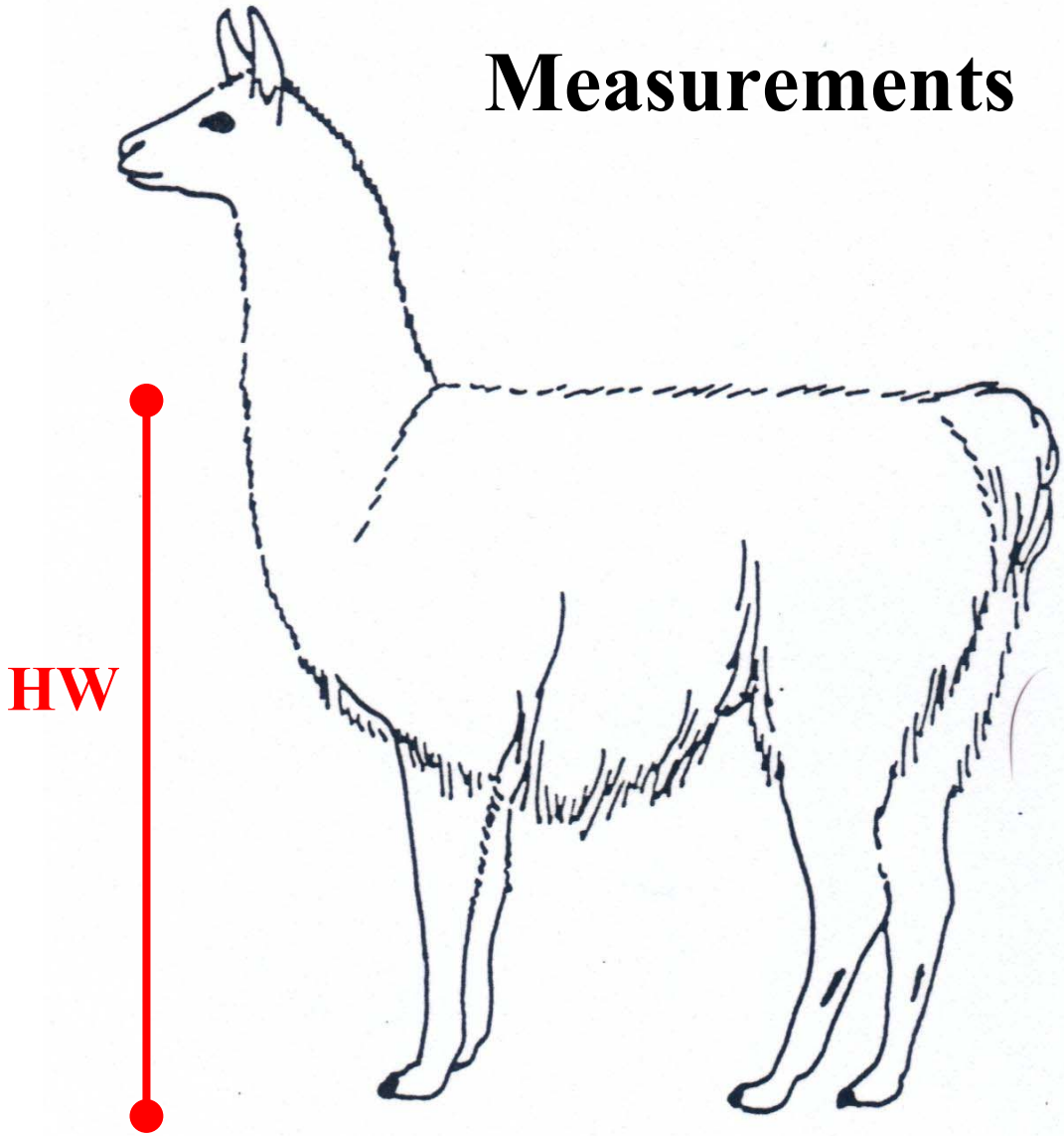
age of the animals: from 1 day to 10 years

4 communities

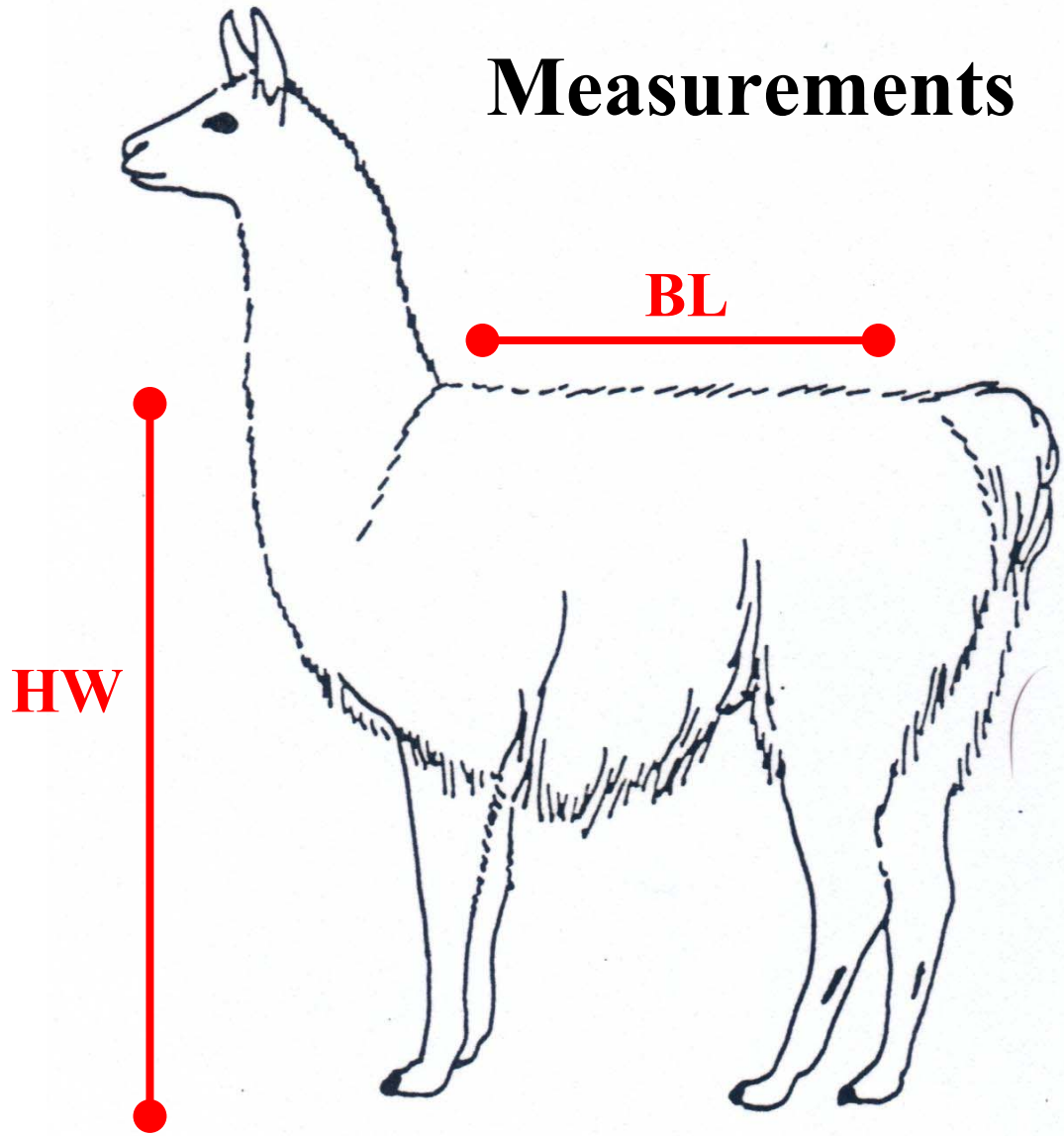
Aim of the Study

- growth curves for different body measurements and body weight
- differences between the two sexes
- differences between the two types
- differences between communities
- heritability and genetic correlations for body measurements and body weight

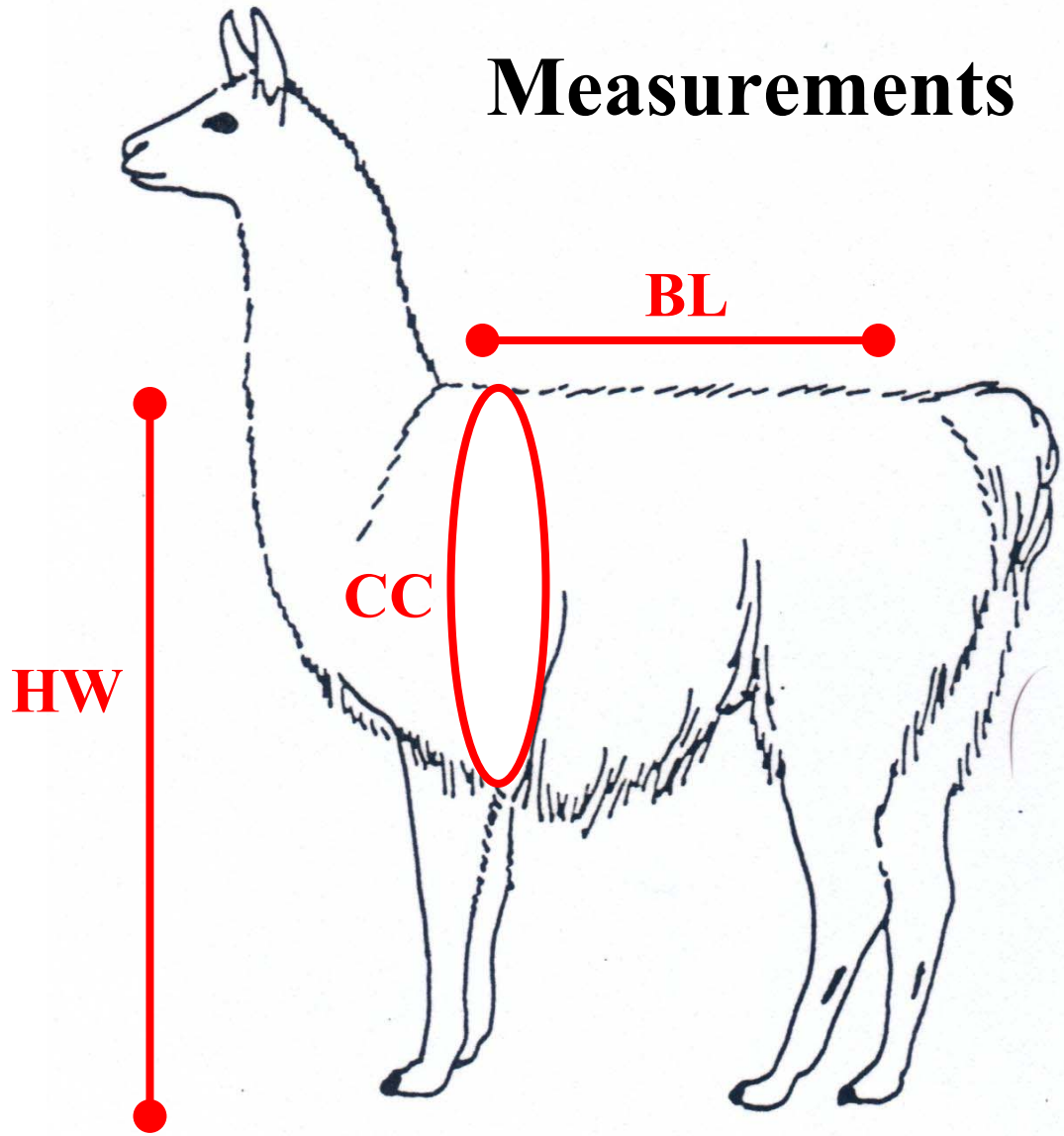
Measurements



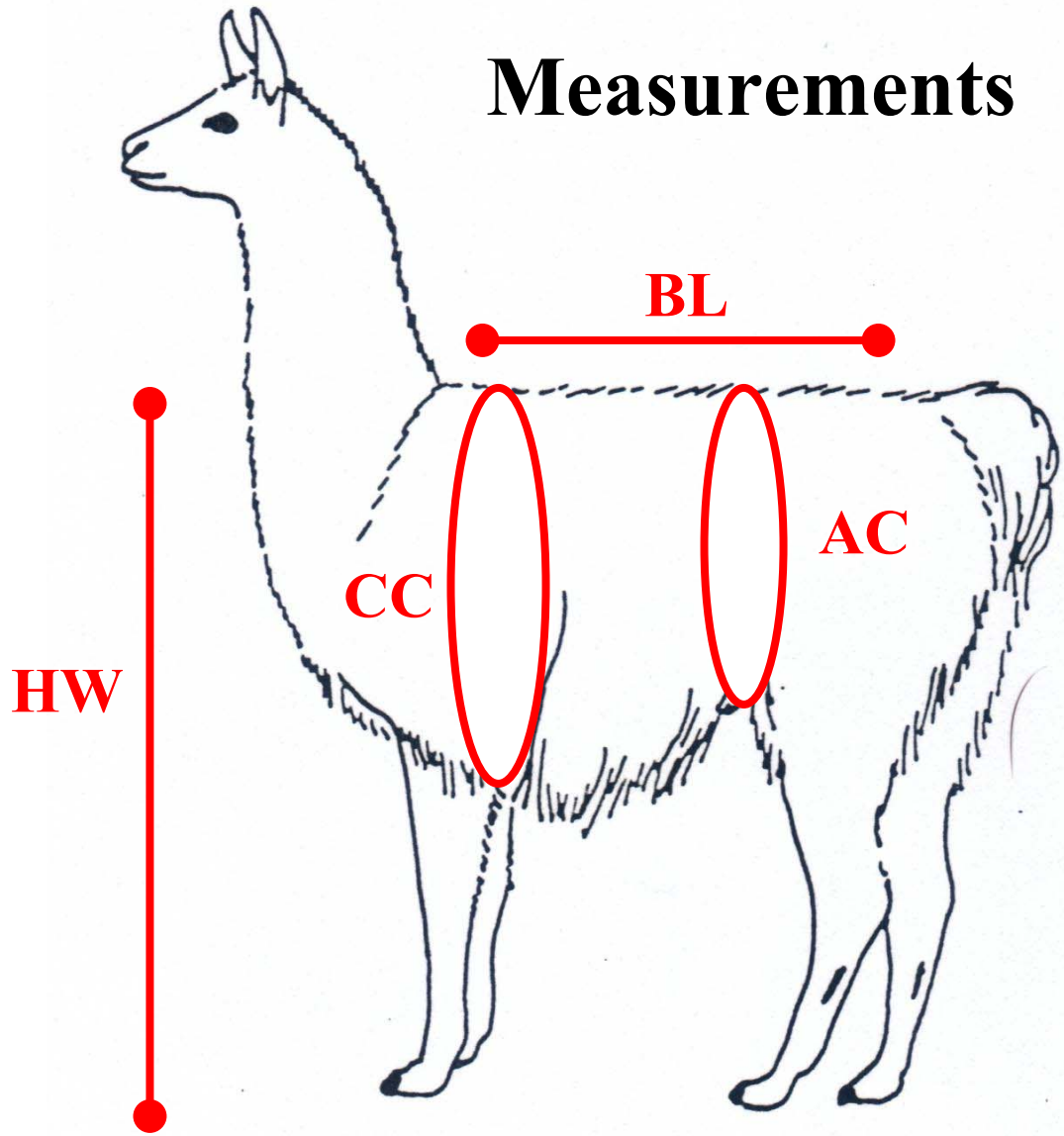
Measurements



Measurements



Measurements



Non-linear Brody function

$$y(t) = a*(1-b*e^{(-k*t)})$$

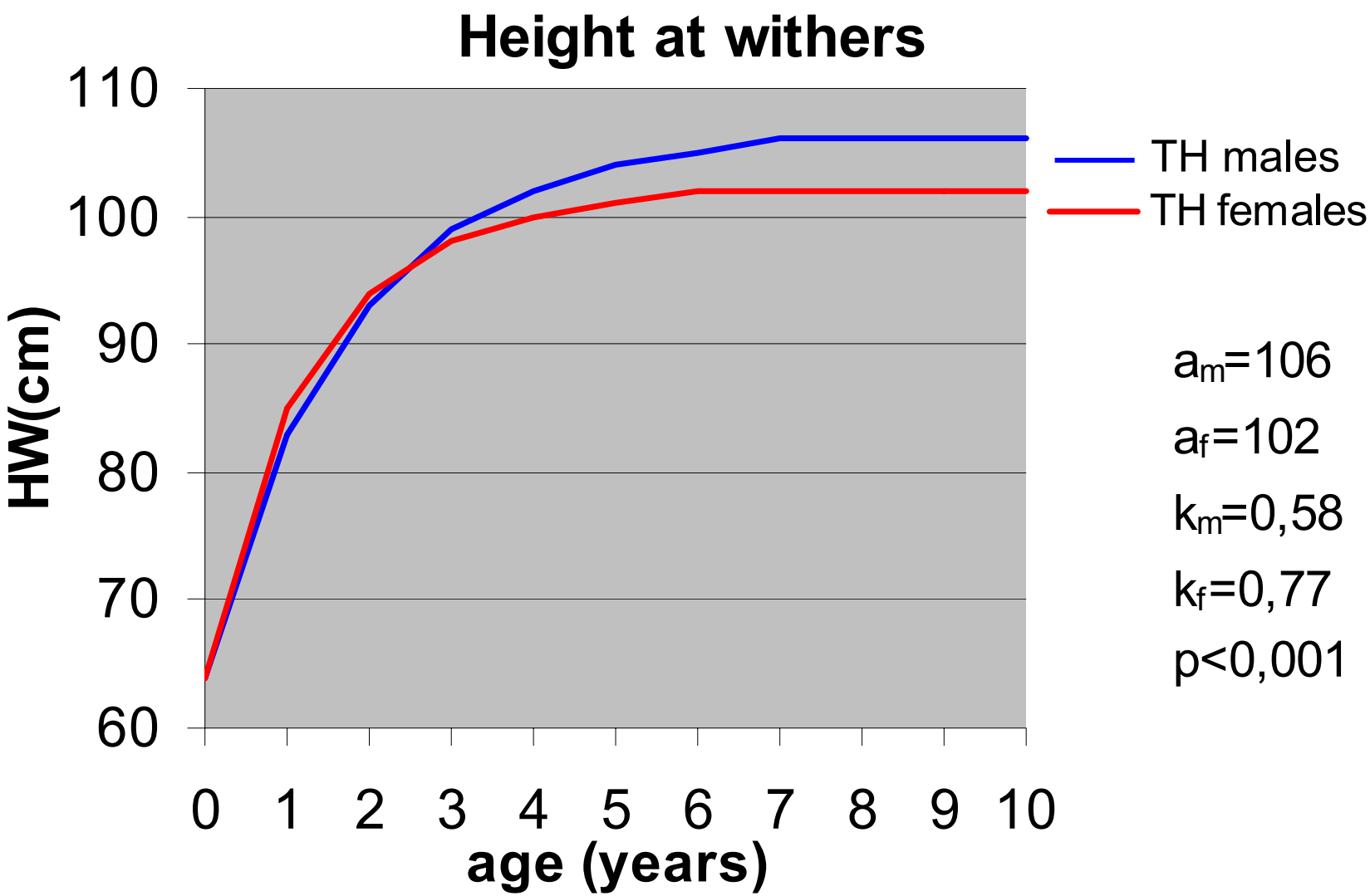
y(t) = size or weight at given time t

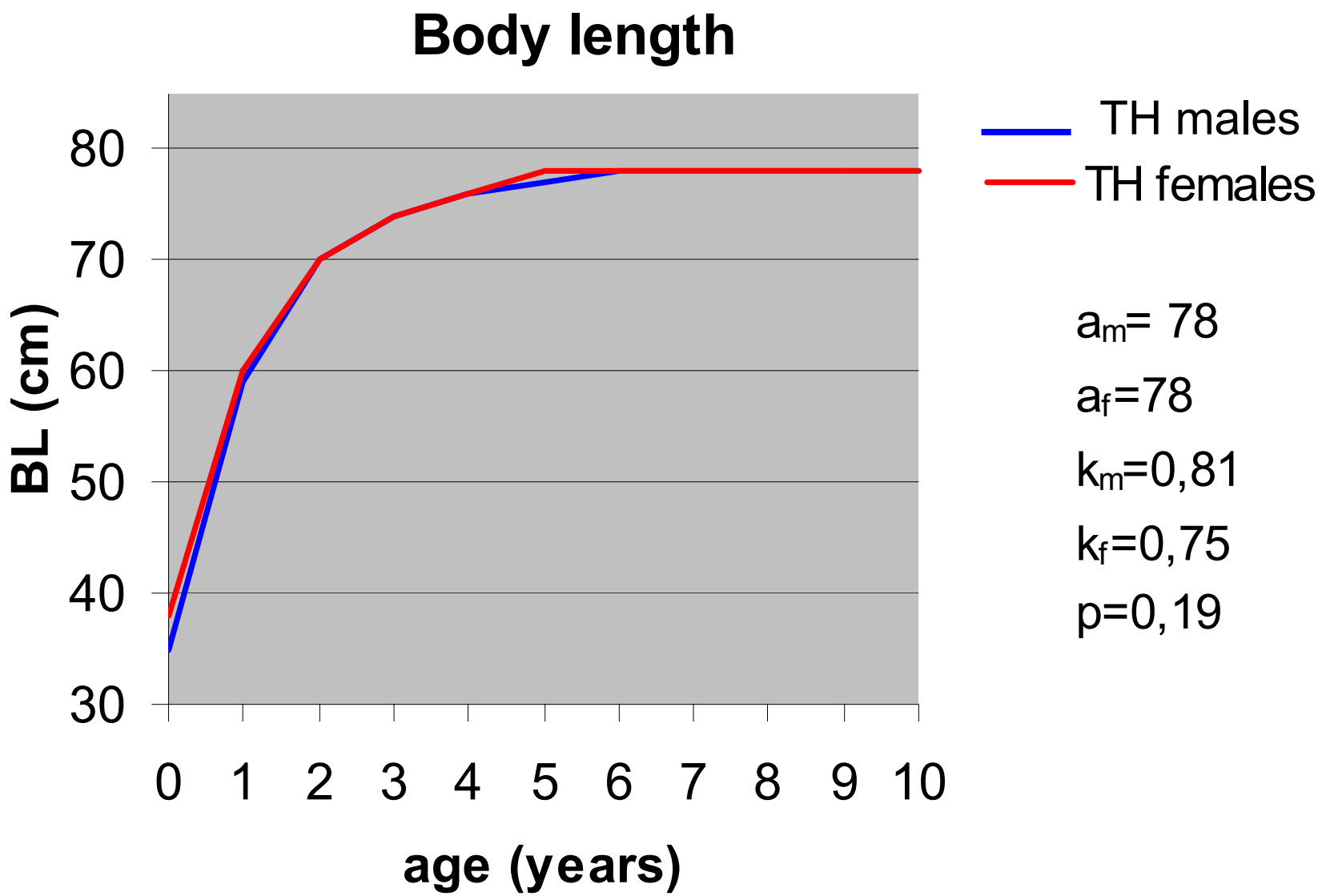
a = asymptotic size or weight at maturity

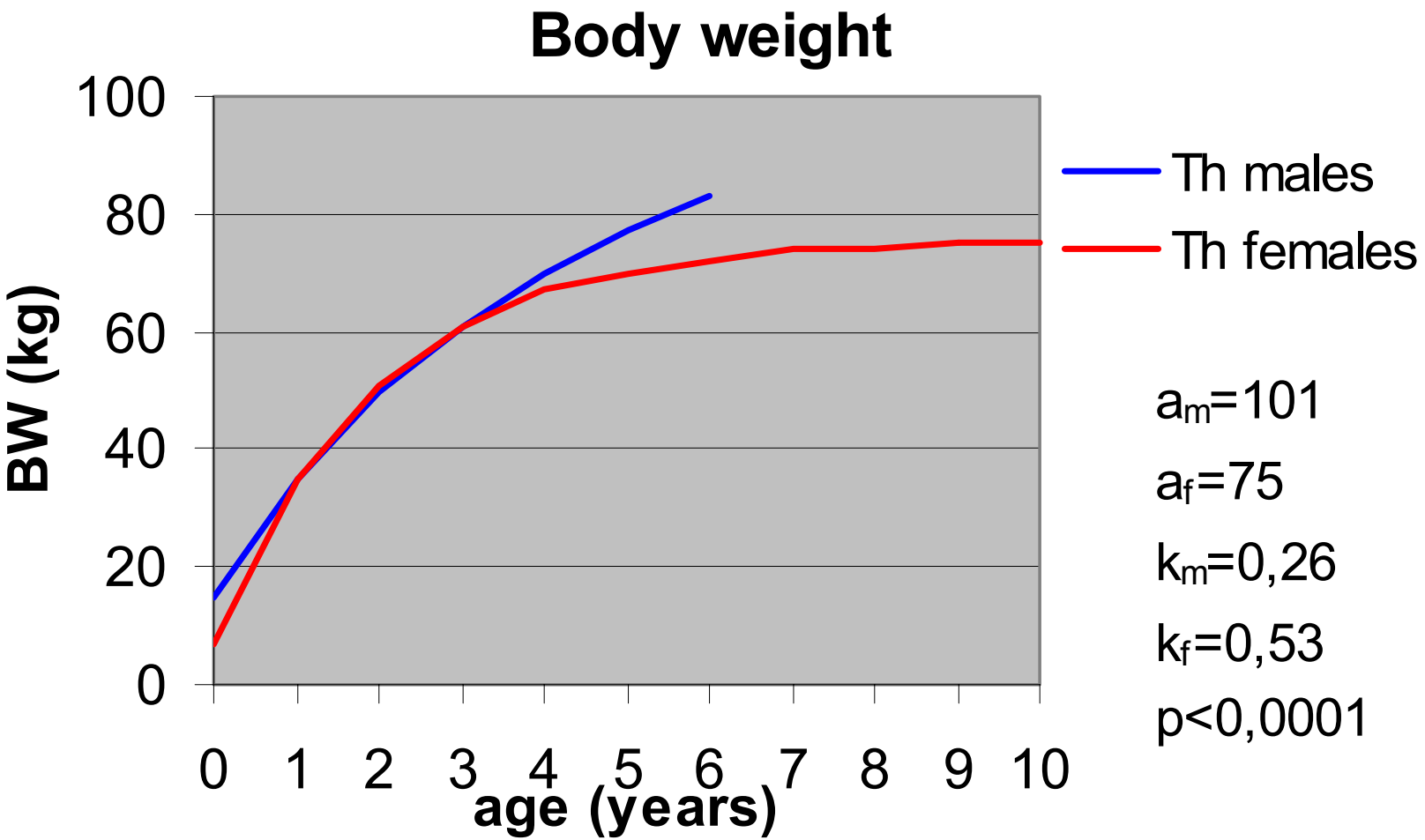
b = proportional difference between a and birth size or weight

k = rate of maturing

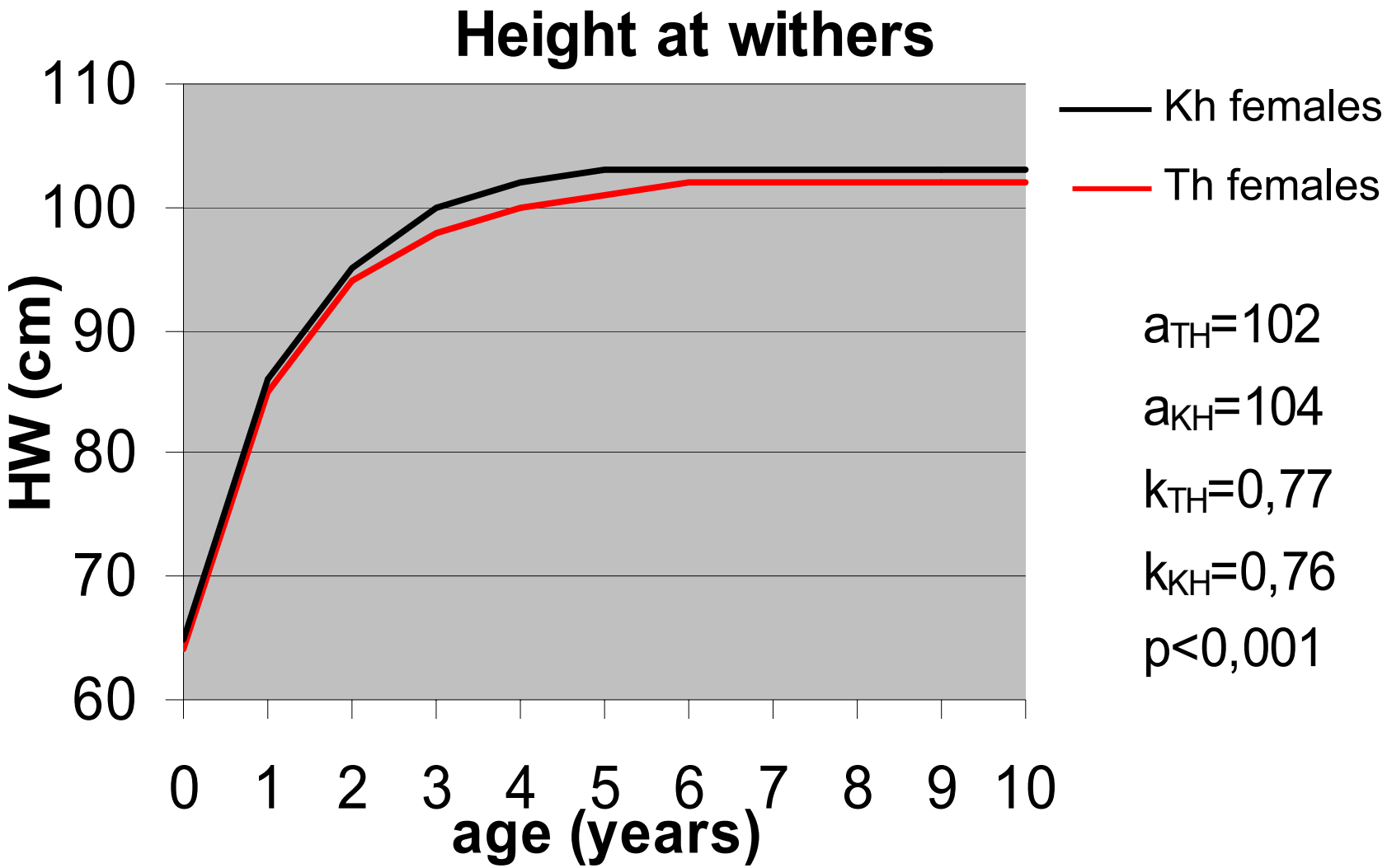
Comparison of the two sexes

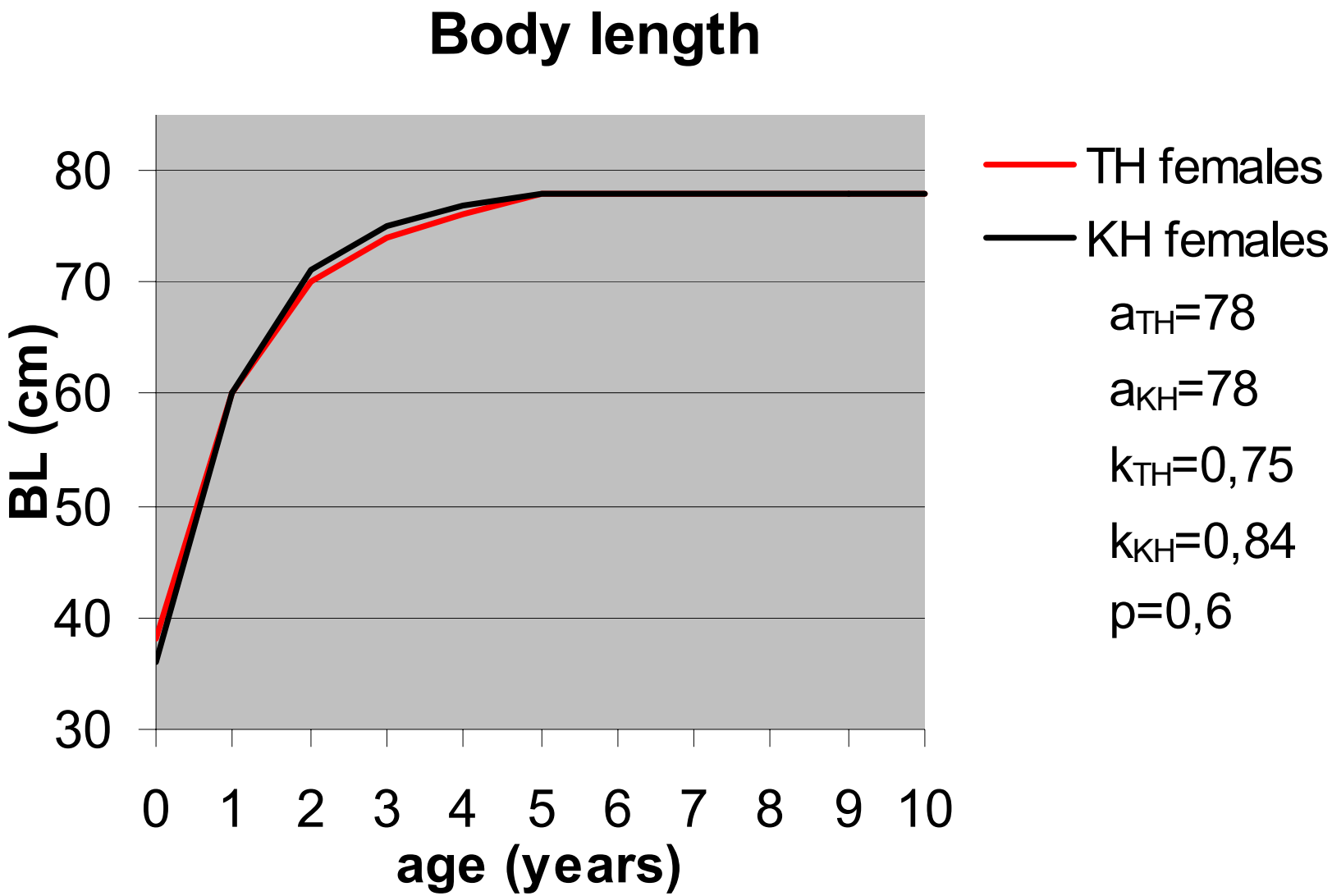

Height at withers
110
100
90
80
70
60
HW(cm)
0
1
2
3
4
5
6
7
8
9
10
age (years)
TH males
TH females
a_m=106
a_f=102
k_m=0,58
k_f=0,77
p<0,001

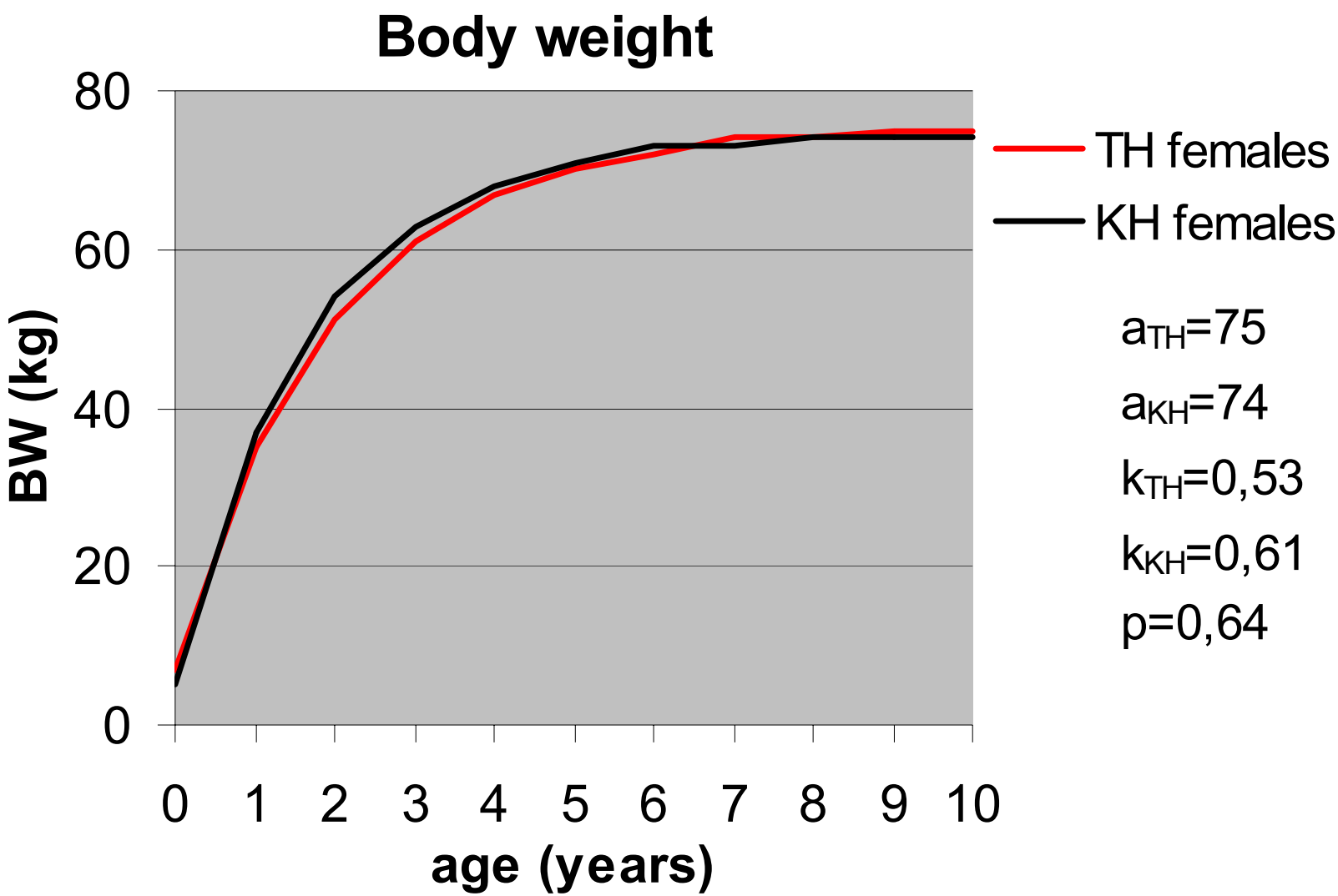

Body length
BL (cm)
80
70
60
50
40
30
0
1
2
3
4
5
6
7
8
9
10
age (years)
TH males
TH females
a_m= 78
a_f=78
k_m=0,81
k_f=0,75
p=0,19


Body weight
BW (kg)
100
80
60
40
20
0
0 1 2 3 4 5 6 7 8 9 10
age (years)
Th males
Th females
a_m=101
a_f=75
k_m=0,26
k_f=0,53
p<0,0001

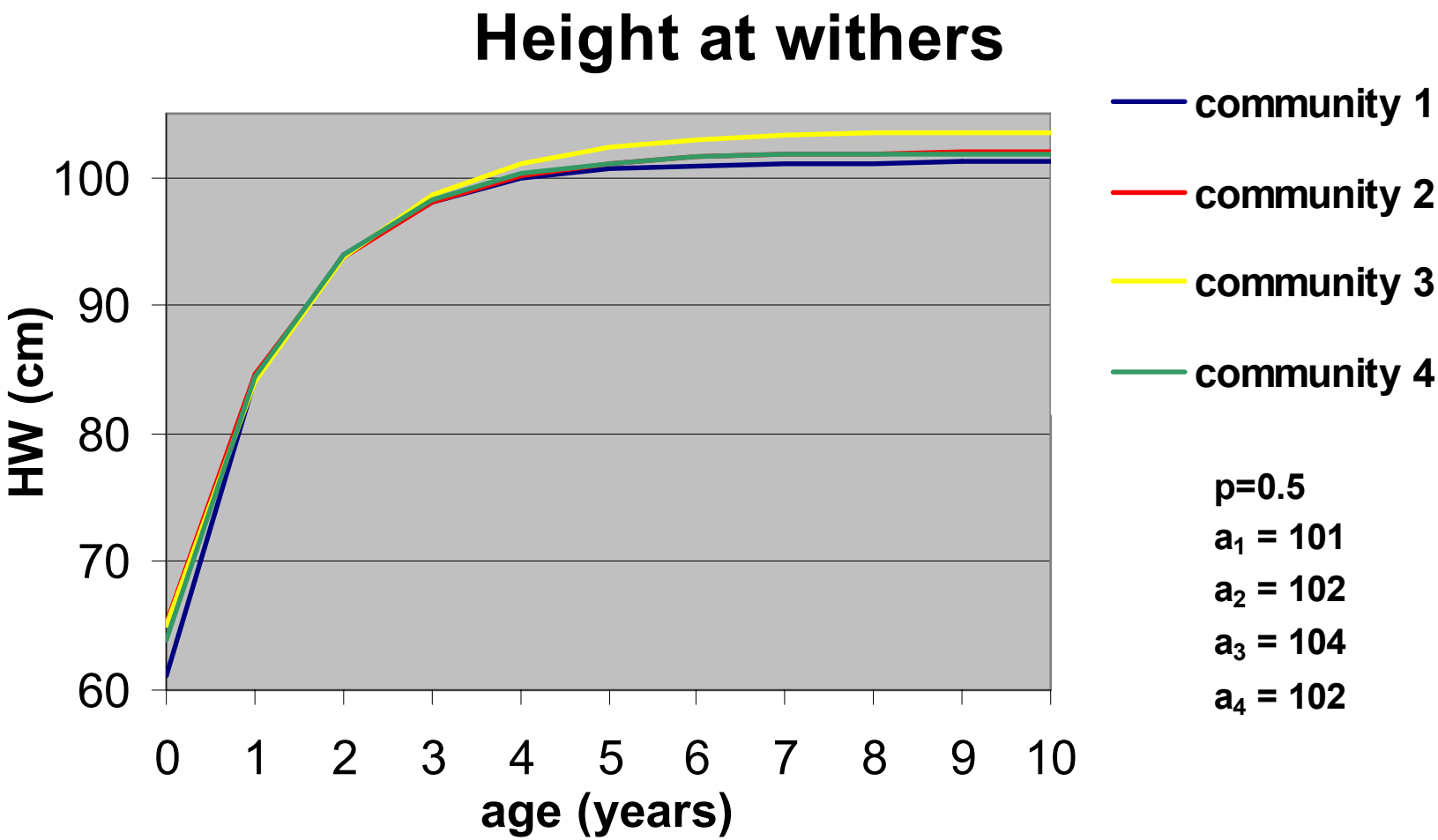
Comparison of the two types Th´ampulli and Kh´ara

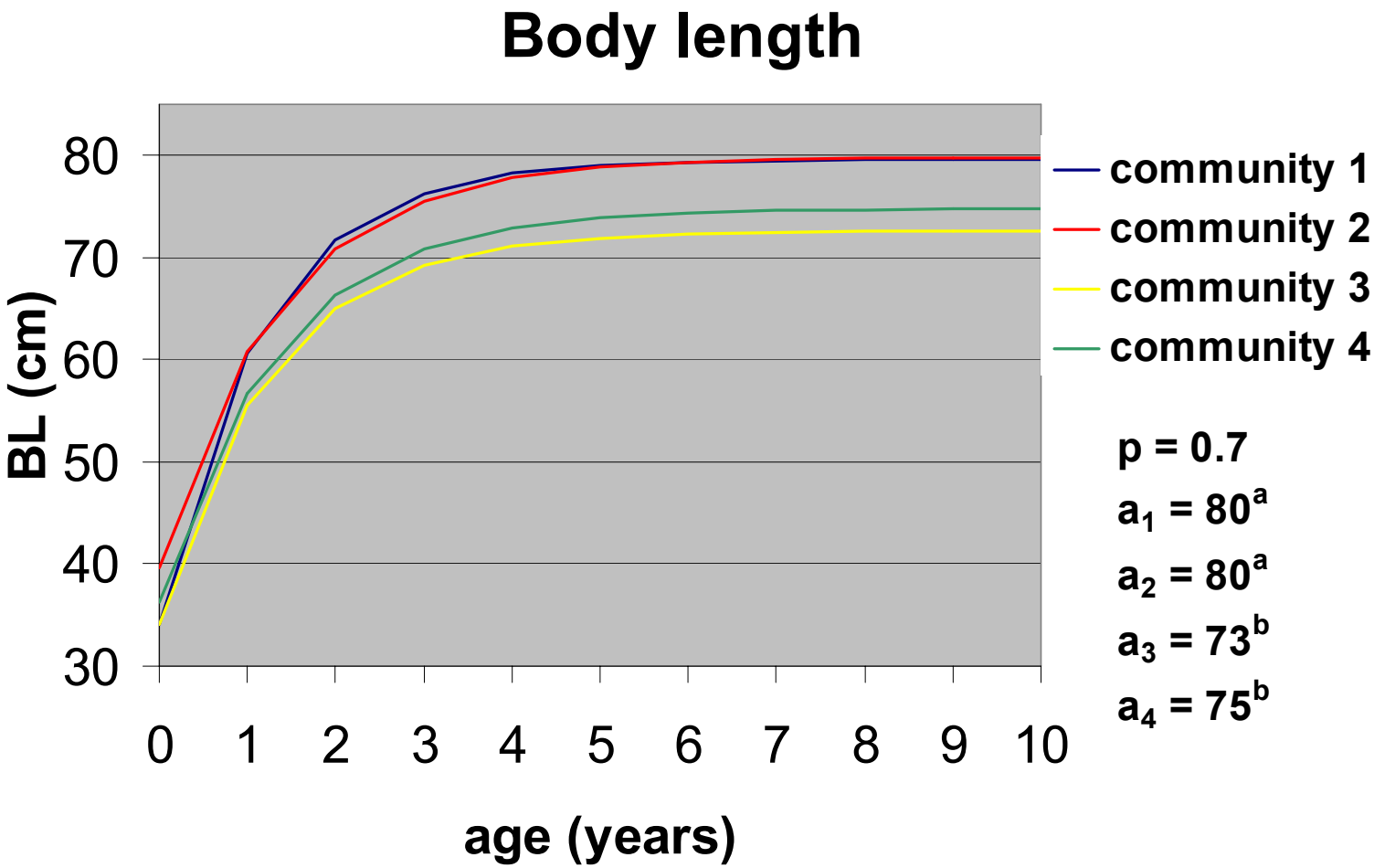

Height at withers
110
100
90
80
70
60
HW (cm)
0 1 2 3 4 5 6 7 8 9 10
age (years)
Kh females
Th females
a_{TH}=102
a_{KH}=104
k_{TH}=0,77
k_{KH}=0,76
p<0,001

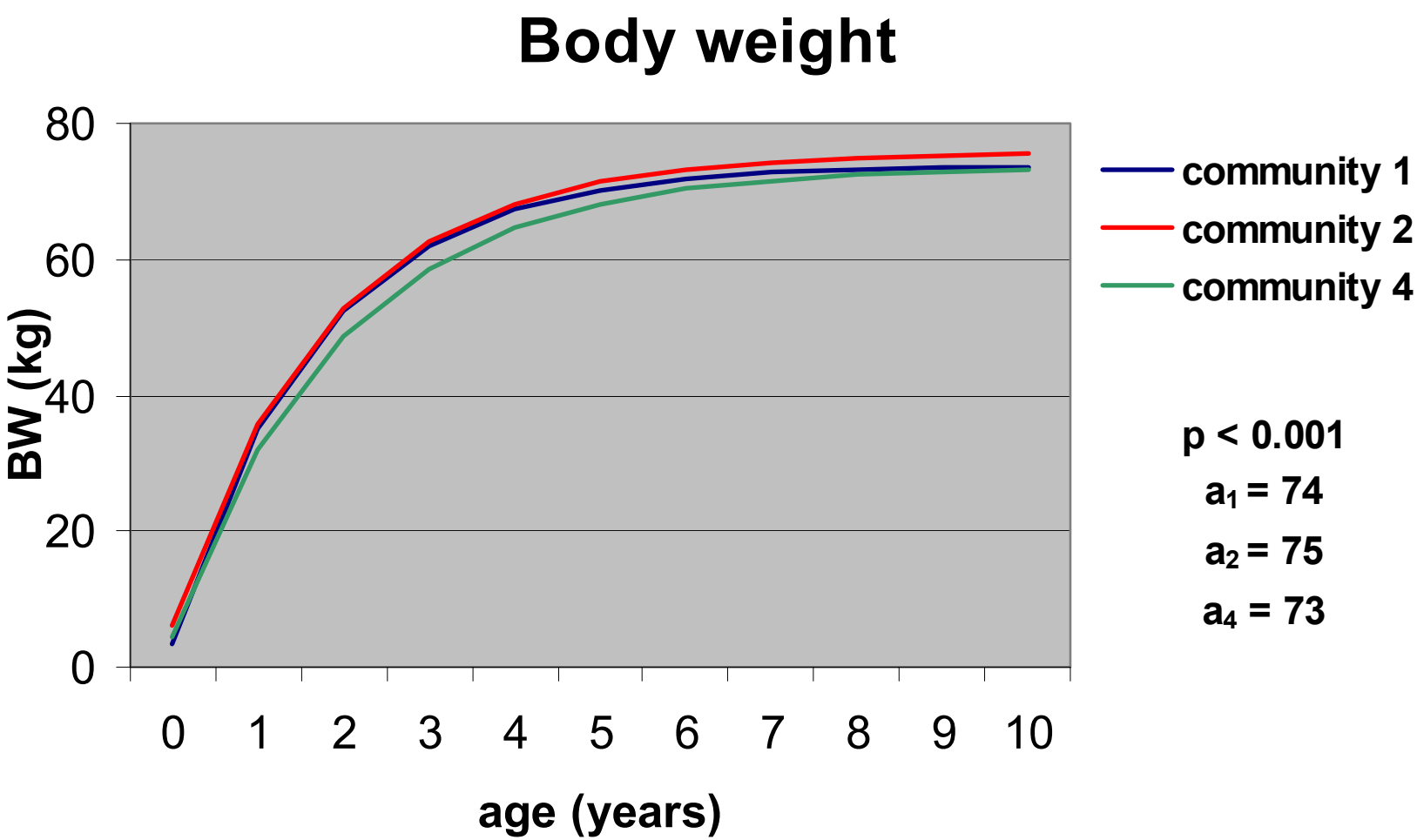

Body length
BL (cm)
80
70
60
50
40
30
0
1
2
3
4
5
6
7
8
9
10
age (years)
TH females
KH females
a_{TH}=78
a_{KH}=78
k_{TH}=0,75
k_{KH}=0,84
p=0,6


Body weight
80
60
40
20
0
BW (kg)
0 1 2 3 4 5 6 7 8 9 10
age (years)
TH females
KH females
a_{TH}=75
a_{KH}=74
k_{TH}=0,53
k_{KH}=0,61
p=0,64

Comparison of the 4 communities


Height at withers
HW (cm)
100
90
80
70
60
0
1
2
3
4
5
6
7
8
9
10
age (years)
community 1
community 2
community 3
community 4
p=0.5
a1 = 101
a2 = 102
a3 = 104
a4 = 102


Body length
BL (cm)
80
70
60
50
40
30
0
1
2
3
4
5
6
7
8
9
10
age (years)
community 1
community 2
community 3
community 4
p = 0.7
a1 = 80a
a2 = 80a
a3 = 73b
a4 = 75b


Body weight
80
60
40
20
0
BW (kg)
0
1
2
3
4
5
6
7
8
9
10
age (years)
community 1
community 2
community 4
p < 0.001
a1 = 74
a2 = 75
a4 = 73

Statistical model for heritabilities and genetic correlations

$$Y_{ijklmno} = \mu_i + F_{ij} + T_{ik} + S_{il} + YS_{im} + b_{1i}x + b_{2i}x^2 + a_{in} + pe_{in} + e_{ijklmno}$$

Estimates of heritabilities, genetic correlations and correlations between permanent environmental effects

	BW	HW	CC	BL	AC
BW	0.36	0.66	0.83	0.87	0.82
HW	0.63	0.27	0.81	0.77	0.65
CC	0.64	0.99	0.15	0.63	0.94
BL	0.62	0.99	0.99	0.09	0.55
AC	0.65	0.77	0.75	0.86	0.11

Estimates of heritabilities, genetic correlations and correlations between permanent environmental effects

	BW	HW	CC	BL	AC
BW	**0.36**	**0.66**	**0.83**	**0.87**	**0.82**
HW	**0.63**	**0.27**	**0.81**	**0.77**	**0.65**
CC	**0.64**	**0.99**	**0.15**	**0.63**	**0.94**
BL	**0.62**	**0.99**	**0.99**	**0.09**	**0.55**
AC	**0.65**	**0.77**	**0.75**	**0.86**	**0.11**

Estimates of heritabilities, genetic correlations and correlations between permanent environmental effects

	BW	HW	CC	BL	AC
BW	0.36	0.66	0.83	0.87	0.82
HW	0.63	0.27	0.81	0.77	0.65
CC	0.64	0.99	0.15	0.63	0.94
BL	0.62	0.99	0.99	0.09	0.55
AC	0.65	0.77	0.75	0.86	0.11

Conclusions 1

- Differences between sexes for some traits
- Differences between the two types are small
- Differences between communities are small
- Growth traits are in the range of results given in the literature for other populations in South America
- Compared to animals in Europe the llamas are smaller and lighter

Conclusions 2

- **First estimation of heritabilities with a reasonable number of animals**
- **Heritabilities are similar to estimates in other species**