Stability of development of overweight and obesity in boys and girls between 8 to 18 years of age. The Wrocław Growth Study

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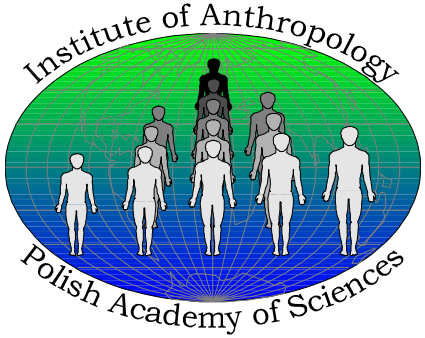
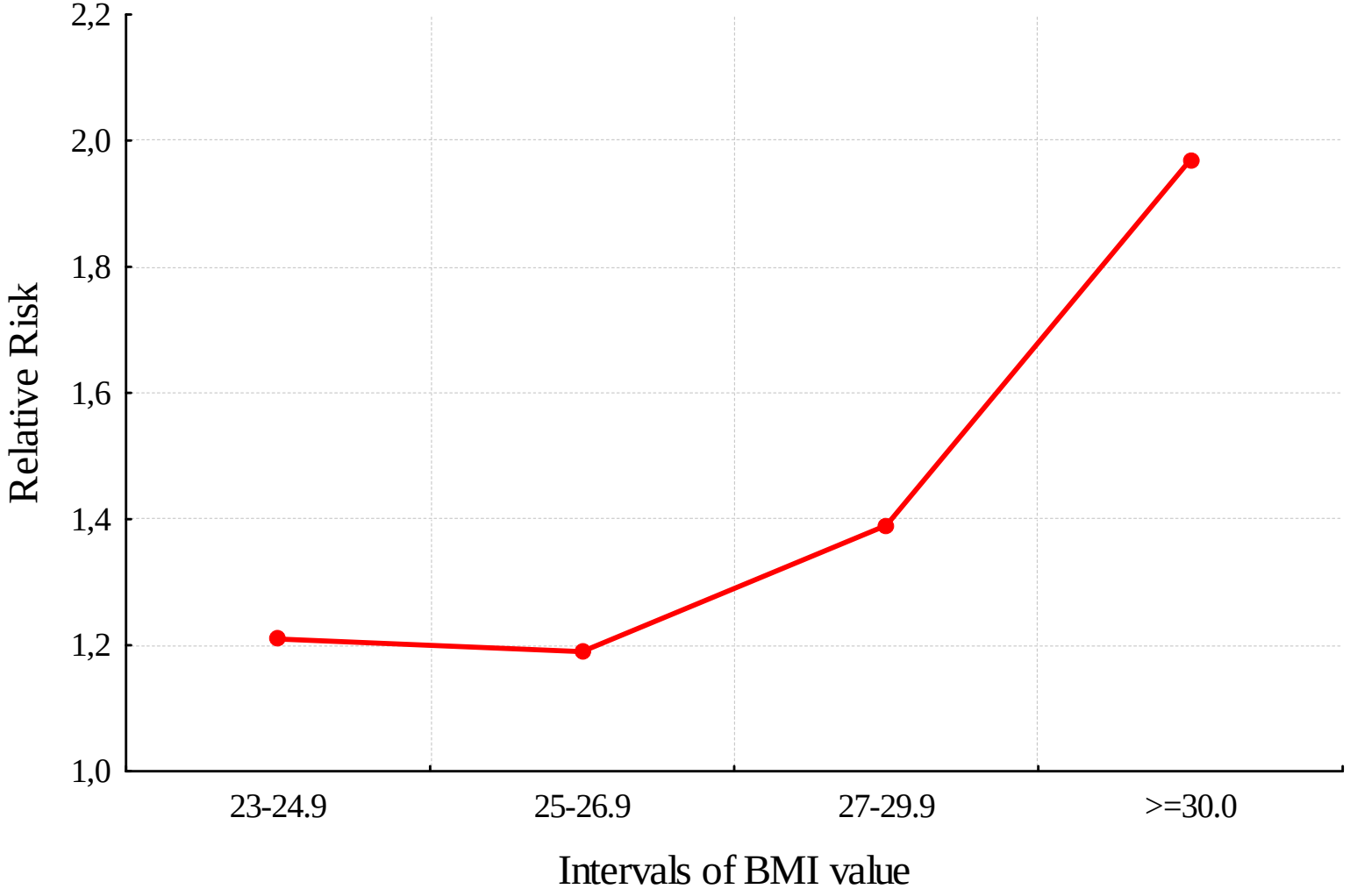


Excessive body fatness

- **Elevates risk of all-cause mortality**

Relationship between relative risk of mortality and intervals of BMI value in men older than 65 years in comparison to men with BMI < 23.0 *(Baik et al. 2000 Am J Epidemiol)*



Excessive body fatness

- **Increases the costs of treatment for its consequences**

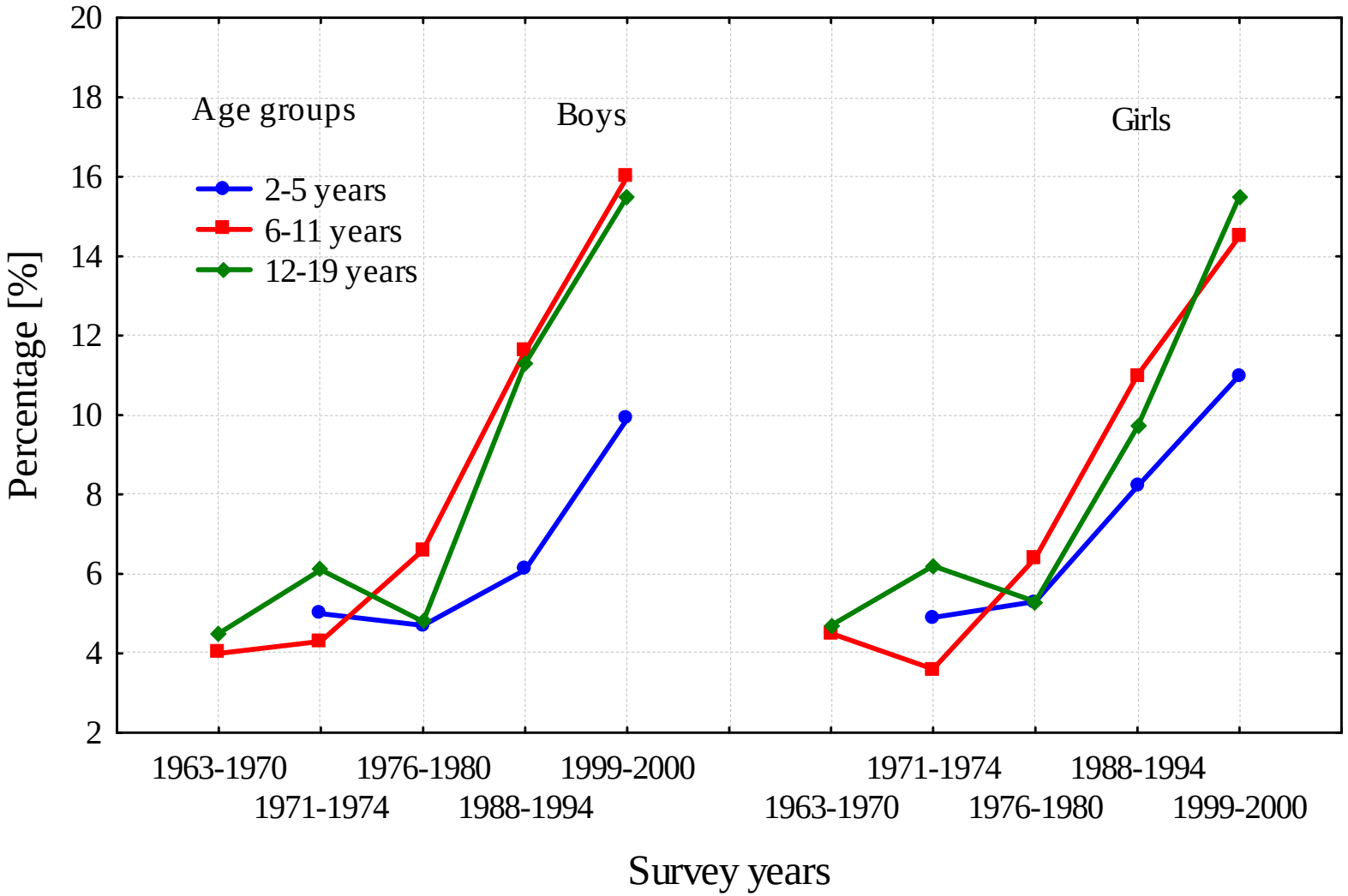
The consequences of obesity	Costs of treatment (million £)
Hypertension	134.8
Cardiovascular diseases	126.9
Type 2 diabetes	123.5
Osteoarthritis	34.8
Cancers	18.5
Stroke	16.7

Report by the Comptroller and Auditor General
HC 220 Session 2000-2001: 15 February 2001

Excessive body fatness

• Dramatically increased in all post-industrial countries

Prevalence of overweight in American children and adolescents 2-19 years of age in national surveys betweeen 1963 and 2000 *(Malina 2004, modified)*



Tracking of fatness

- Inter-age correlations between childhood (<13y) and adulthood (25-36y) are low **0.30**; between adolescence (13-14y) and adulthood (25-26y) range from **0.46** to **0.91** in males and from **0.60** to **0.78** in females *(Power at al. 1997)*;

- „adiposity rebound" – early increase of BMI after a low value at about 6y has higher risk of obesity in adulthood *(Rolland-Cachera et al. 1984)*.

The search for the factors responsible for the onset of obesity in childhood is of great importance at least for three reasons:

- The risk of becoming obese in adulthood is a few times, and in some population even 6.5 times greater in obese than in normal-weight children *(Serdula et al. 1993)*;

- The risk of health complications related to obesity in adult life is higher the longer the obesity persists *(Bjorntrop 1984, 1985)*;

- Children are more susceptible not only to preventive actions but also to changes and elimination of already existing health risk-factors and habits *(Epstein et al. 1995).*

Aim of the study

- To estimate the risk of overweight and obesity at the age of 18 years in relation to the occurrence of overweight and obesity at ages 8 to 17 years in boys and girls as represented in the Wrocław Growth Study;

- To track the development of BMI in boys and girls between 8 to 18 years in relation to BMI values at ages 8 and 18 years.

Materials

- 198 boys and 165 girls from Wrocław Growth Study (WGS) examined from 8 to 18 years of age in 1961-1972 years *(Bielicki and Waliszko 1975; Waliszko and Jedlińska 1976)*

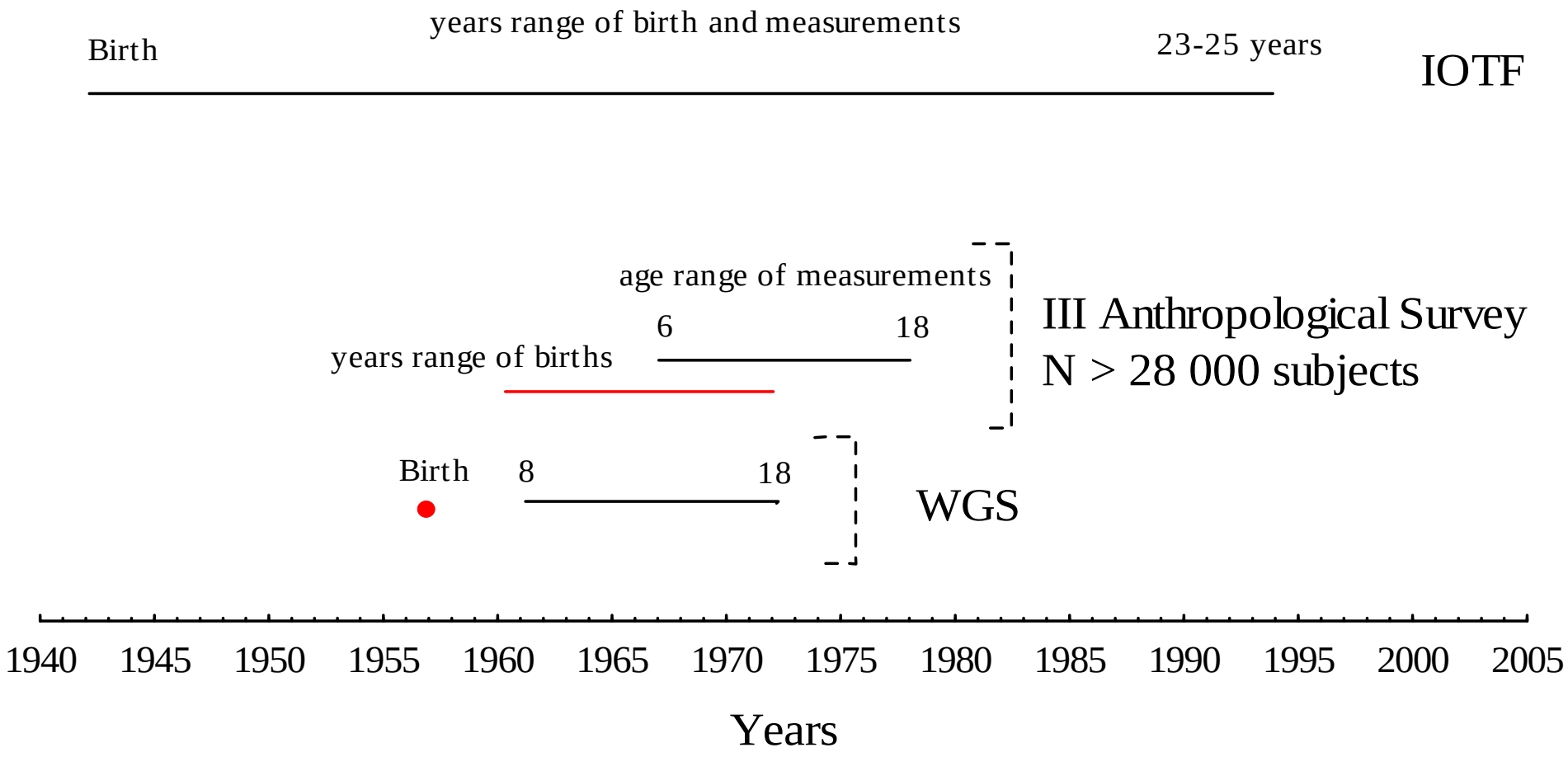
- Measures: height; weight; BMI

Methods

- LMS *(Cole and Green 1992)*
- Estimates of risk: relative risk (RR), odds ratio (OR), risk differences (RD) *(Streiner 1998)*
- Preece-Baines model 1 *(Preece and Baines 1976)*
- Two-way analysis of variance with repeated measurements.

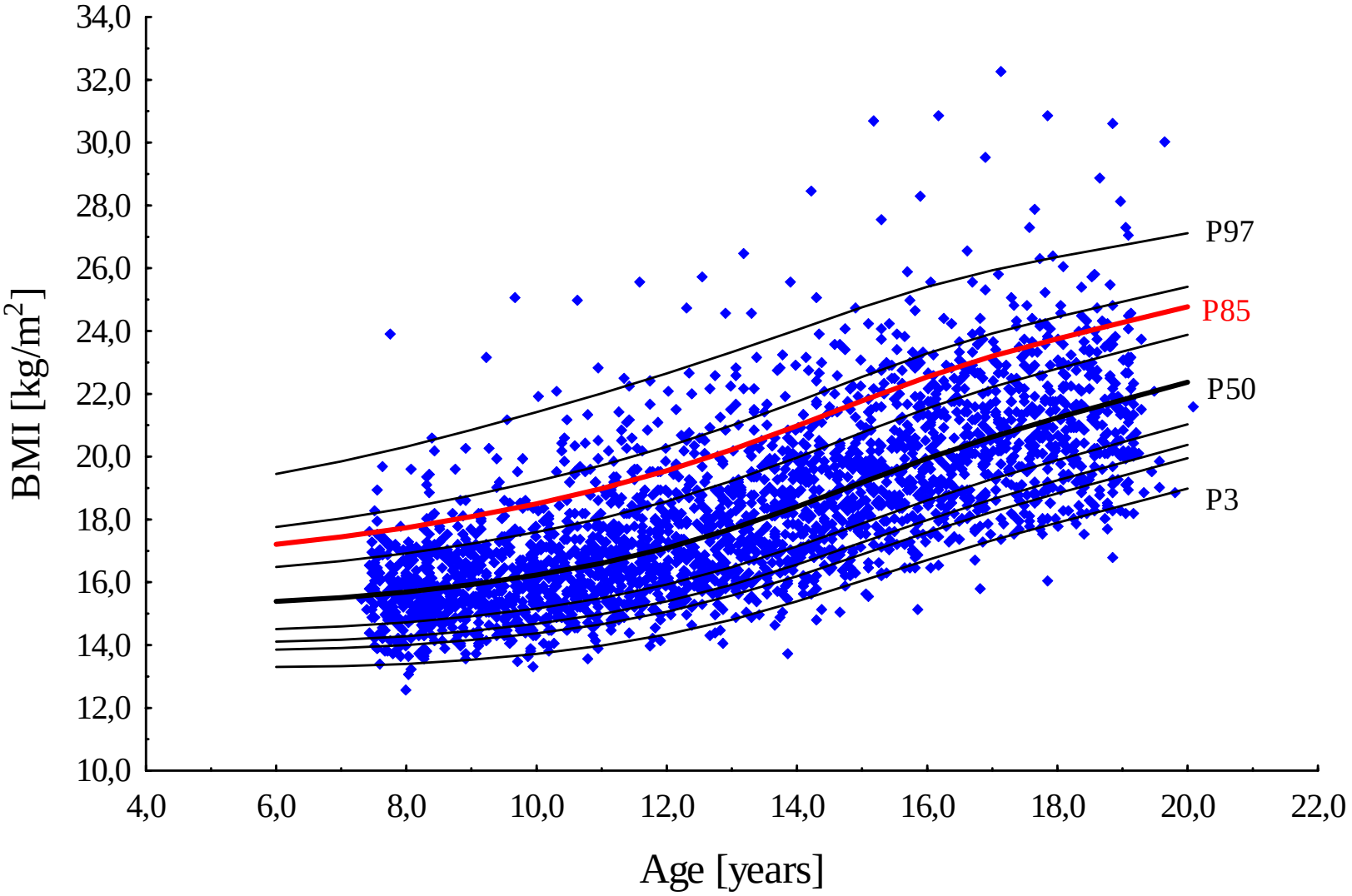
Analysis I

Reference population



Definition of overweight and obesity

BMIs of BOYS from WGS measured between 8 to 18 years of age on the centiles for III Anthropological Survey conducted in 1978

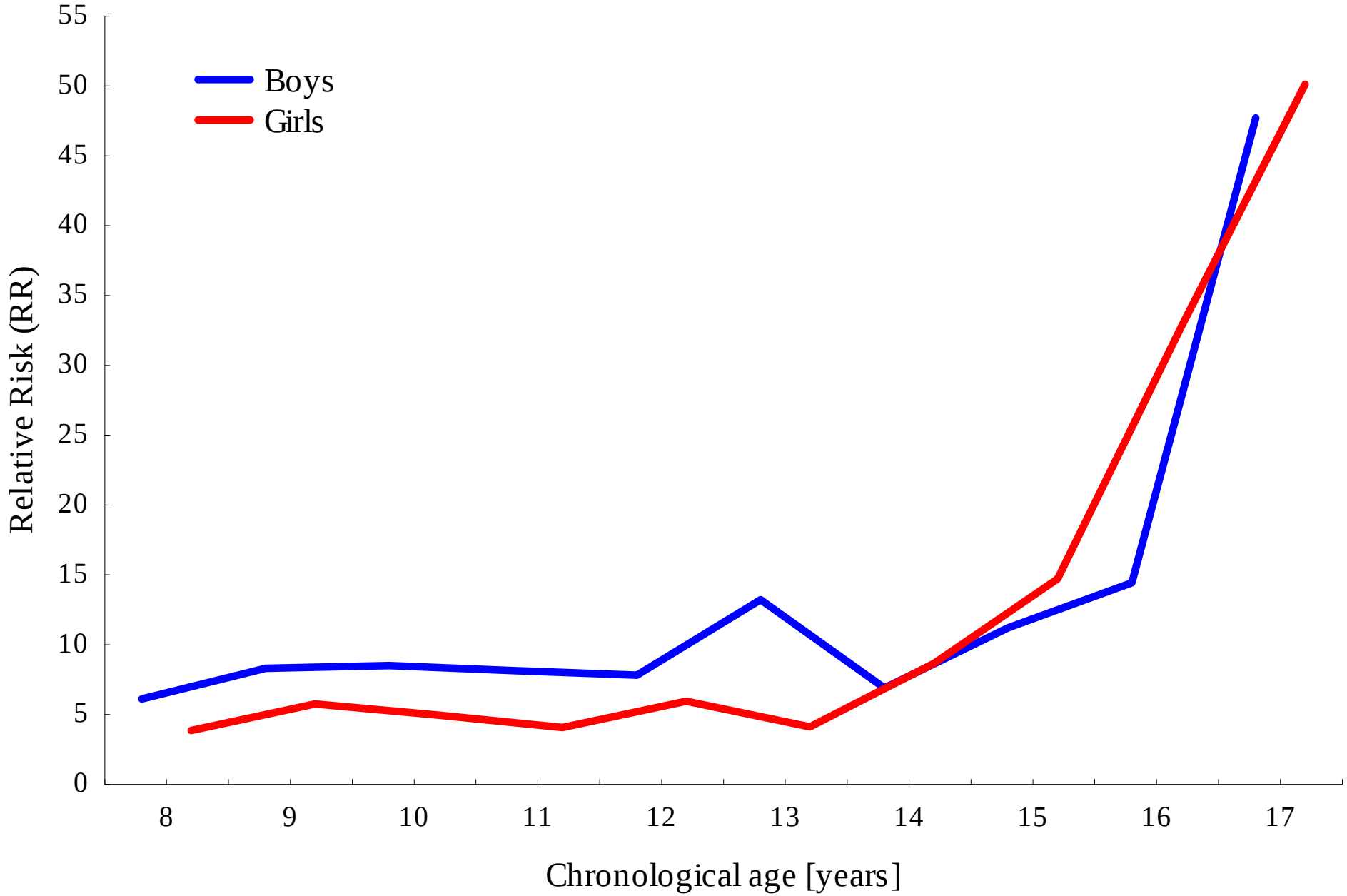


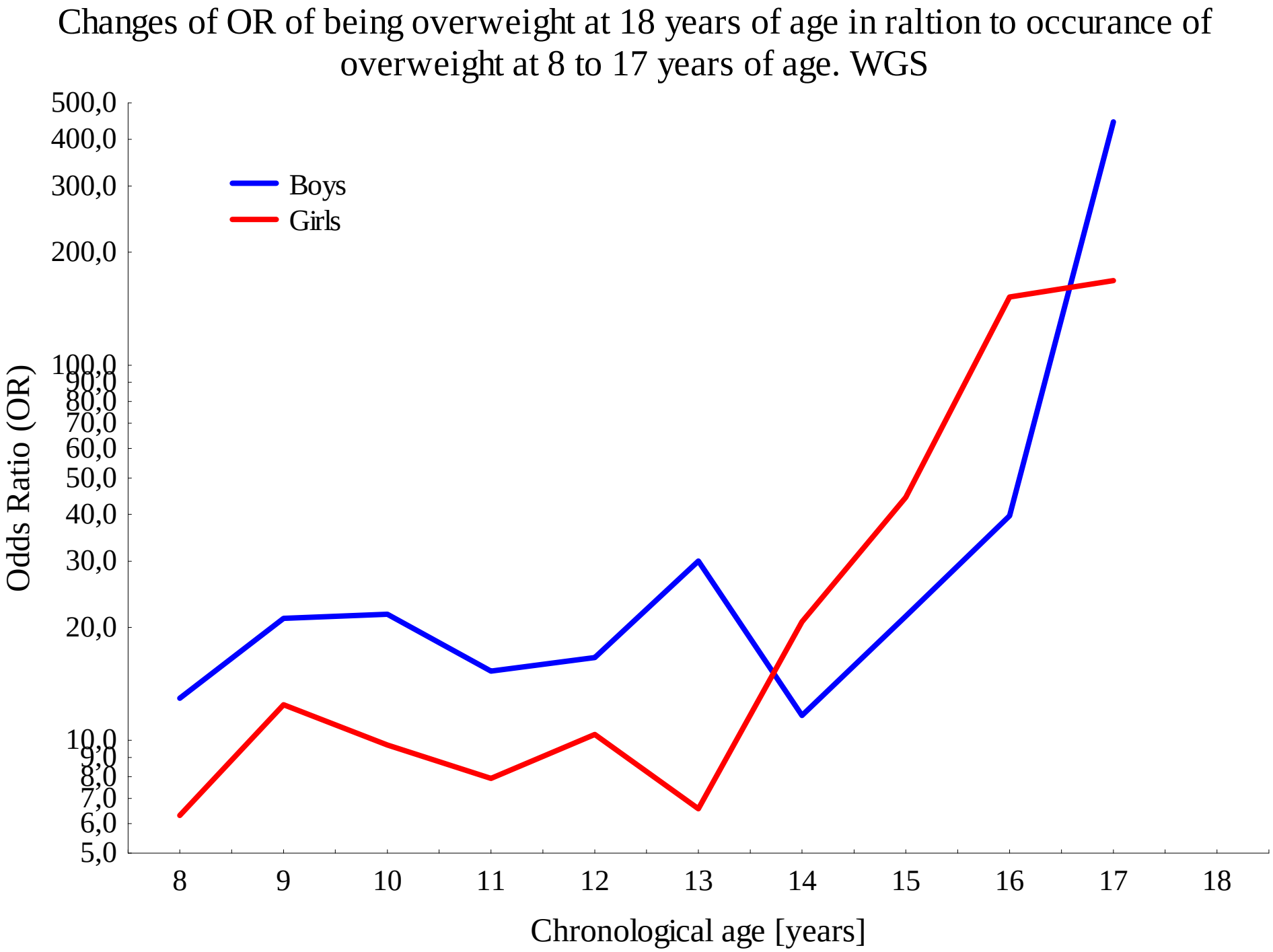
Estimates of risk

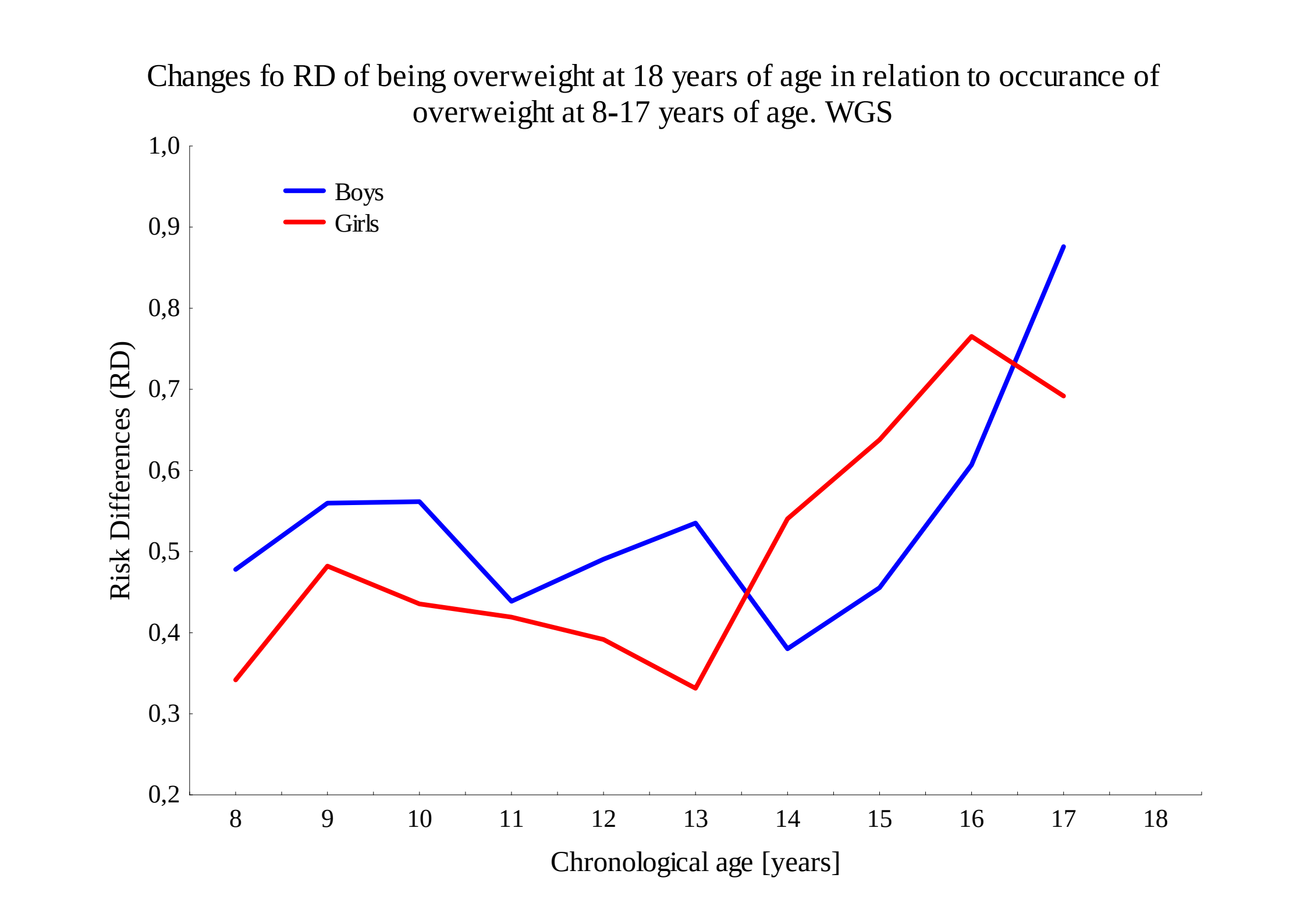
- **Relative risk (RR) -** the probability for overweight children at the particular age to be overweight at age 18 years compared to their normal peers. [RR=(A/A+B)/(C/C+D)];

- **Odds ratio (OR) –** how many times it is more likely for overweight children at a particular age to be overweight at age 18 years compared to their normal peers. [OR=(A/C)/(B/D)];

- **Risk differences (RD) -** how much the risk for overweight children at the particular age to be overweight at the age 18 differs in comparison with normal-weighted peers. [RD=(A/A+B) – (C/C+D)].


Changes of RR of being overweight at 18 years of age in relation to occurance of overweight at 8-17 years of age. WGS
Boys
Girls
Relative Risk (RR)
0
5
10
15
20
25
30
35
40
45
50
55
8
9
10
11
12
13
14
15
16
17
Chronological age [years]


Changes of OR of being overweight at 18 years of age in raltion to occurance of overweight at 8 to 17 years of age. WGS
Boys
Girls
Odds Ratio (OR)
500,0
400,0
300,0
200,0
100,0
90,0
80,0
70,0
60,0
50,0
40,0
30,0
20,0
10,0
9,0
8,0
7,0
6,0
5,0
8
9
10
11
12
13
14
15
16
17
18
Chronological age [years]


Changes fo RD of being overweight at 18 years of age in relation to occurance of overweight at 8-17 years of age. WGS
Boys
Girls
Risk Differences (RD)
1,0
0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
8
9
10
11
12
13
14
15
16
17
18
Chronological age [years]

Analysis II

Definition of groups

- Based on terciles of BMI at 8 years of age boys and girls were divided into 3 groups: **Fat, Normal, Lean** and tracked forward to age of 18 years. Factor FNL8

- Based on terciles of BMI at 18 years for boys and 17 for girls subjects were divided into 3 groups: **Fat, Normal, Lean** and tracked backward to age of 8 years. Factor FNL18 (17)

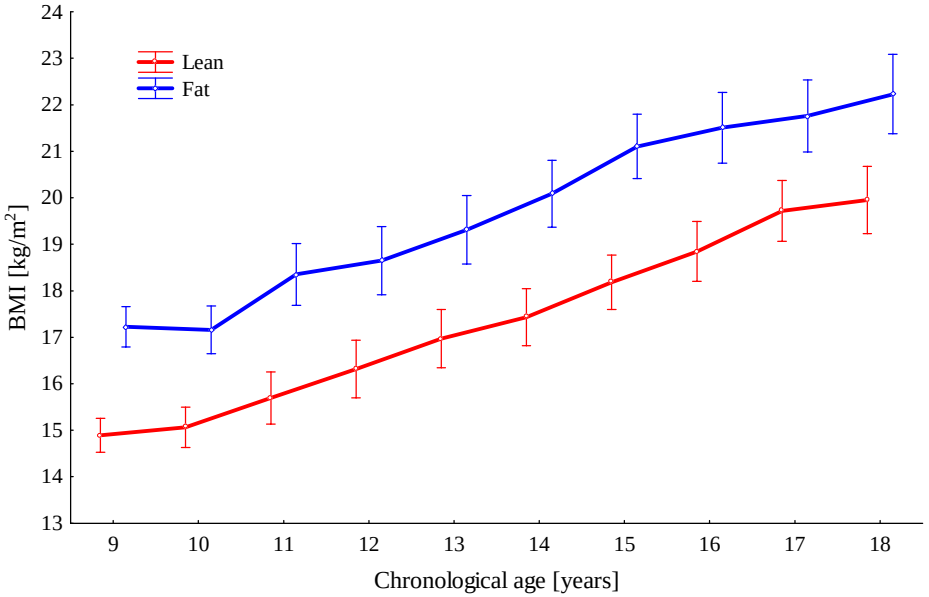
Results of analysis of variance - Boys

Dependent variable: BMI between 8-18 years;
Factors: Tempo of maturation (3 categories), FNL at 8 and 18 years (3 categories), age classes

	SS	df	MS	F	p
BMI at 8 years					
Age	1814,1	9	201,67	339,2	<0.001
Age x FNL8	11,54	18	0,64	1,08	0,3696
Age x Maturation	18,60	18	1,03	1,74	0,0293
BMI at 18 years					
Age	1763,6	9	195,95	386,78	<0.001
Age x FNL18	68,61	18	3,81	7,52	<0.001
Age x Maturation	15,03	18	0,84	1,65	0,0442

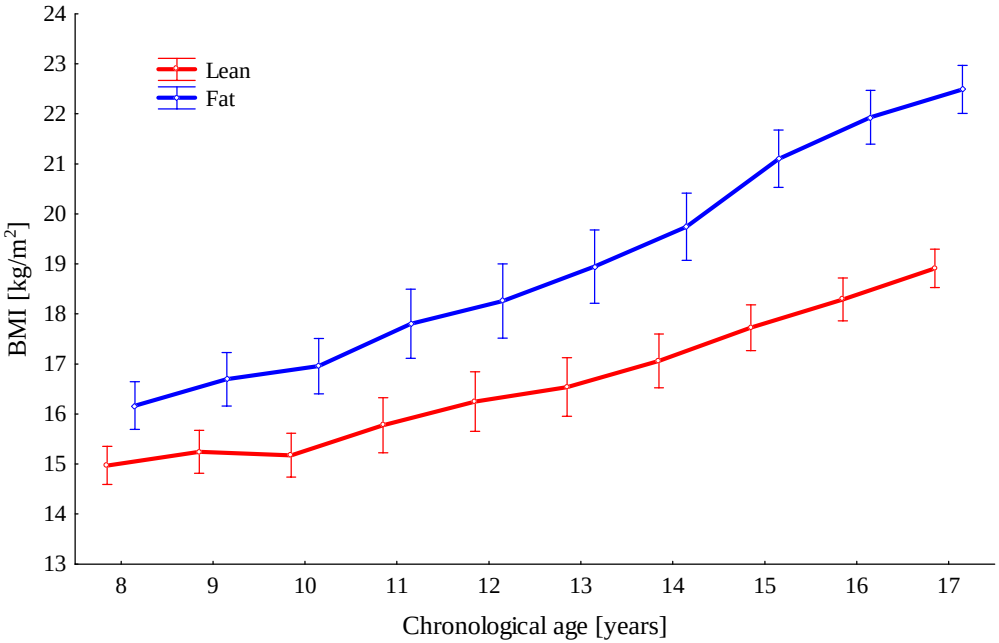
Changes of mean BMI by age in two extreme groups of boys (Lean vs. fat) defined based on tertiles of BMI at 8 years of age

Interaction effect: F(18, 630)=1.0788, p=0.36959



Changes of mean BMI by age in two extreme groups of boys (Lean vs. fat) defined based on terciles of BMI at 18 years of age.

Interaction effect: F(18, 630)=7.5231, p< 0.001



Results of analysis of variance - Girls

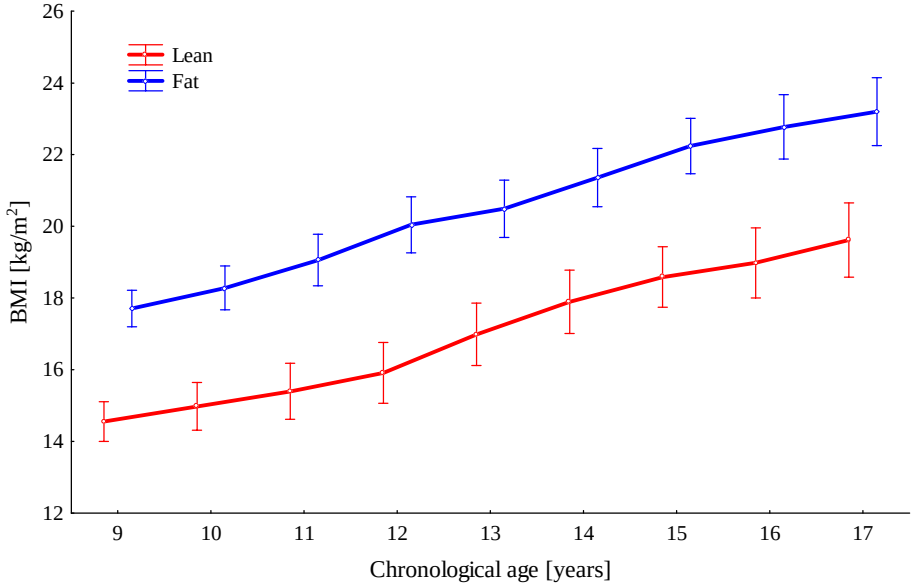
Dependent variable: BMI between 8-17 years;

Factors: Tempo of maturation (3 categories), FNL at 8 and 17 years of age (3 categories), age classes

	SS	df	MS	F	p
BMI at 8 years					
Age	1672.1	8	209.01	267.08	<0.001
Age x FNL8	9.61	16	0.60	0.77	0.7236
Age x Maturation	36.36	16	2.27	2.90	0.0001
BMI at 17 years					
Age	1896,0	8	237,01	410,41	<0.001
Age x FNL17	88,48	16	5,53	9,58	<0.001
Age x Maturation	42,62	16	2,66	4,61	<0.001

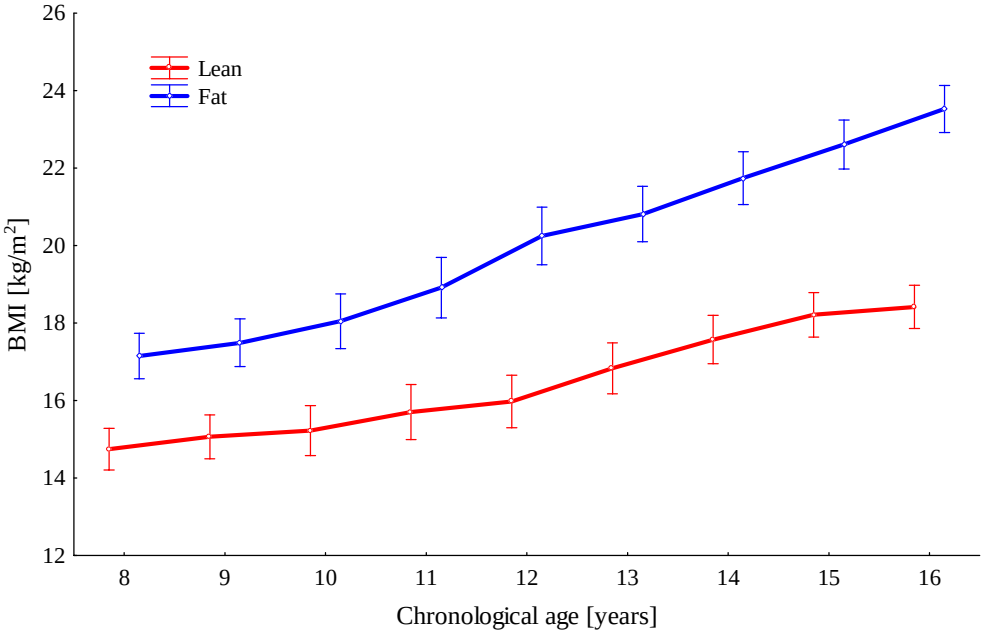
Changes of mean BMI by age in two extreme groups of girls (lean vs. fat) defined based on terciles of BMI at 8 years of age.

Interaction effect: F(16, 560)=0.76715, p=0.72358



Changes of mean BMI by age in two extreme groups of girls (Lean vs. fat) defined based on terciles of BMI at 17 years of age.

Interaction effect: F(16, 560)=9.5760, p=0.0000



Conclusion

- Risk of being overweight in adulthood dramatically increases for overweight subjects during adolescence. Adolescence seems to be **a critical period** for the development of overweight in early adulthood.

- To a large extent, placement on the centile distribution of BMI is determined in childhood. As many as **57%** of boys and **46%** of girls overweight at 18 years of age were overweight already at 8 years of age.

Thank you very much for your attention

Wyniki analizy składowych głównych

Analizie poddano wartości 3 fałdów skórno-tłuszczowych
Przekształcone wg wzory: log(fałd/suma fałdów) *(Tanner i Healy 1981)*

	Chłopcy		Dziewczęta	
Fałdy	**PC1**	**PC2**	**PC1**	**PC2**
Podłopatkowy	-0,489	0,869	-0,263	-0,962
Ramieniowy	0,993	-0,048	-0,890	0,441
Brzuszny	-0,802	-0,590	0,982	0,142
Wartości własne	1.868	1,107	1,828	1,141
Udział (%)	62,3	36,9	60,9	38,0

Wyniki analizy wariancji - chłopcy

Zmienna zależna: wartości PC1 w wieku 8-18;

Czynniki: Tempo dojrzewania (3 kat), PC1 w wieku 8 i 18 lat (3 kat),

klasy wieku

	SS	df	MS	F	p
PC1 8 lat					
Wiek	293,16	9	32,57	111,33	0,0000
Wiek x PC1	5,02	18	0,28	0,95	0,5123
Wiek x Tempo d.	5,30	18	0,29	1,01	0,4505
PC1 18 lat					
Wiek	256,84	9	28,54	91,90	0,0000
Wiek x PC1	8,33	18	0,46	1,49	0,0873
Wiek x Tempo d.	5,20	18	0,29	0,93	0,5408

Wyniki analizy wariancji - dziewczęta

Zmienna zależna: wartości PC1 w wieku 8-17;

Czynniki: Tempo dojrzewania (3 kat), PC1 w wieku 8 i 17 lat (3 kat),

klasy wieku

	SS	df	MS	F	p
PC1 8 lat					
Wiek	98,01	8	12,25	29,08	0,0000
Wiek x PC1	5,71	16	0,36	0,85	0,6319
Wiek x Tempo d.	6,79	16	0,42	1,01	0,4473
PC1 17 lat					
Wiek	127,42	8	15,93	36,58	0,0000
Wiek x PC1	7,57	16	0,47	1,09	0,3658
Wiek x Tempo d.	10,56	16	0,66	1,52	0,0899

Wnioski II

- **Stopień dystrybucji tkanki skórno-tłuszczowej w dzieciństwie nie determinuje jej dystrybucji w okresie dorosłym.**
- **Działania profilaktyczne zapobiegające rozwojowi nadwagi i otyłości w okresie dorosłym powinny obejmować szczególnie dzieci z nadwagą w okresie dzieciństwa i pokwitania.**