

# Predictive value of overweight in early detection of metabolic syndrome in schoolchildren

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# Introduction (1)

- Metabolic syndrome is a set of interrelated risk factors for development of cardiovascular diseases, and diabetes mellitus type II
- Components:
  1. overweight or obesity
  2. elevated blood pressure
  3. dyslipidemia
  4. glucose intolerance

*Reaven GM. Banting lecture 1988. Role of insulin resistance in human disease. Diabetes 1988; 37:1595-607.*

*Kaplan NM. The deadly quartet and the insulin resistance syndrome: an historical overview. Hypertens Res 1996;19 Supl 1:S9-11.*

*DeFronzo RA, Ferrannini E. Insulin resistance. A multifaceted syndrome responsible for NIDDM, obesity, hypertension, dyslipidemia, and atherosclerotic cardiovascular disease. Diabetes Care 1991;14:173-94.*

# Introduction (2)

- Diagnostic Criteria:
  - WHO
  - NCEP / ATP III
  - IDF
- Diagnosis in children: specifics regarding age, growth and development, reference values for blood pressure and waist circumference ➡ IDF criteria

*Zimmet P, Alberti KG, Kaufman F, i sur. IDF Consensus Group. The metabolic syndrome in children and adolescents — an IDF consensus report. Lancet 2007;369:2059–61.*

*Steinberger J, Daniels SR, Eckel RH, Hayman L, Lustig RH, McCrindle B, Mietus-Snyder ML; American Heart Association Atherosclerosis, Hypertension, and Obesity in the Young Committee of the Council on Cardiovascular Disease in the Young; Council on Cardiovascular Nursing; and Council on Nutrition, Physical Activity, and Metabolism. Progress and challenges in metabolic syndrome in children and adolescents: a scientific statement from the American Heart Association Atherosclerosis, Hypertension, and Obesity in the Young Committee of the Council on Cardiovascular Disease in the Young; Council on Cardiovascular Nursing; and Council on Nutrition, Physical Activity, and Metabolism. Circulation 2009 3;119:628-47.*

*Definition, diagnosis and classification of diabetes mellitus and its complications: Report of a WHO Consultation. Part 1: diagnosis and classification of diabetes mellitus. Geneva : World Health Organization; 1999. Dostupno na //http://whqlibdoc.who.int/hq/1999/who\_ncd\_ncs\_99.2.pdf. Pristupljeno: 23. ožujka 2015.*

# Introduction (3)

## Prevalence of Metabolic Syndrome in Children:

- the differences regarding the: age, gender, weight status and applied criteria
  - NCEP / ATP III criteria: 3% - 11%
    - In overweight and obese children 10% - 29%
  - IDF criteria: 0 - 2%
    - In overweight and obese children 5% - 33%

*Rizk N, Amin M, Yousef M. A pilot study on metabolic syndrome and its associated features among Qatari schoolchildren. Int J Gen Med 2011;4: 521–5.*

*Kim SJ, Lee J, Nam CM, Lee SJ. Impact of Obesity on Metabolic Syndrome among Adolescents as Compared with Adults in Korea. Yonsei Med J 2011; 52:746-52.*

*Alvarez MM. Prevalence of metabolic syndrome and of its specific components among adolescents from Niterói City, Rio de Janeiro State, Brazil. Arq Bras Endocrinol Metab 2011;55:164-170.*

*Wee BS. Risk of metabolic syndrome among children living in metropolitan Kuala Lumpur: A case control study. BMC Public Health 2011;11:333.*

*Sangun Ö, DüNDAR B, Köşker M, Pirgon Ö, DüNDAR N. Prevalence of metabolic syndrome in obese children and adolescents using three different criteria and evaluation of risk factors. J Clin Res Pediatr Endocrinol 2011;3:70-6.*

# Introduction (4)

Overweight and obesity as risk factors for development of metabolic syndrome

- Increased prevalence of metabolic syndrome and DM type II in children due to growing epidemic of obesity
- Excess body weight in childhood have a significant effect on blood pressure, lipids, insulin levels and insulin resistance

*Grundy SM. Metabolic syndrome pandemic. Arterioscler Thromb Vasc Biol 2008;28:629-36.*

*Cook S, Weitzman M, Auinger P, Nguyen M, Dietz WH. Prevalence of a metabolic syndrome phenotype in adolescents: findings from the third National Health and Nutrition Examination Survey, 1988-1994. Arch Pediatr Adolesc Med 2003;157:821-7.*

*L'Allemand-Jander D. Clinical diagnosis of metabolic and cardiovascular risks in overweight children: early development of chronic diseases in the obese child. Int J Obes (Lond) 2010;34 Supl 2:S32-6.*

# Objective

- The aim of the study was to determine predictive value of overweight in early school age in detection of metabolic syndrome in adolescence

# Methods and participants (1)

- longitudinal study included 447 respondents (49.9% males) in school year 2014/2015, 46.1% of initial cohort from a representative sample of first-grade students of elementary school in year 2003/2004
- data were obtained by survey, anthropometry and laboratory blood testing
- International Diabetes Federation (IDF) criteria were used to diagnose metabolic syndrome
- data was analyzed using descriptive statistics, univariate and multivariate logistic regressions

# Methods and participants (2)

- IDF criteria:

Age (years)	Waist circumference (cm)	Triglycerides (mmol/L)	HDL - cholesterol (mmol/L)	Blood pressure (mmHg)	Glucose (mmol/L)
6 to < 10	≥ 90.th percentile				
10 to < 16	≥ 90.th percentile or criteria for adults if it is lower	≥ 1.7 mmol/L	< 1.03 mmol/L	Systolic ≥ 130 mmHg and/or diastolic ≥ 85 mmHg	≥ 5.6 mmol/L
16+	≥ 94 cm (M) ≥ 80 cm (F)	≥ 1.7 mmol/L	≤ 1.03 mmol/L (M) ≤ 1.29 mmol/L (F)	Systolic ≥ 130 mmHg and/or diastolic ≥ 85 mmHg or diagnosed and treated hypertension	≥ 5.6 mmol/L or diagnosed and treated diabetes mellitus (IDF criteria for adults)

Zimmet P, Alberti G, Kaufman F, et al. IDF Consensus Group. The metabolic syndrome in children and adolescents — an IDF consensus report. *The Lancet* 2007;369:2059–61.



# Results (1)

Prevalence of metabolic syndrome in adolescents regarding the weight status in survey 2014/2015.										
Metabolic syndrome	Underweight		Normal weight		Overweight		Obese		Total	
	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
	N	N	N	N	N	N	N	N	N	N
	(Proportion)	(Proportion)	(%)	(%)	(Proportion)	(Proportion)	(Proportion)	(Proportion)	(%)	(%)
Yes	0 (0/10)	0 (0/16)	0 (0.0)	0 (0.0)	<b>2</b> <b>(2/40)</b>	<b>1</b> <b>(1/27)</b>	<b>3</b> <b>(3/9)</b>	<b>5</b> <b>(5/16)</b>	5 (2.2)	6 (2.7)
No	10 (10/10)	16 (16/16)	164 (100.0)	165 (100.0)	38 (38/40)	26 (26/27)	6 (6/9)	11 (11/16)	218 (97.8)	218 (97.3)
Total	10	16	164 (100.0)	165 (100.0)	40	27	9	16	223 (100.0)	224 (100.0)

# Results (2)

Metabolic syndrome	Prevalence of metabolic syndrome in adolescents regarding the weight status in survey 2003/2004.									
	Underweight		Normal weight		Overweight		Obese		Total	
	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
	N (Proportion)	N (Proportion)	N (%)	N (%)	N (Proportion)	N (Proportion)	N (Proportion)	N (Proportion)	N (%)	N (%)
Yes	0 (0/16)	0 (0/9)	<b>2</b> <b>(1.2)</b>	<b>2</b> <b>(1.1)</b>	<b>2</b> <b>(2/27)</b>	<b>1</b> <b>(1/18)</b>	<b>1</b> <b>(1/13)</b>	<b>3</b> <b>(3/8)</b>	5 (2.2)	6 (2.7)
No	16 (16/16)	10 (9/9)	165 (98.8)	187 (98,9)	25 (25/27)	17 (17/18)	12 (12/13)	5 (5/8)	218 (97.8)	218 (97.3)
Total	16	9	167 (100.0)	189 (100.0)	27	18	13	8	223 (100.0)	224 (100.0)

# Results (3)

Number of criteria for metabolic syndrome	Previously normalweight -currently normalweight	Previously overweight- currently overweight	Previously obese- currently obese	Previously underweight- currently underweight	Moved to group with higher BMI	Moved to group with lower BMI	Total
	N (%)	N (Proportion)	N (Proportion)	N (Proportion)	N (Proportion)	N (Proportion)	N (%)
None	286 (97.9%)	13 (13/20)	1 (1/9)	9 (9/9)	43 (43/69)	47 (47/48)	399 (89.3%)
Increased waist circumference	4 (1.4%)	3 (3/20)	1 (1/9)	0 (0/9)	8 (8/69)	1 (1/48)	17 (3.8%)
Increased waist circumference + 1 criteria	2 (0.7%)	3 (3/20)	3 (3/9)	0 (0/9)	12 (12/69)	0 (0/48)	20 (4.5%)
Increased waist circumference +2 criteria	0 (0.0%)	<b>1 (1/20)</b>	<b>4 (4/9)</b>	0 (0/9)	<b>5 (5/69)</b>	0 (0/48)	10 (2.2%)
Increased waist circumference + 3 criteria	0 (0.0%)	0 (0/20)	0 (0/9)	0 (0/9)	1 (1/69)	0 (0/48)	1 (0.2%)
Total	292 (100%)	20	9	9	69	48	447 (100%)

# Results (4)

## Logistic regressions

Characteristic	B	S.E.	Wald	df	Sig.	Exp(B)	95% CI of EXP(B)	
<b>Weight status</b>								
Normal weight (ref)			11.67	3	.009			
Underweight	-16.753	7211.24	.00	1	.998	.00	0.00	
Overweight	2.826	1.00	8.04	1	<b>.005</b>	16.88	2.39	119.02
Obese	2.462	.90	7.49	1	<b>.006</b>	11.73	2.01	68.37
<b>Systolic and/or diastolic blood pressure</b>								
Normal (ref)			7.23	2	.027			
Hypertension	2.355	.98	5.78	1	<b>.016</b>	10.54	1.55	71.90
Prehypertension	1.978	.955	4.30	1	<b>.038</b>	7.23	1.11	46.96
<b>Exercise in sports club</b>								
Da (ref) vs ne	1.838	.80	5.32	1	<b>.021</b>	6.29	1.32	29.98
<b>Stomach pain</b>								
Rarely or never (ref)			.99	2	.609			
Daily or more than once a week	1.309	1.33	.97	1	.324	3.70	.27	49.91
Once a month or more often	.017	.99	.00	1	.986	1.02	.15	7.05
<b>Sense of irritability</b>								
Rarely or never (ref)			5.50	2	.064			
Daily or more than once a week	-16.212	7118.93	.00	1	.998	.00	0.00	
Once a month or more often	1.968	.84	5.50	1	<b>.019</b>	7.15	1.38	37.02
Constant	-7.223	1.17	37.87	1	.000	.00		

# Conclusion

- Results showed:
  - prevalence of metabolic syndrome among 17-18 years old adolescents of 2.5% (2.2% in males, and 2.7% in females)
    - highest in the group of obese adolescents (eight of 25), and in the group of overweight three of 67
    - according to the weight status in early school age, the highest prevalence of metabolic syndrome was found among those who were obese (four of 21); followed by overweight (three of 45), and in group of normally weighed was 1.1%
- Childhood overweight, obesity, prehypertension, hypertension, and sense of irritability were significant predictors of metabolic syndrome in adolescence
- School Health Service in Croatia during routine health examination could detect children with risk factors and refer them to laboratory tests for early detection of metabolic syndrome