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SECULAR TRENDS IN BMI AND WAIST CIRCUMFERENCE AND THE PREVALENCE OF OVERWEIGHT AND OBESITY IN AUSTRIAN CANDIDATES FOR CONSCRIPTION FROM 2007 TO 2016

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Abstract: *The increase of prevalence of overweight and obesity progressed worldwide and is associated with lifetime diseases. Operational readiness of armed forces is depending on anthropometric data and physical fitness of soldiers. The aim of the study was the investigation of temporal and regional trends of BMI and waist circumference of Austrian conscripts.Data came from the Ministry of Defence of Austria. Mean of body mass (BM, kg), body mass index (BMI, kg/m²,) and waist circumference (WC, cm) across age, urbanity and regions were analysed, effect size was checked by Cohen's d and f eta. Significance was selected at p values <0.05.Mean of BM, BMI and WC showed significant differences, effect sizes were trivial. A significant high correlation was ascertained by BM (r = 0.78 – 0.82) and BMI (r = 0.77 – 0.81) to WC in all age cohorts. Regional differences were detected in BM, BMI and WC. The results show a significant increase of BM, BMI and WC in the years 2007 to 2010 and a stabilisation during the rest of investigation period. Prevalence of overweight and obesity in young men has reached a worrying level for public health in Austrian society.*

Keywords: BMI, Waist circumference, prevalence of overweight of conscripts

1. Introduction

Medical and epidemiological studies show, that also in Europe overweight and obesity strongly increased [1,2,3]. Particularly in industrialized countries, this phenomenon has reached epidemic rates [4]. Obesity is associated with co-morbidities as high blood pressure, chronic metabolic syndrome, diabetes type 2 or cardiovascular diseases although in young adults [5,6].

The categorisation for overweight and obesity for adults by the World Health Organization (WHO) with body mass index (BMI) is valid consistently since 1995 [7,8].

Most information about overweight and obesity in the official WHO data bank are based on BMI data.

In contrast to more susceptible methods like waist circumference, waist-to-hip-ratio or measurement of skin fold thickness BMI is basically an indirect measurement. However no statements about body fat distribution can be made [2,9,10].

Military activities are dominated by high physical and psychological load. The assessment for armed forces is based on health and physical fitness. Several studies have demonstrated that poor muscle fitness and endurance as well as high or very low BMI are risk factors for overuse injuries and sickness absence from military basic training. So from the economical point of view the selection process is important for classification for specific military tasks.

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Investigations of samples of Austrian population showed that prevalence of overweight rose significantly from 13.3% to 15.7%, and obesity from 2.6% to 5.4% ($p<0.001$) over a period of 20 years [3]. Consequently, the mean of BMI and mean WC registered a significant increase. Furthermore, with regard to the prevalence of overweight and obesity, as well as the mean BMI and WC, a significant east west gradient was detected. Besides, urban citizens showed significantly lower values in comparison to the rural population.

In Austria, there are hardly, nationally measured and therefore objective, exact and representative data for prevalence of overweight and obesity.

A representative investigation and interpretation of regional, and age related trends in young men is relevant for health-political reasons as well as for the suitability for certain duties within the Austrian Federal Army. Overweight in adolescents and young adults means that mostly they will keep up their excessive body size into the middle age. Particularly men were later on exposed to raised risks for morbidity and mortality
[6, 11-14].

The identification of risk groups, caused by prosperity, malnutrition and physical
Inactivity [15,16] is accurately possible by representation of connections between body composition and physical efficiency and fitness[17,18,19].

The aim of this study was to investigate temporal and regional trends of body mass
(BM), body mass index (BMI) and waist circumference (WC) of Austrian conscripts candidates from 2007 to 2016.

2. Methods

The data of Austrian candidates for conscription between 2007 and 2016 were provided by the Department Pers Marketing of Ministry of Defence. In six medical centres of the Austrian Federal Army [20],they were collected from all male mostly 17 or 18years (several exceptions for later call up) with Austrian citizenship and permanent residence. Every record is to be assigned to a single person about the zip code, the date of birth and the investigation date. For the measurement of data, devices were calibrated regularly.

The records were cleaned around missing data, for example, by untimely termination of investigation for medical or psychological reasons, as well as not plausible values by admission mistake (missing date of birth, missing zip code, unrealistic values of body weight or body height). Because young men increase in the possible period of call up (from 17y to 24y) developmentally and naturally in body mass, cohorts of age were formed for the detailed analysis.For investigation of regional differences, the federal territory was divided into three regions, EAST(Vienna, Lower Austria, and Burgenland), CENTRAL(Styria, Upper Austria, Carinthia), and WEST(Salzburg, Tyrol, Vorarlberg). Besides that, young Austrians from conurbations with more than 100,000 inhabitants[22] (Vienna, Graz, Linz, Klagenfurt, Salzburg and Innsbruck) were compared to those from provincial towns and rural areas.

The statistical evaluation of data occurred with the programme IBM SPSS Statistics 18.Descriptive statistics were summarized as means, standard deviation(± S.D) for anthropometric parameters. Comparisons of means of BM, BMI and WC among age and regions were done using one way ANOVA with Bonferroni adjustments for multiplicity of testing,effects were checked by Cohen's d and f eta, effect size was categorized as 0.02~small, 0.13~medium and 0.26~large.

Pearson's correlation coefficients were determined for linear associations of BMI and waist circumference. Significance was selected at P values <0.05.

3. Results

From 591975male conscripts age 18.3 years (y) ± 2.5 y, 89% belonged to cohort1

(≤19y) 6.1% to cohort 2 (20 - 21y), 1.9% to cohort 3, (22 - 23y) and 3% to cohort 4 (≥24y). 31.3% conscripts lived in conurbations with more than 100,000 inhabitants and 68.7% in provincial towns or in rural surroundings. Regional categorization showed that 39.1% had the main residence in the eastern region, 39.3% in the central region as well as 21.6% in the western region.

3.1. Body Mass, Body Mass Index and Waist Circumference

Mean BM increased significantly from 74.1 to 75.1 kg by about 1 kg (F(9,591967, p =0.000). The mean BMI registered a significant increase of 23.4 in 2007 on 23.6 in 2012. The values from 2012 on showed significant variations at high level (F(9,591967, p =0.000). Mean waist circumference registered the highest value in 2007 with 86.3 cm and showed in the investigation period a relatively big variation width of approx. 3 cm. Effect sizes of the significant differences of BM , BMI and WC were trivial (f ≤0.01).

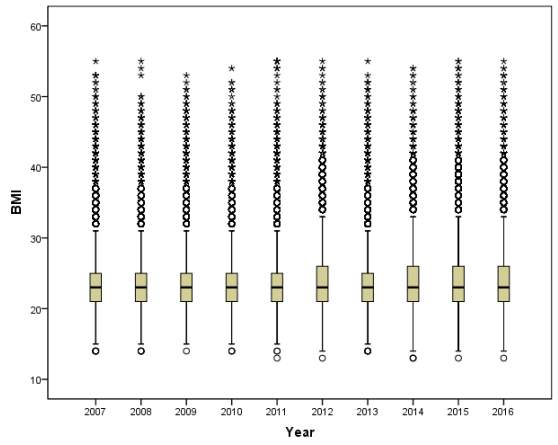

Figure 1: Distribution of body mass index between 2007 and 2016

The results showed a significant increase of the mean body mass in all cohorts of age, cohort 4 had the highest values. Also mean BMI differed significantly, in cohort 1between 23.3 and 23.6 with trend increase, in cohort 2 from 23.4 to 23.9, in cohort 3 of from 23.6 to 24.2 and in cohort 4 between 23.7 and 24.5 big arhythmical annual variations were ascertained.

The range for prevalence of overweight (BMI 25-29,9) in the period was between 20 and 21.9% (mean 20.8%), for obesity I (BMI 30 -34,9) between 5.9 and 6.6% (mean 6.3%) and for obesity II (BMI ≥ 35) between 2.3 and 2.6% (mean 2.5%).

3.2. Regional Trends

Regional differences (see Tab 1) were detected, mean BM raised by 0.9 kg, mean BMI 0.4 kg/m² and WC about 2.7 cm from western to the eastern region. Like the values of the overall collective of candidates, the data of the regions showed a clear growth of mean BM and BMI till 2010 and stabilisation later on.

Table 1: Significant differences of body mass, body mass index and waist circumference

	BM_kg		BMI_kg/m²		WC_cm	
East	74.8		23.7		85.9	
Cent	74.8	.394	23.5	.000*	85.4	.000*
West	73.9	.000*	23.3	.000*	83.2	.000*
Cent	74.8		23.5		85.4	
East	74.8	.394	23.7	000*	85.9	.000*
West	73.9	.000*	23.3	.000*	83.2	.000*
West	73.9		23.3		83.2	
EastCent	74.8	.000*	23.7	.000*	85.9	.000*
	74.8	.000*	23.5	.000*	85.4	.000*

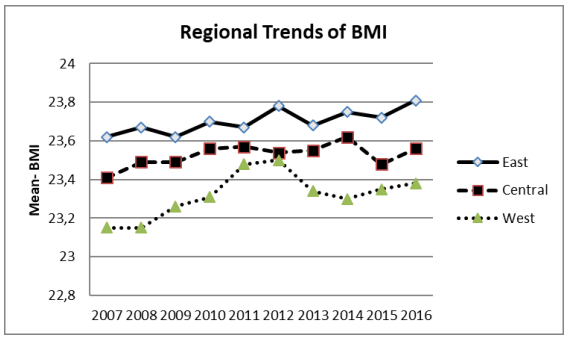

Figure 2: Trends of BMI in different regions

The comparison of mean BM, BMI and WCof conscripts with main residence in the conurbations ≥ 100,000 inhabitants showed significant differences (see Tab 2)

They had lower body mass of 0.7 kg (t(591975) = -16.428, p = 0.000) and therefore a 0.2 lower BMI (t(591975) = -20.349, p = 0.000) and conspicuously waist circumference was 0.4 cm larger (t(591975) = -14.471, p = 0.000), the effect size dedectet was trivial (f ≤0.1).

Table 2: Mean of body mass, body mass index and waist circumference in comparison of conurbations – rural areas

Conurbation / Rural area	BM kg	BMI kg/m²	WC cm
Conurbbations	74.1*	23.4*	85.4*
Rural areas	74.8*	23.6*	85.0*
Cohen's d effect size	0.05	0.06	0.04

4. Discussion

The present data are to be considered as representative for male population [20,21,24]with Austrian citizenship, about 90% of the suitable cohort are grasped with call up, nearly 99% of the examined are at that time between 17 and 20 years old [2,21],but evaluations about anthropometric development of young men with immigration background without Austrian citizenship are not possible.

The reliability of the records is given by the strict nationwide standardisation of the collection process of these data[20,21], even thougherror susceptibility of measurement of waist circumference is known[9,10] and differs in reliability clearly from studies with self-reports data about body height, BM, BMI and WC [24,25].

As in other regional and global studies [2,4,17,23] the mean BMI registered a significant increase of 23.4 in 2007 to the highest ascertained value 23.6 in 2012. The values from 2010 on showed significant variations at high level [23].

The increase of prevalence of overweight in average on 20.8% and from obesity on 8.7% in comparison to previous other studies [1,3,23] is alarming, because overweight in combination with high waist circumference is indicating an unfavourable fat distribution.

A significant high correlation was ascertained by BM BMI and WC in the cohorts of age from Grp1 (≤19y) r= 0.765 up to Grp 4 (≥24y) r= 0.813 [27,28]. Even if the forecast exactness for overweight and negative health effects by BMI and waist circumference is controversially discussed [6,29,30] from the significant raise of BM, BMI and WC an increase of the risk of heart circulation illnesses, high blood pressure, diabetes Typ2, as well as a loss of the general physical fitness can be predicted [11,12,19].

Overweight or obesity, caused by physical inactivity and false nutrition, in the crossing of the development from adolescence to adulthood, also hides a high risk for harmful fat distribution in the later sections of life [31-35].

The detected regional differences of raised mean BM of0.93 kg, mean BMI of 0.38kg/m² and mean WC of 2.7 cm increasing from western to the eastern region showed a clear growth from 2007 to 2010 like in the overall collective. From the investigated data, an interpretation of the causes is not possible.

International investigations show also regional differences. These are explained with socioeconomic sphere terms, different educational levels and different possibilities for the access to sports infrastructure [16, 32, 35, 36].

5. Conclusion

To sum up, the results show another significant increase of body weight, BMI and waist circumference during the investigation period. Besides, older conscripts differ significantly from young men. The increase of prevalence of overweight and obesity progressed in the Austrian society and the percentage of the risk groups of co-morbidities as high blood pressure, chronic metabolic syndrome, diabetes type 2 or cardiovascular diseases will rise. Regional differences as well as significant differences between urban and rural population were made visible like in

other studies [2,3,17,28]. The representative data and the constant evaluation standards guarantee a very good base for identification of risk groups with predicted health problems and expected overuse injuries during military basic training. With further studies, it could be the base for exercise programmes and nutrition recommendations to the elevation of public health.

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