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Changes in anthropometric measures in men and women across the life-span: findings from the *InCHIANTI* study

Summary

Objectives: To describe the age distribution of anthropometric parameters in a population-based sample of older persons.

Methods: Cross-sectional survey of a population-based sample of persons over a wide age-range living in the Chianti area, Italy, between 1998 to 2000. Total cohort: 1453 men and women, of whom 424 younger than 65 and 1029 aged 65 years or older. Participation rate: 69.4 % in < 65 yrs and 91.6 % in ≥ 65 yrs. Analytical cohort: anthropometric measures were available for 1266 subjects.

Results: Height and weight declined with increasing age in both sexes. In men, Body mass index (BMI) increased with age up to age 45–54 and then it declined. In women, it reached its maximum at age 65–74 and remained higher than in men in each corresponding age group above 65 years of age. Waist-to-hip ratio (WHR) progressively increased in men up to age 55–64 and then slightly declined. In women WHR steadily increased over the entire age range.

Conclusions: Height and weight decline with age, regardless to differences in body size attributable to secular trend. In both sexes, important fat redistribution occurs between 45 and 54 years and in older women the increase in WHR mostly reflects a reduction of fat deposits in the hips. This information may be relevant for a correct interpretation of changes in WHR in older persons. However, these findings were obtained in a cross-sectional study and should be verified in a longitudinal perspective.

Keywords: Aging – Anthropometry – BMI – WHR – InCHIANTI.

Substantial changes in body composition occur over the aging process. Many studies (Evans & Campbell 1993; Baumgartner et al. 1995; Poehlman et al. 1995; Christmas et al. 2002) have suggested that over the aging process the amount of fat tends to increase and to be preferentially stored in the abdominal area, while skeletal muscle mass and bone mineral density decline. Changes in body composition occur gradually during adulthood, probably as a consequence of an unbalance between energy intake and expenditure coupled with a progressive reduction of physical activity and, for reasons that are still unclear, are highly accelerated in old and very old age. Understanding how changes in body composition, and especially fat distribution, affect the risk for many chronic diseases that are highly prevalent and frequent cause of disability in the elderly, is a primary concern. Indeed, many studies (Folsom et al. 1990; Lean et al. 1998; Rexrode et al. 1998; Turcato et al. 2000) have shown that both in adult and older persons the accumulation of fat in the abdominal area plays an important role in the causal pathway leading to non-insulin dependent diabetes and cardiovascular disease. Moreover, Visser et al. (1998) have suggested that high body fatness is an independent predictor of mobility-related disability in older persons.

Thus, understanding the age-related changes in body composition is critical to design interventions that may effectively prevent ill-health and disability in the elderly. Unfortunately, only few studies (De Groot et al. 2002) have collected data on anthropometric measures in representative populations of old and very old persons and even less information is available on how anthropometric measures change over time in the same individual. Thus, reference data for body composition in the older age groups, which are needed to evaluate health, functional and nutritional status in this particular population are scant. For instance, whether recommended body weight should remain constant throughout adulthood or should be higher for older adults remains unclear. Studies of sufficient size to generate meaningful age-specific estimates are rare. Furthermore, there is inadequate information to support the need to specify different

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recommended weights in older persons of different age groups, and it is unclear whether the relationship between body composition parameters and health-related outcomes remains stable at different ages. As a consequence, the Word Health Organization (WHO) has not recommended age-specific range of weight for a given height in older people. Thus, it is important to generate more data on body composition in elderly persons in order to trace down the relationship linking anthropometry, disease status, and the aging process.

Our purpose is to provide data on anthropometric measures assessed in a population-based sample of persons of a wide age-range living in the center of Italy.

Materials and methods

The population sample

InCHIANTI (Invecchiare in Chianti, aging in the Chianti area) is an epidemiological study of risk factors contributing to the decline in the ability to walk in late life. The study was performed in two small towns located in Tuscany (Italy): *Greve in Chianti* and *Bagno a Ripoli*, adjacent to the city of Florence, between September 1998 and April 2000. The design and data collection methods of InCHIANTI were described in details elsewhere (Ferrucci et al. 2000).

The study population consisted of a random sample of the population aged 65 years and older selected from the city registry of the two municipalities. Furthermore, men and women randomly sampled from the age strata 20–29, 30–39, 40–49, 50–59 and 60–64 years were sequentially invited to participate in the study until at least 30 men and 30 women for each decade and 15 men and 15 women aged 60 to 64 years had been enrolled. Of the 1530 subjects originally sampled, 1453 agreed to participate in the study. The response rate was 69.4 % in those aged less than 65 years and 91.6 % in those aged 65 years and older. The analytical cohort of the present study included 565 men (78 % > 65 yrs) and 701 women (79 % > 65 yrs). Clinical visits and assessments were performed in the study clinic and were preceded by an interview conducted at the participants' home. The interviewers administered two structured questionnaires providing data on and on food intake (Pisani et al. 1997), social networks, household composition, economical status, smoking habits, and information on ability to walk and to perform daily life activities, foot problems, pharmacological treatments, incontinence, quality of sleep.

Home visits and assessments were arranged for the subjects who because of physical problems or lack of transportation could not come to the study clinic.

Table 1 General characteristics of the study sample. Chianti, Italy, 1998–2000

		Men (N = 639) n	(%)	Women (N = 814) n	(%)
Age (years)	20–44	75	(12)	81	(10)
	45–54	33	(5)	29	(4)
	55–64	35	(5)	45	(5)
	65–74	284	(44)	325	(40)
	75–84	149	(23)	219	(27)
	85+	63	(10)	115	(14)
Educational degree	none	85	(13)	285	(35)
	elementary	322	(50)	337	(41)
	secondary	98	(15)	67	(8)
	high school	103	(16)	109	(13)
	university	31	(5)	16	(2)
Smoking habits	never smoked	199	(31)	633	(78)
	ex-smoker	130	(20)	89	(11)
	current smoker	310	(49)	92	(11)
Marital status	unmarried	77	(12)	92	(11)
	married	484	(76)	399	(49)
	widowed	70	(11)	311	(38)
	divorced/separated	8	(1)	12	(2)
Household composition	one person	54	(8)	177	(22)
	two persons	280	(44)	289	(36)
	more than two persons	305	(48)	348	(43)
Economical status	refused to answer	6	(1)	13	(2)
	adequate	125	(20)	106	(13)
	barely adequate	247	(39)	260	(34)
	inadequate	251	(40)	412	(52)
Source of income	pension	487	(76)	619	(76)
	employed	130	(20)	107	(13)
	other sources	9	(1)	16	(2)
	none	13	(2)	72	(9)
Perceived general health	very bad	28	(5)	66	(8)
	fairly bad	144	(24)	238	(31)
	pretty good	368	(61)	367	(48)
	good/very good	68	(11)	96	(12)

Anthropometric measures

The participants were invited to the study clinic for a comprehensive evaluation of health status and anthropometric measures assessed using standardised methods described by Lohman et al. (1988) and Chumlea et al. (1984). Weight was measured to the nearest 0.1 kg, with the participant wearing light clothes and without shoes, using high precision mechanical scale. Standing height without shoes was measured to the nearest 0.1 cm.

The circumferences were taken using a flexible, fiberglass tape while the participant was standing. *Hip circumference (cm)*: at maximum posterior extension of the buttocks. *Waist circumference (cm)*: at the point of the thinner level of the waist, usually 1 cm above the iliac crest. *Mid-arm circumference (cm)*: at the midpoint between the acromion and the olecranon. *Thigh circumference (mm):* at the point that

separates the proximal two-third and the distal one-third of the distance between the anterior iliac spine and the superior edge of the patella. *Calf circumference (mm)*: at the point that separates the proximal two-third and the distal one-third of the distance between the anterior medial knee joint cleft and the medial malleolus. *Tibia length (mm)*: distance between the medial knee joint cleft and the medial malleolus (both identified by manual palpation) while the participant was lying supine.

Body mass index (BMI): was calculated as weight (kilograms) divided by the square of height (meters). *Waist-to-hip ratio (WHR)*: was calculated as waist circumference (cm) divided by the hip circumference (cm). Overweight and obesity were defined according to WHO definitions (www.who.int/archives/inf-pr-1997/en/pr97–46.html). Specifically, normal weight, overweight and obesity were defined, respectively, as BMI < 25 kg/m^2, < 25 BMI < 30, kg/m^2 and BMI ≥ 30 kg/m^2.

Statistical analysis

In the attempt to control for the possible effect of secular trend, differences in height and weight were analysed using linear regression models adjusted for tibia length interpreted as an indicator of "body size". Taking into account that especially age-associated changes in weight may not be linear, the age group was entered in the regression analysis predicting weight using dummy variables for the different age groups, and using the younger age group for reference.

Mean differences of BMI and WHR between men and women within each specific age strata and their 95 % confidence intervals (CI) were analysed using linear regression models, adjusted for residual age differences in order to obtain a standardised mean difference between women and men.

The distributions of the anthropometric measures mentioned in the above section are described using percentiles P10, P25, P50, P75, P90, as well as mean values and standard deviations (SD), and reported according to sex and age strata.

All analyses were performed using the SAS statistical software (Version 8.1, SAS institute, Cary, NC).

Results

Percentiles P10, P25, P50 (median), P75, P90, means and standard deviations (SD) of anthropometric measures are reported in Tab. A1–A5 of the appendix, separately for men and women and according to age group.

Height and weight declined with increasing age both in men and women. In men, we found that the oldest group (65 kg, aged 85 + yrs) weighted on average 15 kg less than the youngest (80 kg, aged 20–44 yrs). Instead, in women, the average weight showed only a 4 kg reduction from age 20–44 yrs (62 kg) to the age of 85 + yrs (58 kg). The split difference on weight reduction with age between genders is evident. Overall, from the youngest to the oldest group, the reduction of the average weight was three times greater in men compared to women. Interestingly, the decline was not linear in women. In fact, between the age group 20–44 and 45–54 years we observed a weight increment of 8 kg and, thereafter, a steady decline. As known, changes in height and weight with advancing age may partially be affected by

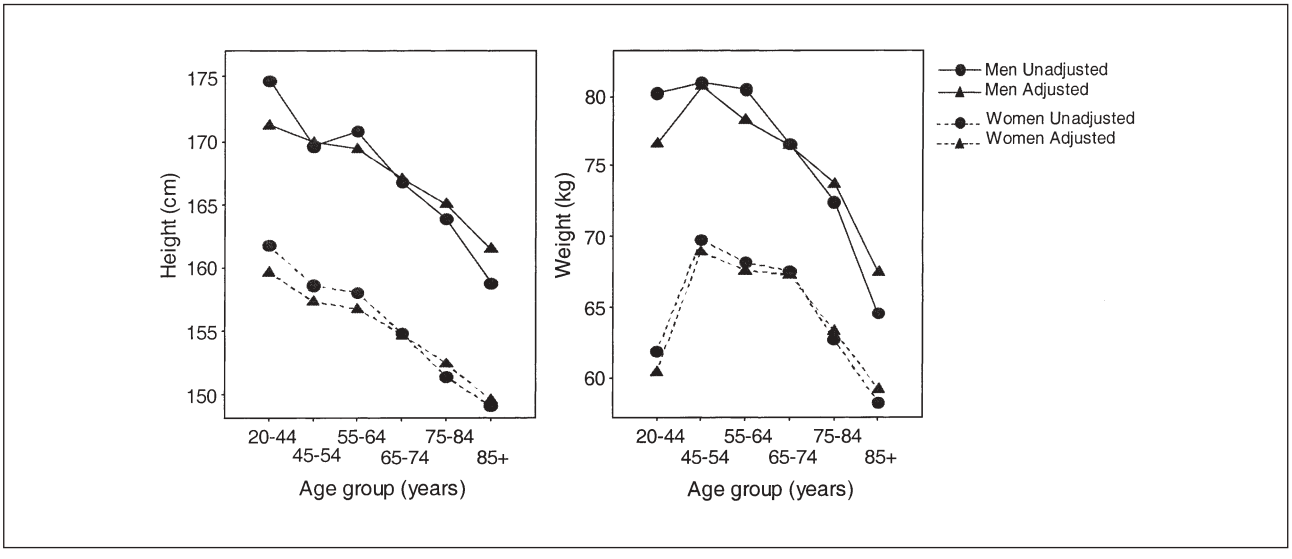

Figure 1 Average height and weight, according to sex and age group. Both crude values and values adjusted for tibia-length are reported in the same figure (see text). Chianti, Italy, 1998–2000

secular trend. In order to control, at least in part, for the possible effect of secular trend on the differences in weight and height between age groups, we computed mean values for these variables adjusted for tibia length. That may be considered as an indicator of "body size". The age trend observed in the unadjusted analysis was confirmed in the adjusted analysis (Fig. 1). Thus, our results suggest that changes in height and weight seem to occur with advancing age in both men and women, regardless of differences in body size attributable to secular trend.

The average BMI increased in men from the first to the second age group (respectively 20–44 years; 45–54 years) and then progressively declined. Instead, in women, BMI steadily increased up to the age 65–74 years (from 23.6 ± 3.5 in the youngest group, to 28.2 ± 4.6 in aged 65–74 years), and declined only in the two oldest age groups (Fig. 2).

Interestingly, between the age 20–44 years and the age 45–54 years, the increase in BMI was slightly larger in women than in men. Moreover, as shown in Tables 2 and A3 the average BMI, the parameter normally used as an indirect marker of obesity, was slightly higher in women than in men, in each corresponding age group above 65 years of age. This is a clear cut difference between gender, with women remaining fatter than man after 64 years.

As a parameter describing the local distribution of fat we also used WHR. The larger difference of WHR was observed between the age 20–44 years and the age 45–54 years, although during this age interval weight remained approximately stable in men. As shown in Tab. 3 and A3, WHR progressively increases in men from the age group 20–44 years up to the age group 55–64. In women, the WHR steadily increases across the entire life span, although there is a reduction of BMI after 75 years. These findings indicate that in women, the decline in weight after 75 years is mostly attributable to a reduction of the hip circumference (5 cm, from 64–75 age group to 85+ years) rather than to a reduction of the waist circumference (2 cm, from age 64–74 to 85+ years).

The prevalence rates of overweight and obesity defined according to the WHO are reported in Table 4, separately by sex. The highest prevalence of overweight (25≤ BMI >30) was found in men aged 65–74 years (57.4%) and in women aged 45–54 years (46.4%). Concerning obesity (BMI ≥30), the highest prevalence was found in men aged 45–54 years (33.3%) and in women aged 65–74 years (31.4%). Among participants 85 years old or older only 5% of men aged 85+ years were obese compared to 20% of women but the percentage of overweight was higher in men (44%) than in women (34%).

Table 2 Differences on average body mass index (BMI) between gender and their 95% confidence interval (CI). Chianti, Italy, 1998–2000

Age Group (years)	BMI				Mean difference [a]	(95%CI) [a]
	Women		Men			
	n	mean	n	mean		
20–44	75	23.6	70	26.2	−2.64	(−1.52; −3.76)
45–54	28	27.7	30	28.1	−0.35	(1.83; −2.53)
55–64	44	27.3	34	27.3	−0.57	(1.66; −2.28)
65–74	299	28.2	263	27.4	0.81	(1.48; 0.14)
75–84	181	27.4	125	26.9	0.64	(1.78; −0.50)
85+	68	26.3	39	25.5	0.76	(3.26; −1.74)

[a] Adjusted for age residual differences between women and men.

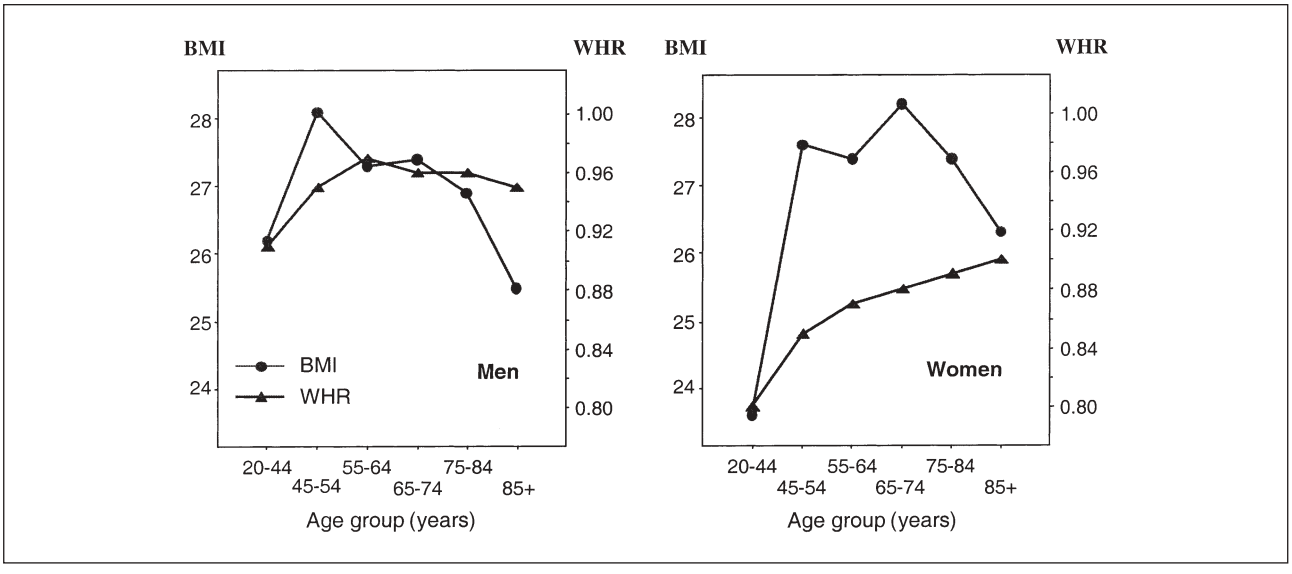

Figure 2 Body mass index (BMI) and waist-to-hip Ratio (WHR), according to sex and age-group. Chianti, Italy, 1998–2000

Table 3 Differences on average waist-to-hip-ratio (WHR) between gender and their 95% confidence interval (CI). Chianti, Italy, 1998–2000

Age group (years)	WHR				Mean Difference [a]	(95%CI) [a]
	Women		Men			
	n	mean	n	mean		
20–44	77	0.799	67	0.910	−0.112	(−0.094; −0.130)
45–54	28	0.847	30	0.951	−0.101	(−0.072; −0.130)
55–64	45	0.868	33	0.965	−0.097	(−0.072; −0.132)
65–74	295	0.881	260	0.961	−0.080	(−0.070; −0.090)
75–84	183	0.888	131	0.957	−0.069	(−0.054; −0.084)
85+	71	0.899	39	0.953	−0.054	(−0.030; −0.078)

[a] Adjusted for age residual differences between women and men.

Table 4 Prevalence of overweight and obesity, according to sex and age groups. Chianti, Italy, 1998–2000

Age group (years)	Overweight (25< BMI <30)				Obesity (BMI ≥30)			
	Men		Women		Men		Women	
	n	(%)	n	(%)	n	(%)	n	(%)
20–44	33	(47.8)	15	(19.7)	10	(14.5)	5	(6.6)
45–54	12	(40.0)	13	(46.4)	10	(33.3)	7	(25.0)
55–64	18	(52.9)	14	(31.1)	8	(23.5)	12	(26.7)
65–74	151	(57.4)	128	(42.8)	52	(19.8)	94	(31.4)
75–84	48	(37.8)	78	(42.6)	32	(25.2)	47	(25.7)
85+	18	(43.9)	24	(33.8)	2	(4.9)	14	(19.7)

Discussion

The present study provides data on the distribution of anthropometric measures assessed in a population-based sample of persons living in the Chianti area. Our purpose was to understand how anthropometric measures change over the aging process and, especially, in old and very old men and women. This objective is particularly important since data on the anthropometric characteristics of older persons are scarce. We reported also the prevalence of overweight and obesity in late life.

Because the present analyses were based on cross-sectional data, some of the age differences in anthropometric measures may be generation changes. In fact, as suggested by Launer & Harris (1995), secular trend may affect changes in height and, as consequence, in body weight. As reported earlier (Friedlaender et al. 1977; Borkan et al. 1983), secular trends in skeletal changes can be detected in the lower body segments even at an advanced age. In order to investigate on possible age change in selected anthropometric parameters, we evaluated the effect of age on height and weight, controlled for tibia length. This last measure is a reliable affirmation of leg length that is usually considered a good index of "body size" (Pini et al. 2001). Thus, we worked under the hypothesis that the correlation observed between age and tibia length depends on changes in height within the secular trend. In line with previous studies (Shatenstein et al. 2001; De Groot et al. 2002) our results suggest that changes in height and weight seem to occur in men and women with advancing age, regardless to "body size". Thus, the decrease in height may be explained by the postural changes and reduction in inter-vertebral spaces, which typically occur over the aging process (Milne & Lauder 1976).

Our findings clearly indicate that in both sexes the largest increase in both BMI and WHR occur between the 20–44 and the 45–54 age groups. In this last age group we also observed the highest prevalence of overweight women (46.4%), and obese men (33.3%). It is well known that the period between 45–54 years is a critical stage of life mostly because the serum concentration of several hormones decline, especially androgens in men and estrogens in women. These hormonal changes are likely implicated into weight gain and fat redistribution that occur in this particular period of life. In fact, many studies (Ley et al. 1992; Couillard et al. 2000) have suggested that increased adiposity and abdominal fat accumulation are associated with reduced sex hormone levels. Moreover, it has been suggested (Haarbo et al. 1991; Troisi et al. 1995) that hormone replacement therapy (HRT) is associated with lower WHR. Taking into account that in women the HRT use may be the strongest determinant of generation changes in WHR, we also analysed the distributions of average WHR in each age group, excluding persons that referred to have used HRT during their life-span. However, the results did not substantially change, probably because of the very low percentage of women (7,1%) included in our sample that referred to have used HRT during their life-span (data not shown).

Interestingly, in spite of a reduction in weight after 65–74 years, the WHR continued to increase in old and very old women. In agreement with data provided from Baumgartner et al. (1995) the increase in WHR observed in older women was not associated to an increase in waist circumference, but rather, mainly to a decrease in hip circumference. This last finding suggests that in women, the adipose tissue stored in the abdominal area is more difficult to mobilise compared to the fat stored in other parts of the body. Moreover, taking into account that skeletal muscle mass tend to decline with advancing age as showed by Evans & Campbell (1993), we may hypothesise the reduced volume of the gluteal muscles also to the observed decrease in hip circumference.

Our results suggest that the accumulation of abdominal fat with age observed both in men and women occurs primarily in middle-age and there may be little further change at older ages. Interestingly, between the age of 20–44 years and the

age 45–54 years, the increase in weight was on average 1 kg in men and 8 kg in women and, in the same age group, the decrease in height was 5 and 3 cm in men and women, respectively. Thus, the increase in BMI and WHR observed in both sexes in the middle-aged group, has probably a different causal effect. In men from 20–44 to 45–54 age group, the increase in BMI and WHR principally depends on decrease in height and on redistribution of fat, respectively. Instead, in women from the 20–44 to the 45–54 age group, the increase in BMI and WHR mainly depends on weight gain with consequential increased fat tissue stored preferentially in the abdominal area. Considering these two different causal pathways in men and women, a different planning intervention aimed at preventing obesity and excess of central fat has to be taken into account between different sex, and should be focused on persons aged 45–54 years. In fact, the weight reduction that occurs at later ages, principally affects deposit of fat that are not centrally located and, consequently, may not substantially affect the risk of cardiovascular diseases.

We observed a different trend in increasing BMI and WHR between older men and women that could be explained by sex-related differences in both hormonal changes and lifestyle such as physical activity, smoking and nutritional habits. Several studies (Seeman & Robbins 1994) have shown a significantly higher unstimulated cortisol production in elderly women, possibly owing in part to differences in cortisol-binding globulin. The high levels of plasma cortisol influences the deposit of fat in the abdominal area and it may explain the weak reduction in waist circumference in older women in advanced age, in spite of the reduction in body weight. Furthermore, the different sex-related trend in BMI and WHR that occurs with aging, can be explained by findings of other previous studies (Trichopoulos et al. 2001) suggesting that BMI was associated with WHR more strongly in men than women and that energy intake and physical activity have a strong effect on WHR regardless of BMI, selectively in men. Moreover, some studies (Shimokata et al. 1989; Kaye et al. 1990; Troisi et al. 1990; Dallongeville et al. 1998) suggested that smoking habits and alcohol consumption are positively related to WHR. Thus, the different trends of age-related changes in WHR may be explained by level of physical activity, usually higher in men then in women, as well as alcohol drinking and smoking habits more frequent in men than in women, especially in old age. As consequence, the reduction in WHR observed in older men may be explained hypothesising that men in old age tend to give up smoking and to reduce alcohol consumption because of health problems that often occur over the aging process. Thus, the sex difference in lifestyle may partially explain the reduction in WHR observable with age in men but not in women.

In interpretating our findings, some limitations of the study should be taken into account. It should be noted that the sample of people aged less than 65 years is not very numerous. Moreover, because of the cross-sectional nature of the study, it is difficult for us to make causal inference and to completely dissect the effect of age from the effect of secular trend. Thus, our findings need to be further investigated in a longitudinal perspective.

In conclusion, this is one of a few population-based studies in which anthropometric parameters were measured over the entire life-span (age range: 20–103 years). The follow-up of this population will provide data to verify to what extent changes are truly attributable to aging process, independent of the effect of secular trends.

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Zusammenfassung

Veränderungen der anthropometrischen Messgrössen von Frauen und Männer im Verlauf des Lebens: Resultate der InCHIANTI Studie

Fragestellung: Beschreibung der Altersverteilung der anthropometrischen Parameter in einer Bevölkerungsstichprobe älterer Individuen.

Methoden: Querschnittsstudie für einer Bevölkerungsstichprobe von Personen über einen grossen Altersbereich, die im italienischen Chianti-Gebiet leben. Die gesamte Kohorte umfasste 1453 Männer und Frauen. Davon waren 424 jünger als 65 Jahre und 1029 waren 65 Jahre und älter. Für 1266 Personen waren anthropometrische Daten verfügbar (analytische Kohorte).

Resultate: Bei Männern wie Frauen nahmen Grösse und Gewicht mit zunehmenden Alter ab. Bei den Männern stieg der BMI bis zum Alter von 45–54 Jahren und nahm danach wieder ab. Bei den Frauen hingegen wurde das Maximum der BMI-Werte erst im Alter von 65–74 Jahren erreicht und blieb immer über den Werten der Männer in den entsprechenden Altergruppen über 65 Jahre. Der Taille-Hüft-Quotient (waist-to-hip ratio WHR) nahm bei den Männern bis zum Alter von 55–64 Jahren stufenweise zu und nahm dann wieder langsam ab. Bei den Frauen stieg der WHR aber stetig über die gesamte Altersspanne.

Schlussfolgerungen: Grösse und Gewicht nehmen mit zunehmendem Alter ab, unabhängig von Unterschieden in der Körpermasse, die einem langfristigen Trend zuzuschreiben sind. Im Alter zwischen 45 und 54 Jahren findet in beiden Geschlechter eine wichtige Körperfettumverteilung statt. Der zunehmende WHR bei den älteren Frauen dürfte vor allem auf eine Reduktion der Fettansammlung im Hüftbereich beruhen. Diese Informationen könnten für eine korrekte Interpretation veränderter WHR bei älteren Personen bedeutsam sein. Allerdings stammen diese Erkenntnisse von einer Querschnittsstudie und sollten aus einer longitudinalen Perspektive bestätigt werden.

Résumé

Evolution au cours de la vie des mesures anthropométriques d'hommes et de femmes: résultats de l'étude InCHIANTI

Objectifs: Décrire la distribution par âge de paramètres anthropométriques dans un échantillon populationnel de personnes âgées.

Méthodes: Enquête transversale à partir d'un échantillon populationnel de personnes âgées de plus de 65 ans de la région de Chianti en Italie, de 1998–2000. Cohorte totale: 1463 hommes et femmes, dont 424 de moins de 65 ans et 1029 de 65 ans et plus. Taux de participation: 69,4 % chez les moins de 65 ans et 91,6 % chez les 65 ans et plus. Cohorte analytique: mesures anthropométriques disponibles pour 1266 personnes.

Résultats: La taille et le poids diminuent avec l'âge dans les deux sexes. Chez les hommes, l'index de masse corporelle augmente jusqu'à l'âge de 45–54 ans puis décline, alors que chez les femmes il atteint son maximum à l'âge de 65–74 et tend à rester plus élevé que chez les hommes dans tous les groupes d'âge au-dessus de 65 ans. Le rapport taille sur hanches (RTH) augmente progressivement chez les hommes jusqu'à l'âge de 65–74 ans, puis décline lentement, alors que chez les femmes le RTH augmente régulièrement avec l'âge.

Conclusions: La taille et le poids déclinent avec l'âge, indépendamment des différences en taille corporelle attribuables à un effet de génération. Dans les deux sexes, il se produit une importante redistribution de graisse entre 45 et 54 ans, et chez les femmes plus âgées l'augmentation du RTH reflète avant tout une réduction de la graisse déposée dans les hanches. Cette information peut être importante pour interpréter correctement les changements du RTH chez les personnes âgées. Ces résultats provenant d'une enquête transversale, ils devraient être validés dans une enquête longitudinale.

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Appendix

Table A 1 Weight and height distributions by sex and age groups. Chianti, Italy, 1998–2000

Age (years)	n	Percentiles (P)						
		P10	P25	P50	P75	P90	Mean	(SD)
Weight in men (kg)								
20–44	70	65	71	80	89	96	80	(12.3)
45–54	30	66	74	80	87	101	81	(13.2)
55–64	34	69	75	79	86	94	80	(10.1)
65–74	263	64	69	76	84	91	77	(10.9)
75–84	127	57	62	72	82	89	72	(12.3)
85+	41	56	58	65	70	73	65	(7.0)
Total[a]	565							
Weight in women (kg)								
20–44	75	50	55	62	68	72	62	(9.4)
45–54	28	54	63	67	77	88	70	(12.2)
55–64	45	54	58	68	76	85	68	(12.0)
65–74	299	53	60	68	74	81	68	(11.2)
75–84	183	49	54	62	70	76	63	(11.0)
85+	71	46	51	56	63	74	58	(10.2)
Total[a]	701							
Height in men (m)								
20–44	70	1.67	1.70	1.75	1.79	1.85	1.75	(0.07)
45–54	30	1.64	1.65	1.69	1.72	1.80	1.70	(0.07)
55–64	34	1.60	1.68	1.72	1.76	1.79	1.72	(0.06)
65–74	263	1.59	1.62	1.67	1.71	1.76	1.67	(0.07)
75–84	126	1.55	1.59	1.65	1.69	1.73	1.64	(0.07)
85+	40	1.51	1.55	1.58	1.65	1.69	1.59	(0.07)
Totala	563							
Height in women (m)								
20–44	75	1.55	1.57	1.61	1.66	1.70	1.62	(0.06)
45–54	28	1.51	1.55	1.60	1.63	1.65	1.59	(0.05)
55–64	44	1.50	1.54	1.57	1.62	1.68	1.58	(0.06)
65–74	299	1.46	1.50	1.55	1.59	1.64	1.55	(0.06)
75–84	182	1.43	1.47	1.50	1.56	1.60	1.51	(0.07)
85+	68	1.40	1.45	1.50	1.54	1.58	1.49	(0.07)
Total[a]	696							

[a] Total may vary because of missing values.

Table A2 Hip and waist circumference, distributions by sex and age groups. Chianti, Italy, 1998–2000

Age (years)	n	Percentiles (P)						
		P10	P25	P50	P75	P90	Mean	(SD)
Hip circumference in men (cm)								
20–44	67	88	93	98	103	106	98	(7.4)
45–54	30	91	95	98	103	110	99	(7.0)
55–64	33	92	95	100	104	107	100	(7.1)
65–74	260	92	96	100	103	107	100	(6.7)
75–84	131	89	94	100	105	110	100	(8.4)
85+	39	89	91	95	99	102	95	(4.9)
Total[a]	560							
Hip circumference in women (cm)								
20–44	77	85	89	96	99	105	95	(4.9)
45–54	28	89	97	102	106	116	102	(9.5)
55–64	45	91	95	102	107	116	103	(10.4)
65–74	295	93	98	103	108	115	104	(9.6)
75–84	184	89	94	101	108	113	101	(9.5)
85+	71	87	92	97	103	110	99	(9.1)
Total[a]	700							
Waist circumference in men (cm)								
20–44	67	78	81	90	95	101	89	(9.4)
45–54	30	84	89	94	99	106	94	(8.4)
55–64	33	88	90	95	101	109	96	(9.6)
65–74	260	86	91	96	101	107	96	(8.7)
75–84	131	81	89	95	102	109	95	(9.8)
85+	39	81	85	90	95	99	90	(6.6)
Total[a]	560							
Waist circumference in women (cm)								
20–44	77	65	69	75	81	88	76	(9.2)
45–54	28	73	78	85	95	101	86	(11.8)
55–64	45	74	80	89	96	106	89	(12.0)
65–74	295	77	84	92	98	104	91	(10.9)
75–84	183	77	83	89	97	104	90	(11.0)
85+	71	74	80	87	96	103	89	(11.1)
Total[a]	699							

[a] Total may vary because of missing values.

Table A3 Body mass index (BMI) and waist-to-hip ratio (WHR) distributions, by sex and age groups. Chianti, Italy, 1998–2000

Age (years)	n	Percentiles (P)						
		P10	P25	P50	P75	P90	Mean	(SD)
Body mass index in men (kg/h²)								
20–44	70	22.2	23.5	26.0	8.5	0.5	26.2	(3.5)
45–54	30	23.8	24.9	27.5	30.6	33.2	28.1	(4.1)
55–64	34	22.6	25.3	27.4	29.1	31.4	27.3	(3.2)
65–74	263	23.8	25.2	27.3	29.2	31.8	27.4	(3.2)
75–84	125	22.1	23.9	26.8	30.1	31.6	26.9	(3.6)
85+	39	21.8	23.6	25.1	28.0	29.2	25.5	(2.6)
Total[a]	561							
Body mass index in women (kg/h²)								
20–44	75	20.0	21.0	23.1	25.7	28.4	23.6	(3.5)
45–54	28	23.1	24.4	26.9	30.0	34.3	27.7	(4.3)
55–64	44	21.9	23.6	27.3	30.2	33.2	27.3	(4.6)
65–74	299	22.5	25.0	28.0	30.9	34.2	28.2	(4.6)
75–84	181	22.0	24.3	27.1	30.1	33.5	27.4	(4.4)
85+	68	20.8	22.4	26.6	29.0	33.0	26.3	(4.6)
Total[a]	695							
Waist-to-hip ratio in men								
20–44	67	0.84	0.89	0.91	0.94	0.97	0.910	(0.05)
45–54	30	0.89	0.92	0.95	0.98	1.01	0.951	(0.05)
55–64	33	0.91	0.94	0.96	0.99	1.02	0.965	(0.06)
65–74	260	0.91	0.94	0.96	0.99	1.02	0.961	(0.05)
75–84	131	0.89	0.91	0.96	1.00	1.03	0.957	(0.06)
85+	39	0.90	0.92	0.93	0.99	1.02	0.952	(0.05)
Total[a]	560							
Waist-to-hip ratio in women								
20–44	77	0.72	0.76	0.80	0.84	0.88	0.800	(0.06)
45–54	28	0.76	0.80	0.85	0.89	0.93	0.847	(0.06)
55–64	45	0.79	0.83	0.87	0.90	0.95	0.868	(0.06)
65–74	295	0.80	0.84	0.88	0.93	0.97	0.881	(0.07)
75–84	183	0.80	0.85	0.89	0.93	0.97	0.888	(0.07)
85+	71	0.83	0.85	0.89	0.94	0.98	0.899	(0.07)
Total[a]	699							

[a] Total may vary because of missing values.

Table A4 Mid-arm and thigh circumference distributions, by sex and age groups. Chianti, Italy, 1998–2000

Age (years)	n	Percentiles (P)						
		P10	P25	P50	P75	P90	Mean (SD)	
Mid-arm circumference in men (mm)								
20–44	70	275	290	310	330	345	310	(29.0)
45–54	30	280	290	315	325	342	314	(30.2)
55–64	33	270	290	305	315	335	302	(23.2)
65–74	263	260	280	295	315	330	296	(28.9)
75–84	133	245	260	280	300	320	281	(30.9)
85+	40	225	240	260	270	280	256	(26.1)
Total[a]	569							
Mid-arm circumference in women (mm)								
20–44	75	240	255	275	295	320	279	(32.6)
45–54	28	265	280	302	327	340	303	(28.5)
55–64	45	260	280	300	320	345	301	(34.1)
65–74	300	260	273	295	320	340	297	(32.8)
75–84	191	240	260	280	300	320	281	(32.8)
85+	81	220	240	260	280	300	259	(30.7)
Total[a]	720							
Thigh circumference men (mm)								
20–44	70	465	490	519	540	560	514	(43.5)
45–54	30	468	480	499	520	558	506	(38.1)
55–64	34	432	470	500	520	535	495	(41.4)
65–74	261	430	460	480	505	525	481	(43.2)
75–84	133	400	430	462	490	510	459	(43.4)
85+	40	385	403	430	445	458	425	(30.4)
Total[a]	568							
Thigh circumference in women (mm)								
20–44	77	430	456	490	510	560	491	(51.1)
45–54	28	450	483	509	530	580	508	(47.2)
55–64	45	414	455	485	525	560	485	(58.7)
65–74	292	422	450	490	520	560	489	(50.6)
75–84	185	400	425	465	500	532	468	(58.6)
85+	72	370	402	440	468	490	441	(71.2)
Total[a]	699							

[a] Total may vary because of missing values.

Table A5 Calf circumference and tibia length distributions, by sex and age groups. Chianti, Italy, 1998–2000

Age (years)	n	Percentiles (P)						
		P10	P25	P50	P75	P90	Mean (SD)	
Calf circumference in men (mm)								
20–44	70	340	350	375	390	403	371	(28.4)
45–54	30	335	345	363	384	400	367	(29.3)
55–64	34	322	350	360	380	390	363	(26.8)
65–74	261	320	335	355	372	390	356	(36.4)
75–84	133	300	320	340	358	370	339	(30.9)
85+	40	300	310	321	340	360	326	(23.1)
Total[a]	568							
Calf circumference in women (mm)								
20–44	77	311	330	343	360	380	347	(28.4)
45–54	28	320	340	350	368	390	355	(26.3)
55–64	45	320	330	350	370	391	354	(36.0)
65–74	291	310	330	350	365	389	349	(34.9)
75–84	185	290	315	334	360	378	335	(36.0)
85+	72	280	300	320	341	360	321	(34.2)
Total[a]	698							
Tibia length in men (mm)								
20–44	70	360	370	390	403	420	390	(24.7)
45–54	30	350	360	371	380	395	373	(18.6)
55–64	34	352	370	390	400	410	383	(23.5)
65–74	261	350	360	372	386	400	373	(22.4)
75–84	133	340	350	368	385	400	367	(23.9)
85+	40	338	350	360	370	389	360	(19.2)
Total[a]	568							
Tibia length in women (mm)								
20–44	78	326	340	353	370	386	355	(22.8)
45–54	28	320	339	354	365	380	352	(22.2)
55–64	45	325	340	350	365	380	352	(22.0)
65–74	296	318	330	345	360	375	346	(22.1)
75–84	187	315	330	341	355	368	341	(20.5)
85+	72	320	330	340	352	370	341	(20.2)
Total[a]	706							

[a] Total may vary because of missing values.