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NICE's recent guidelines on "the size of your waist" unfairly penalizes shorter people.

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The National Institute for Clinical Excellence (NICE) has just released its latest guidelines to assess and predict health risk, such as type 2 diabetes, hypertension or cardiovascular disease. Their latest advice is to "Keep the size of your waist to less than half of your height". NICE added the waist-to-height ratio to its draft guideline after looking at evidence from several studies which showed that, alongside BMI, it could be used to assess and predict weight-related conditions in all ethnicities and sexes.

Numerous studies now recognised the importance of waist circumference (WC) as a more sensitive anthropometric measure associated with obesity and health risk compared with, for example, BMI^{1 2 3}. However, unadjusted WC will always penalize taller subjects (taller people will have, on average, greater WC but not necessarily be at greater health or cardio-metabolic risk). This can be clearly seen in Table 1 using a stratified random sample of 53390 participants from private households in England obtained from the Health Survey for England (HSE) 2008-2018³. Although not overtly reported by Nevill et al.³, Table 1 clearly shows that by adopting the WC cut-off points (94 cm in men and 80 cm in women, as recommended by Alberti et al., 2005⁴), taller people will be more frequently assessed as exceeding these cut-off point(s) and hence be unfairly penalize. The percentage of people whose WC exceed the above cut-off points increases systematically in taller people, irrespective of age or sex — see bold figures in Table 1. Also note that 7/10 age-group-by-sex chi-square tests of independence, and 9/10 chi-square tests for linear trend were significant $P < 0.05$.

Table 1 about here

To overcome this bias towards taller people being over penalized, Ashwell and co-workers suggest that WC should be divided by height to more fairly reflect the associated health risk with WC. The catalyst for this decision appears to come from research by Ashwell et al.⁵ who assumes that WHTR is independent of height and argues that the waist-to-height ratio (WHTR) is the strongest predictor of cardio-metabolic risk (CMR) in adults. However, recently Nevill et al.³ reported that waist circumference increases both theoretically⁶ and empirically¹ in proportion to height raised to the power 0.5, and consequently, a new waist-by-height ratio, $WHT \cdot 5R = WC/Height^{0.5}$, was found to be both independent of height but also a stronger predictor of cardio-metabolic risk (CMR). Clearly, unadjusted WC will penalize taller subjects, as described in Table 1. In contrast, WHTR will penalize shorter individuals (the correlation between WHTR and height is negative, i.e., height over scales WC). The only WC-by-height ratio that will not penalize taller or shorter individuals (i.e., it removes the effect of height from WC completely) is the new $WHT \cdot 5R = WC/Height^{0.5}$, see Nevill et al.¹, i.e., it correctly scales WC for differences in height. Nevill and co-workers³ recently made this point using the above stratified random sample of 53390 participants. Again although not overtly reported by Nevill et al.³, Table 2 clearly shows that by adopting the cut-off point of $WHTR = 0.5$ as recommended by NICE, shorter people will be unfairly penalize. The percentage of people whose WHTR is ≥ 0.5 increases systematically with SHORTER, not taller people, irrespective of age or sex — see bold figures in Table 2. Now all 10 chi-square tests of independence, and all 10 tests for linear trend confirmed that by adopting the cut-off point of $WHTR = 0.5$, shorter individuals will be over penalized, and taller people will be under penalized (all $P < 0.001$). By dividing WC by height, as recommended by Ashwell et al.⁵, the original problem has not been solved, it has been exacerbated but in the opposite direction!

Table 2 about here

To illustrate this point, albeit anecdotally, consider NICE's advice to Diego Maradona (height=65ins, waist=37ins, anthropometric data obtained from <https://idolwiki.com/831-diego-maradona.html>). As such, Maradona's WHTR = 0.57.

Based on these observations, shorter people could become unduly stressed by incorrectly failing NICE's latest recommendation (WTHR >0.5), whilst taller individuals might be lulled into a false sense of security! Cut-off points using the waist "independent-of-height" ratio WC/Height^{0.5} were found to either reduce or overcome this anomaly.

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Table 1. The number of participants above WC cut-off points (94 cm in men and 80 cm in women, indicated by 1) by sex, height (HT) and by age groups.

Age group (yrs)		16-29				30-39				40-49				50-59				60-69			
Sex	HT (cm)	WCcutoff01		Total	% >	WCcutoff01		Total	% >	WCcutoff01		Total	% >	WCcutoff01		Total	% >	WCcutoff01		Total	% >
		.00	1.00			.00	1.00			.00	1.00			.00	1.00			.00	1.00		
Female	<145	5	8	13	61.5	8	6	14	42.9	11	19	30	63.3	7	15	22	68.2	5	22	27	81.5
	145-<155	205	149	354	42.1	216	267	483	55.3	202	412	614	67.1	163	516	679	76.0	138	532	670	79.4
	155-<165	1267	917	2184	42.0	970	1448	2418	59.9	948	2123	3071	69.1	709	2259	2968	76.1	408	1705	2113	80.7
	165-<175	934	861	1795	48.0	744	1172	1916	61.2	598	1402	2000	70.1	355	1267	1622	78.1	179	693	872	79.5
	175-<185	94	108	202	53.5	68	136	204	66.7	45	148	193	76.7	18	99	117	84.6	6	28	34	82.4
	≥185	2	2	4	50.0	1	1	2	50.0	1	4	5	80.0	0	5	5	100.0	0	1	1	100.0
Total		2507	2045	4552	44.9	2007	3030	5037	60.2	1805	4108	5913	69.5	1252	4161	5413	76.9	736	2981	3717	80.2
Male	<145	0	0	0		1	0	1	0.0	0	0	0		0	1	1	100.0	0	2	2	100.0
	145-<155	4	1	5	20.0	1	1	2	50.0	4	2	6	33.3	8	2	10	20.0	5	2	7	28.6
	155-<165	93	20	113	17.7	96	50	146	34.2	113	106	219	48.4	106	191	297	64.3	108	189	297	63.6
	165-<175	910	261	1171	22.3	657	523	1180	44.3	677	958	1635	58.6	554	1304	1858	70.2	371	1158	1529	75.7
	175-<185	1249	503	1752	28.7	871	921	1792	51.4	680	1416	2096	67.6	425	1430	1855	77.1	245	997	1242	80.3
	≥185	333	169	502	33.7	198	297	495	60.0	102	301	403	74.7	67	256	323	79.3	18	160	178	89.9
Total		2589	954	3543	26.9	1824	1792	3616	49.6	1576	2783	4359	63.8	1160	3184	4344	73.3	747	2508	3255	77.1

Seven (7/10) age-group-by-sex chi-square tests of independence and nine (9/10) chi-square tests for linear trend were significant $P < 0.05$.

Table 2. The number of participants (%) above ($n \geq 5$) or below ($n < 5$) the WHTR cut-off point (0.5) by sex, by height (HT) and by age groups.

Age group (yrs)		16-29				30-39				40-49				50-59				60-69			
Sex	HT (cm)	WHTR cut-off			% ≥ 5	WHTR cut-off			% ≥ 5	WHTR cut-off			% ≥ 5	WHTR cut-off			% ≥ 5	WHTR cut-off			% ≥ 5
		n < 5	n ≥ 5	Total		n < 5	n ≥ 5	Total		n < 5	n ≥ 5	Total		n < 5	n ≥ 5	Total		n < 5	n ≥ 5	Total	
Female	<145	4	9	13	69.2	5	9	14	64.3	1	29	30	96.7	2	20	22	90.9	0	27	27	100.0
	145-<155	165	189	354	53.4	141	342	483	70.8	142	472	614	76.9	108	570	678	84.1	91	578	669	86.4
	155-<165	1282	902	2184	41.3	992	1425	2417	59.0	980	2091	3071	68.1	727	2241	2968	75.5	414	1699	2113	80.4
	165-<175	1155	640	1795	35.7	972	943	1915	49.2	894	1106	2000	55.3	534	1087	1621	67.1	273	599	872	68.7
	175-<185	136	66	202	32.7	121	83	204	40.7	100	93	193	48.2	46	71	117	60.7	11	23	34	67.6
	>185	4	0	4	0.0	1	1	2	50.0	3	2	5	40.0	2	3	5	60.0	1	0	1	0.0
Total		2746	1806	4552	39.7	2232	2803	5035	55.7	2120	3793	5913	64.1	1419	3992	5411	73.8	790	2926	3716	78.7
Male	<145	0	0	0		0	1	1	100.0	0	0	0		0	1	1	100.0	0	2	2	100.0
	145-<155	3	2	5	40.0	1	1	2	50.0	0	6	6	100.0	1	9	10	90.0	0	7	7	100.0
	155-<165	62	51	113	45.1	19	127	146	87.0	23	196	219	89.5	10	287	297	96.6	19	278	297	93.6
	165-<175	677	494	1171	42.2	283	897	1180	76.0	210	1425	1635	87.2	143	1714	1857	92.3	91	1438	1529	94.0
	175-<185	1070	682	1752	38.9	580	1212	1792	67.6	379	1717	2096	81.9	228	1627	1855	87.7	109	1133	1242	91.2
	>185	335	167	502	33.3	190	305	495	61.6	101	302	403	74.9	66	256	322	79.5	17	161	178	90.4
Total		2147	1396	3543	39.4	1073	2543	3616	70.3	713	3646	4359	83.6	448	3894	4342	89.7	236	3019	3255	92.7

In all 10 age-by-sex sub-tables, the chi-square tests of independence and chi-square tests for linear trend were significant $P < 0.001$.