

Childhood Overweight and the Incidence of Distal Forearm Fracture

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Background

- Incidence of distal forearm fractures has increased between 1970 – 2000, by 56% in females and 32% in males < 35 yrs of age (Khosla et al., 2003, Olmsted County, MN)
- Etiology unclear: changing patterns of physical activity, poor calcium intake, effect of increasing childhood overweight on bone mineral content



Figure 2. This is an X-ray of a normal wrist, looking at it from the front (left) and from the side (right). In the left picture, the radius is the larger bone.

From American Academy of Orthopaedic Surgeons website (www.aaos.org)



Figure 3. This is an X-ray of a typical distal radius fracture, looking at it from the front (left) and from the side (right). In the pictures, the fracture (broken bone) is indicated by the arrows. The other black spaces are the joints.

From American Academy of Orthopaedic Surgeons website (www.aaos.org)

- Adults: overweight is associated with greater bone mineral density, reduced risk of osteoporosis, and protection against fractures.
- Children: effect of overweight on bone mineral content may be different, and is controversial.

Possible Mechanisms for Increased Bone Mineral Content in Childhood Overweight:

- Hormonal influences – increased estrogen or leptin.
- Biomechanical loading – increased body weight and lean mass leading to increased bone loading.
- Diet – increased calcium intake 2° to higher overall caloric intake

- Ellis et al. (2003) – 865 children – whole body bone mineral content higher in children with higher adiposity.
- Leonard et al. (2004) – 235 children – obesity was associated with greater whole body bone area and bone mineral content.

Possible Mechanisms for Decreased Bone Mineral Content in Childhood Overweight:

- Diet - inadequate dietary calcium 2° to overall poor diet quality (↑ intake of processed/fast foods; soda consumption).
- Physical activity – reduced participation in exercise/sports related to difficulty with movement, decreased agility, stigma.

- Goulding et al. (2001) – case-control study of 200 children; overweight and obese children have low bone mineral content and increased fractures.
- Goulding et al. (2000) – 336 children – weight is not protective to bone in obese and overweight children. “Mismatch” between high body weight and bone development.

Hypothesis

- *Childhood overweight is associated with an increased incidence of distal forearm fractures over time*

Methods

- 1982 population-based Heartwatch cohort: 3106 children, 5 – 15 yrs., from 16 schools in Marshfield, WI participated in a cardiovascular disease risk factor study
- Baseline measures: health, dietary, and family history questionnaire, blood pressure, height, weight, fasting serum lipids.
- 99% of the cohort received medical care at the Marshfield Clinic.

Methods

- Baseline data were merged with Marshfield Clinic data on distal forearm fractures (ICD-9 codes 813.4 - 813.9) identified from electronic medical records to determine fracture incidence in the cohort over time.
- 1st fracture diagnosis only
- Subjects with < 5 yrs follow-up (n=255) were excluded from analysis.

Statistical Analysis

- Kaplan-Meier survival analysis - estimate incidence of distal forearm fractures over time; 95% confidence intervals (CI) calculated.
- Cox-proportional hazard model - determine hazard ratios and 95% CI between overweight children and children with a desirable body weight.

Table 1. Baseline* Subject Characteristics

Variables	Subjects w/ fracture (n=269)	Subjects w/o fracture (n=2797)	P-value
Age (yrs)	10.2 ± 2.7	10.6 ± 2.8	0.02
Gender:			
Male	160 (59.5%)	1400 (50.1%)	0.003
Female	109 (40.5%)	1397 (49.9%)	
BMI (kg/m ²)	18.1 ± 3.7	18.4 ± 3.6	0.6
BMI z-score	0.17 ± 1.1	0.15 ± 1.1	0.79
Childhood Weight:			
BMI > 95 th	22 (8.2%)	175 (6.3%)	0.47
BMI 85-95 th	30 (11.2%)	316 (11.3%)	
BMI < 85 th	217 (80.7%)	2306 (82.5%)	
Yrs. Follow-up	28.9 ± 6.4	27.5 ± 7.3	0.002

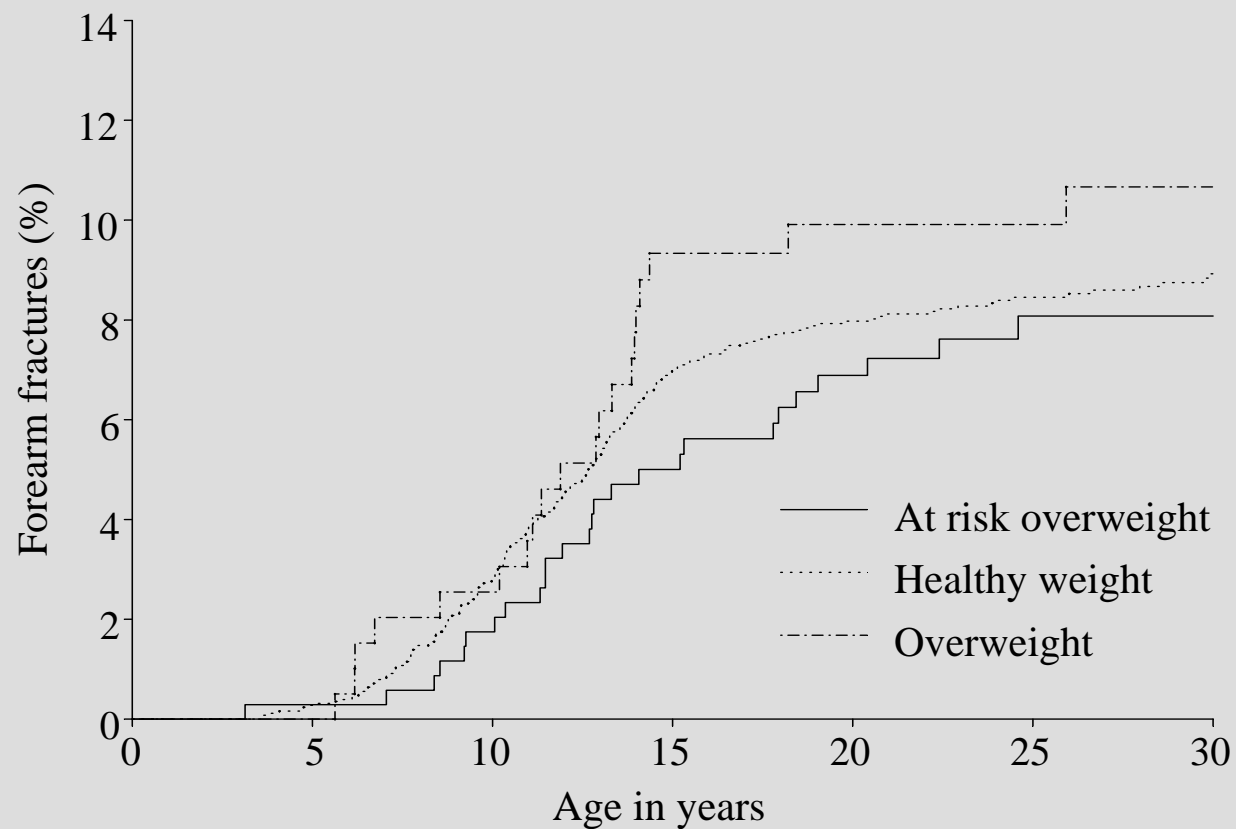
* Baseline parameters assessed in 1982

Table 2. Time to Fracture*

Childhood Weight Status	Male	Female	Overall
Overweight	1.04 (0.56,1.92) P=0.90	1.72 (0.92, 3.23) P=0.09	1.31 (0.84,2.03) P=0.23
At risk for overweight	0.94 (0.57,1.56) P=0.81	1.14 (0.63, 2.04) P=0.67	1.02 (0.70,1.50) P=0.91

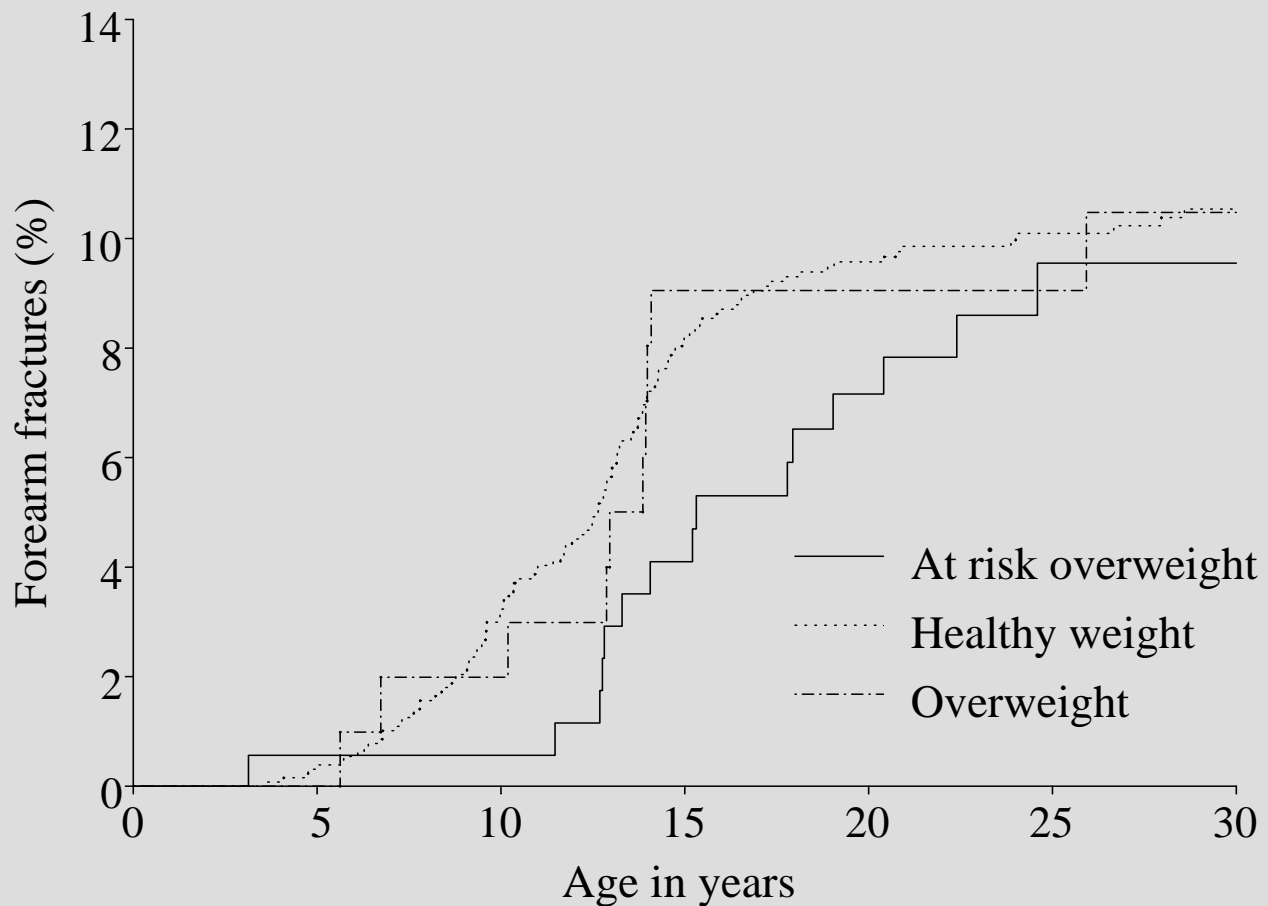
*Hazard ratios and 95% confidence limits for time to fractures by childhood BMI category, adjusted for baseline age. Reference category is BMI < 85th.

Figure 1. Incidence of Distal Forearm Fractures



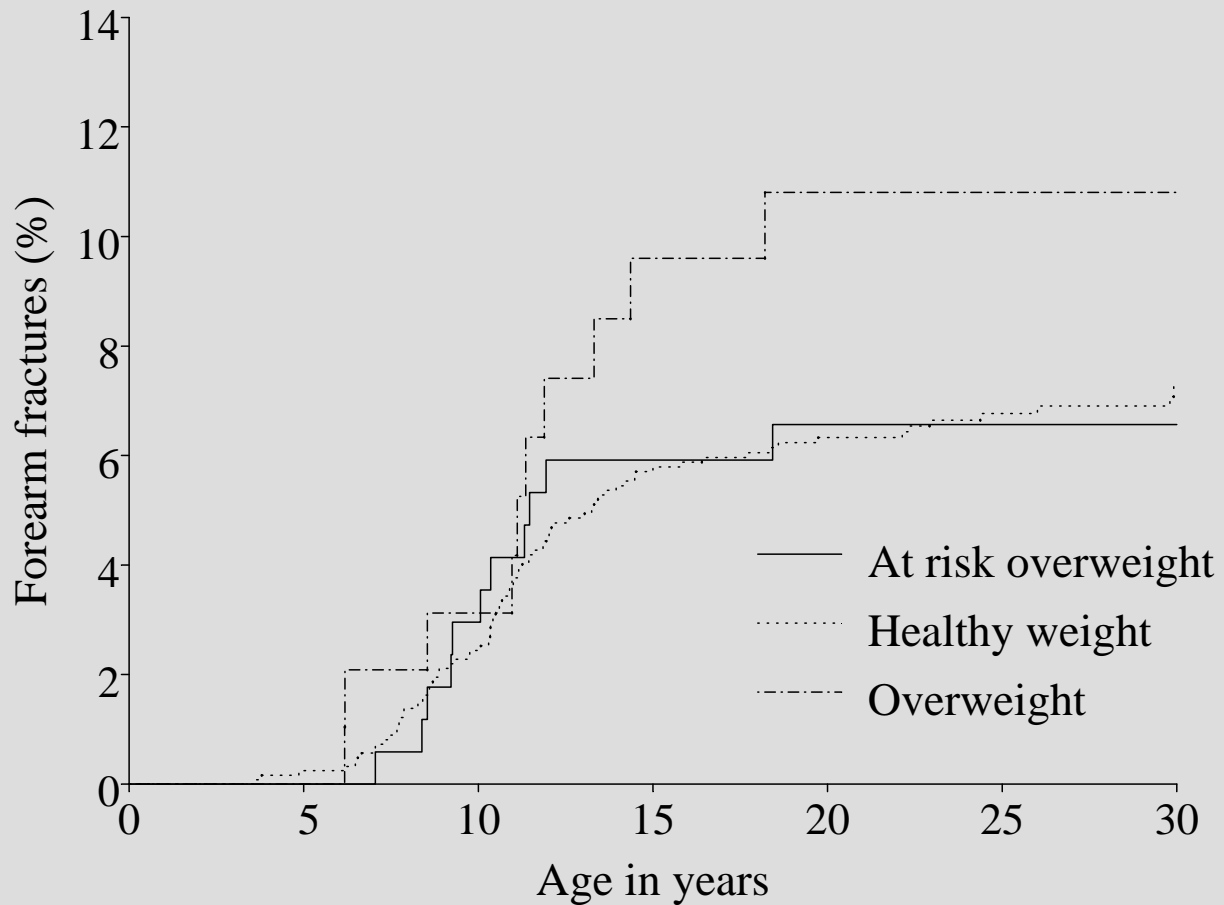
	Number at risk						
	0	5	10	15	20	25	30
At risk overweight	346	345	336	311	277	194	146
Healthy weight	2519	2512	2398	2200	1965	1416	1018
Overweight	197	197	191	169	154	125	94

Figure 2. Incidence of Distal Forearm Fractures (Males)



	Number at risk						
	0	5	10	15	20	25	30
At risk overweight	176	175	172	161	141	92	60
Healthy weight	1281	1277	1215	1102	971	693	502
Overweight	101	101	98	88	81	67	55

Figure 3. Incidence of Distal Forearm Fracture (Females)



	Number at risk						
	0	5	10	15	20	25	30
At risk overweight	170	170	164	150	136	102	86
Healthy weight	1238	1235	1183	1098	994	723	516
Overweight	96	96	93	81	73	58	39

Table 3. Cause of Fracture

	Falls N (%)	MVA N (%)	Sports N (%)	Other N (%)
Desirable Weight	162 (75)	7 (3)	30 (14)	17 (8)
At risk for Overweight	23 (76)	3 (10)	2 (7)	2 (7)
Overweight	18 (85)	1 (5)	0 (0)	2 (10)

Conclusions

- Among female members of the Heartwatch cohort, the incidence of distal forearm fractures over time was greatest among subjects who were overweight during childhood.
- This finding is consistent with the literature showing that overweight contributes to an increased risk of childhood forearm fractures.

Future Studies

- Limitation – small sample size; need to replicate findings in larger cohort (MESA);
- Effect of childhood overweight on bone density and life-long fracture risk;
- Effect of changing weight status over time on fracture risk.

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