HORTICULTURAL ACTIVITY PREDICTS LATER LOCALIZED LIMB STATUS IN A CONTEMPORARY PRE-INDUSTRIAL POPULATION

Jonathan Stieglitz et al.

Materials and methods

Study population

Few Tsimane (<5% of families) rear cattle, and most cattle owners maintain small herds (<3 head) and do not process milk for consumption. Market foods (e.g. pasta, sugar) and domesticated animals (e.g. cattle, chicken, pig) each provide 2% of the daily calories, and eggs provide <0.5% of calories. Despite a lean diet and high fertility (total fertility rate=9 births per woman, see Mcallister et al. [2012]) with prolonged on-demand breastfeeding, Tsimane women's breast-milk concentration of long-chain polyunsaturated fatty acids is high relative to American women, and does not decline with parity or age (Martin et al. 2012). Higher parity and older age are, however, each associated with reduced calcaneal qUS parameters (Stieglitz et al. 2015).

Hunting is almost always performed by men (mean hunt duration=8.5 hours) (Trumble et al. 2014). Horticultural field clearance (typically 0.1-1.5 hectares) entails removal of smaller vegetation with machetes (*fetsaqui'*, done by both sexes in the dry season), clearing of larger trees with an axe (*paĉan*, men only), burning (*cóshtaqui*, both sexes), planting (*cäti*, both sexes) and harvesting (*vädaqui*, both sexes, dry and wet seasons depending on the cultigen). Field maintenance (*jidaqui* or *tsitsonaqui*, both sexes) is done routinely throughout the year and involves removing smaller vegetation with machetes or hoes, and manually removing fallen, dried tree trunks for later chopping as firewood. Horticultural labour is generally performed for several hours at a time, but with frequent breaks due to its energy intensiveness (Trumble et al. 2013) and intense sun exposure.

Tobacco consumption is minimal among Tsimane (for women and men aged 50+: mean±SD pack-years=0.10±0.54 and 0.63±1.15, respectively) (Stieglitz et al. 2016). While 14% of women and 66% of men report occasional tobacco use (often from tobacco grown in home gardens), 97% of women and 77% of men have smoked <1 pack-year. Cigarette smoking (pack-years, or whether any history of smoking is reported) does not predict any qUS parameter and is thus omitted from multivariate analyses.

Participants

Since 2002 the Tsimane have participated in the ongoing Tsimane Health and Life History Project (THLHP; see http://www.unm.edu/~tsimane). All Tsimane residing in study villages are eligible to participate in the THLHP, and most choose to do so at least once. Project physicians have conducted annual medical exams on Tsimane of all ages since 2002 (n~8,500 individuals). A team of physicians, biochemists, and Tsimane research assistants collects data on medical and reproductive histories, functional ability, and other aspects of lifestyle (e.g. food production and sharing), in addition to collecting biological specimens (e.g. serum, urine, feces) among a subset. To date, ~45,000 medical exams have been conducted; of those receiving a medical exam, 85% have received exams in multiple years.

All Tsimane aged 2+ years residing in study villages are eligible to receive an ultrasound of the radius and tibia (i.e. there are no exclusion criteria based on health status, reproductive state, etc.), although adults aged 40+ are over-sampled given the THLHP's focus on aging. Assessment of radial and tibial status using ultrasonography began in October 2014, and to date >1,400 radial and >1,400 tibial scans have been performed (55% among adults aged 40+). Since October 2014, radial and tibial ultrasounds were conducted among 89% of adults aged 20+ that received a medical exam (n=1,078). There are no significant differences in study variables between adults who received an ultrasound and those that received a medical exam without an ultrasound. No participant reported ever using dietary supplements, medications known to affect bone metabolism or consistent hormonal contraception.

Quantitative ultrasonography (qUS) of the radius and tibia

Currently the only validated skeletal site for clinical use of qUS in osteoporosis management is the calcaneus (Krieg et al. 2008), although with recent technological advances it is now clear that qUS at other skeletal sites can discriminate between those with fragility fractures (e.g. of the hip, spine or forearm) and age-matched controls without fractures (Barkmann et al. 2000). Population-based studies show that qUS of the radius and tibia prospectively predicts fragility fracture even after adjusting for risk factors used in the World Health Organization's FRAX fracture risk assessment tool (Olszynski et al. 2013).

The MiniOmni's handheld probe contains several transducers acting as either transmitters or receivers; the transmitter generates waves that move through soft tissue and enter bone. Waves within soft tissue that hit the bone surface at an angle X refract inside the bone at a different angle Y, according to Snell's law (Barkmann et al. 2000; Knapp et al. 2001). There is an angle X where Y=90° (sin Y=1) and the wave continues parallel to the bone's surface along its long axis. At each point of this transmission a small fraction of the energy is radiated out of the bone, through soft tissue toward the skin surface. A fraction of the original beam is detected by the receiver, and these first detected waves are used to calculate wave velocity. If the cortical shell is thin relative to the wavelength, then the waves also travel in the trabecular bone layer immediately under the cortical shell. Bone micro-architectural properties alter the shape, intensity and speed of waves passing through bone. Wave attenuation occurs by a reduction in wave amplitude and results in loss of energy. In trabecular bone the major attenuation mechanism is scattering (i.e. redistribution of energy in one or more directions), whereas in cortical bone the major mechanism is absorption (i.e. dissipation of energy by conversion to heat).

MiniOmni probe placement is at the medial aspect of the distal one-third radius (i.e. midpoint between the olecranon process of the ulna and the tip of the distal phalanx of the third digit) of the non-dominant arm, and at the anteromedial aspect of the midshaft tibia of the left leg (Figure S1). For the tibia, with the knee flexed to 90° and the heel on the ground, a point equidistant between the plantar surface of the foot and the soft tissue above the distal portion of the femur is used to centre the measurement. These end points for the lower and upper limb were recorded to examine associations between limb length and SOS. With the participant seated, ultrasound gel is applied to the skin surface to facilitate acoustic coupling. To obtain a velocity measurement, the operator slowly rotates the probe in a semi-arc perpendicular to the bone's long axis by about 140° without lifting it from the skin surface. During each measurement cycle the ultrasound performs numerous SOS measurements. For each bone a minimum of three cycles is needed to get a valid SOS measure. SOS values obtained from the different cycles must be statistically consistent; if an outlier is detected a fourth cycle (sometimes a fifth) is required. The average of the SOS values is used for analysis.

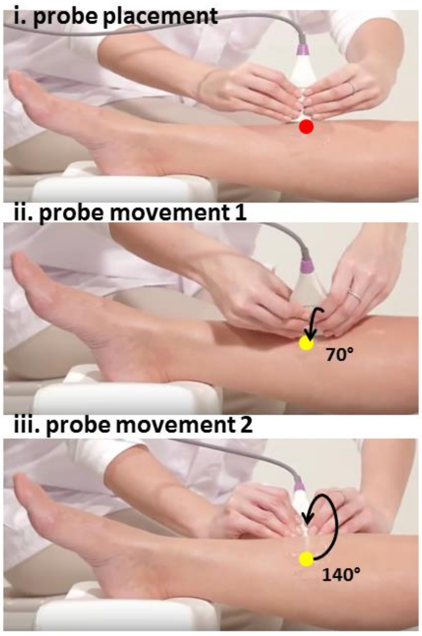
Instrumental quality control measurements of a Perspex phantom provided by the manufacturer were performed daily. *In vitro* precision was assessed by 10 consecutive phantom measurements, with a coefficient of variation (CV) of 1.1% (SD=28.4 m/s). *In vivo* precision was measured using nine volunteers (aged 24-71 years, mean±SD age=41.0±18.3, 56% female) who had two consecutive measurements of each bone. The root mean square CV was 1.5% for the radius (SD=58.5 m/s) and 1.4% for the tibia (SD=50.8 m/s). One ultrasound was used throughout the study and measurements were taken by one trained operator. No systematic differences in measurements were found over time.

Figure S1. qUS measurement of the radius (A) and tibia (B). Images and instructions shown in S1A are taken from the MiniOmni User Guide (Document Number DUM-0081 Revision 02; see pages 47-48) and then modified to show, approximately, probe placement and movement. Images shown in S1B are taken from the manufacturer's training video, and then modified as in S1A; instructions shown in S1B are taken from S1A and modified accordingly.

A: qUS measurement of distal radius

Scan begins with probe vertical to the positioned arm (see i). Scan by moving first (from red circle, denoting starting point) to the lateral direction (yellow circle), about 70 degrees (probe movement denoted by black arrow; see ii). Continue the scan by returning the probe (from yellow circle) to the starting point. Then scan in the opposite (medial) direction, about 70 degrees (see iii), and finally return again to start point.

B: qUS measurement of midshaft tibia



Scan begins with probe vertical to the positioned leg (see i). Scan by moving first (from red circle) to the medial direction (yellow circle), about 70 degrees (see ii). Continue the scan by returning the probe (from yellow circle) to the starting point. Then scan in the opposite (lateral) direction, about 70 degrees (see iii), and finally return again to start point.

Demographics, anthropometrics and behavioral observation

Birth years were assigned based on a combination of methods including using known ages from written records, relative age lists, dated events, photo comparisons of people with known ages, and cross-validation of information from independent interviews of kin. Each method provides an independent estimate of age, and when estimates yielded a date of birth within a three-year range, the average was used. Individuals for whom reliable ages could not be ascertained are not included in analyses.

Anthropometric data were obtained among all participants; in no case did severe foot calluses or other factors (e.g. unclean foot pads on the Tanita scale) obstruct the ability to generate body composition or other anthropometric data.

Accelerometry data were collected throughout the year (31% [69%] of participants were sampled in the wet [dry] season) across 8 villages from 2012-2015. Participants were instructed to wear the accelerometer on the right hip for three consecutive days and to maintain usual habits on sample days (median hours sampled/person=43.6). Data were downloaded in 10-second epochs in 24-hour bouts and recoded into 1-minute intervals. Estimates of 24-hour physical activity energy expenditure (PAEE) were calculated by averaging across separate 12-hour daytime and 12-hour non-daytime estimates.

Data analysis

To test P2, models of bone status were also fit using GAMs (unweighted), although no major differences with the weighted general linear models were found. Inclusion of fixed effects of village region (1=river, 2=near town, 3=forest) or season (1=wet, 0=dry) at time of ultrasound does not improve model fit; these terms are thus omitted. Aside from comparing members in the upper quartile of time spent in a given task (vs. all others), we also conducted alternative comparisons (e.g. upper tercile membership vs. others, or upper vs. lower terciles) but no major differences were found. The magnitude of the difference in task-specific time allocation between those in the upper quartile versus others ranges from 2-fold to 9-fold for men and 2-fold to 10-fold for women (Table S4); food acquisition tasks exhibit greater between-group differences in time allocation than either domestic or leisure tasks.

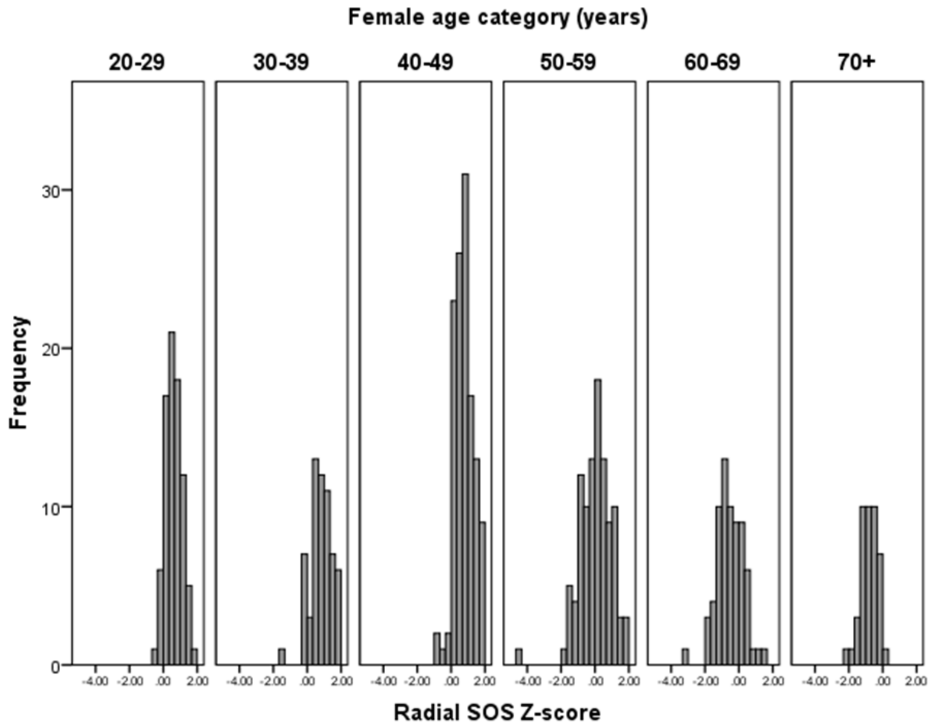
Results

Bone status descriptives by sex, age and anthropometrics

Histograms of radial and tibial SOS z-scores by sex and age are shown in Figure S2. Among all adults aged 20+, upper limb length does not predict radial SOS, and lower limb length does not predict tibial SOS controlling for age, age^2 [if $p \leq 0.1$], sex, $sex*age^2$ [if $p \leq 0.1$], height and weight). However, when examining correlations between anthropometric and qUS variables separately by sex, we find for radial SOS weak but significant positive correlations for women (partial *r*'s range from 0.098-0.152, all p's≤0.05, controlling for age) and no or weak negative correlations for men (partial *r*'s range from -0.108- -0.099, all p's≤0.05) (see Table S2). We find for tibial SOS an identical negative correlation with weight for both sexes (partial r= -0.14, $p \leq 0.01$). Radial SOS is more strongly positively correlated with tibial SOS for women (partial r=0.475, p<0.001) than men (partial r=0.156, p=0.001).

Figure S2. Histograms of radial and tibial SOS z-scores for women (A,C) and men (B,D) by age.

A



B

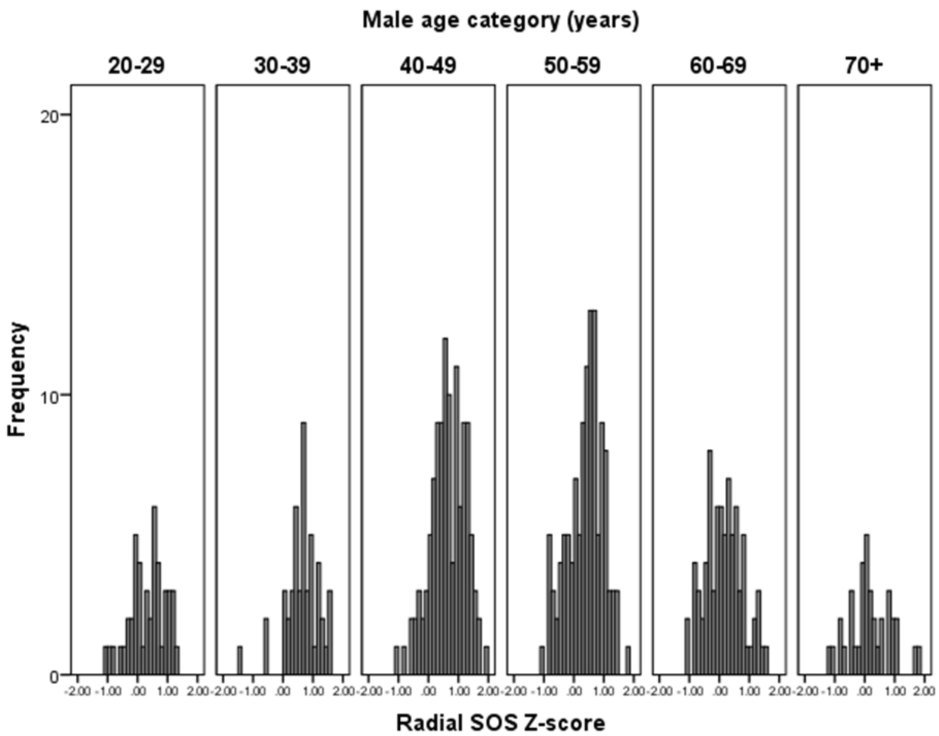
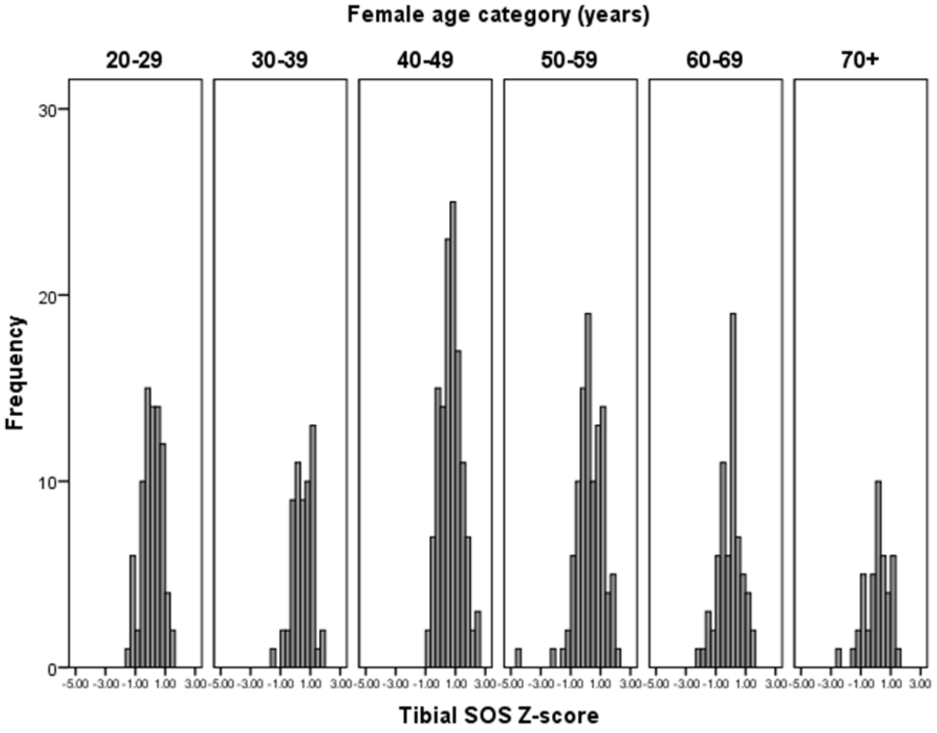


Figure S2 (continued).

C



D

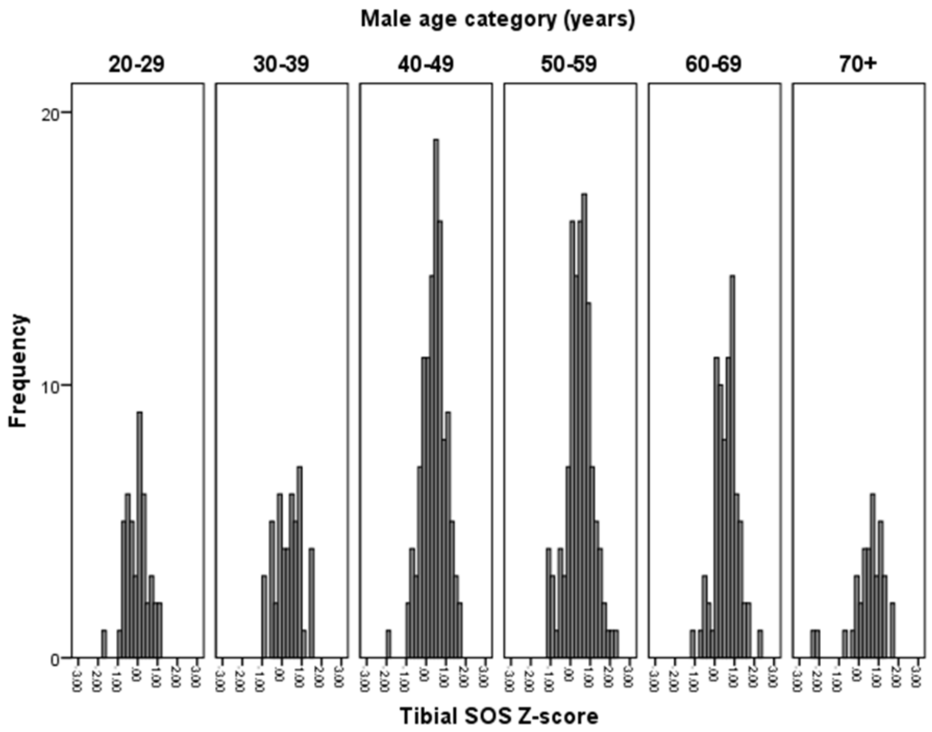


Table S1. Age-stratified radial and tibial speed of sound (SOS, m/s) for men and women.

	MEN			WOMEN		
Age category (years)	N	Mean radial SOS (SD)	Mean tibial SOS (SD)	N	Mean radial SOS (SD)	Mean tibial SOS (SD)
20-29	45	3880.8 (99.0)[***1]	3760.2 (94.2)	81[b]	3920.5 (89.2)[***]	3740.6 (107.0)
30-39	48[a]	3933.9 (94.1)[***]	3815.0 (107.9)	60	3956.3 (122.0)[***]	3797.0 (107.0)
40-49	116[a]	3934.6 (96.0)[***]	3830.8 (102.7)	126[c]	3952.4 (107.2)[***]	3832.1 (112.3)
50-59	119	3891.8 (98.5)[***2]	3842.7 (113.3)[2]	102	3811.1 (179.2)[**]	3767.4 (151.2)
60-69	78	3853.9 (102.0)[2]	3863.1 (98.5)[2]	68[b]	3702.3 (148.8)	3712.1 (125.7)
70+	36	3855.4 (115.2)[2]	3844.1 (140.3)[2]	43	3647.9 (88.8)[***]	3733.1 (132.3)
Total	442[a]	3896.8 (104.0)[***2]	3831.9 (111.1)[2]	480[b,c]	3854.4 (169.8)[***]	3772.9 (130.5)

***p≤0.001 (Wilcoxon signed rank test within sex of radial vs. tibial SOS) **p≤0.01

[1]p≤0.1 (Mann-Whitney U test across sexes of radial or tibial SOS) [2]p≤0.001

[a]For male tibial SOS one observation is missing, resulting in a total N=440. [b]For female tibial SOS one observation is missing, resulting in a total N=478. [c]For female radial SOS two observations are missing.

Table S2. Partial correlations (controlling for age) between anthropometric and qUS variables. Results for women are below the diagonal and for men above.

Variable	Height	Upper limb length[a]	Lower limb length[b]	Weight	Body fat %	Fat-free mass	Radial SOS	Tibial SOS
Height	1	0.655[***]	0.693[***]	0.468[***]	0.064	0.517[***]	0.012	0.045
Upper limb length[a]	0.630[***]	1	0.784[***]	0.321[***]	0.031	0.345[***]	0.001	0.005
Lower limb length[b]	0.504[***]	0.638[***]	1	0.341[***]	0.064	0.351[***]	-0.018	0.016
Weight	0.473[***]	0.340[***]	0.257[***]	1	0.537[***]	0.821[***]	-0.108[*]	-0.136[**]
Body fat %	0.206[***]	0.188[***]	0.117[*]	0.730[***]	1	-0.033	-0.044	-0.064
Fat-free mass	0.516[***]	0.332[***]	0.267[***]	0.799[***]	0.201[***]	1	-0.099[*]	-0.115[*]
Radial SOS	0.149[***]	0.101[*]	0.010	0.152[***]	0.098[*]	0.142[**]	1	0.156[***]
Tibial SOS	0.053	0.004	-0.033	-0.140[**]	-0.131[**]	-0.088[^]	0.475[***]	1

[a]Non-dominant arm

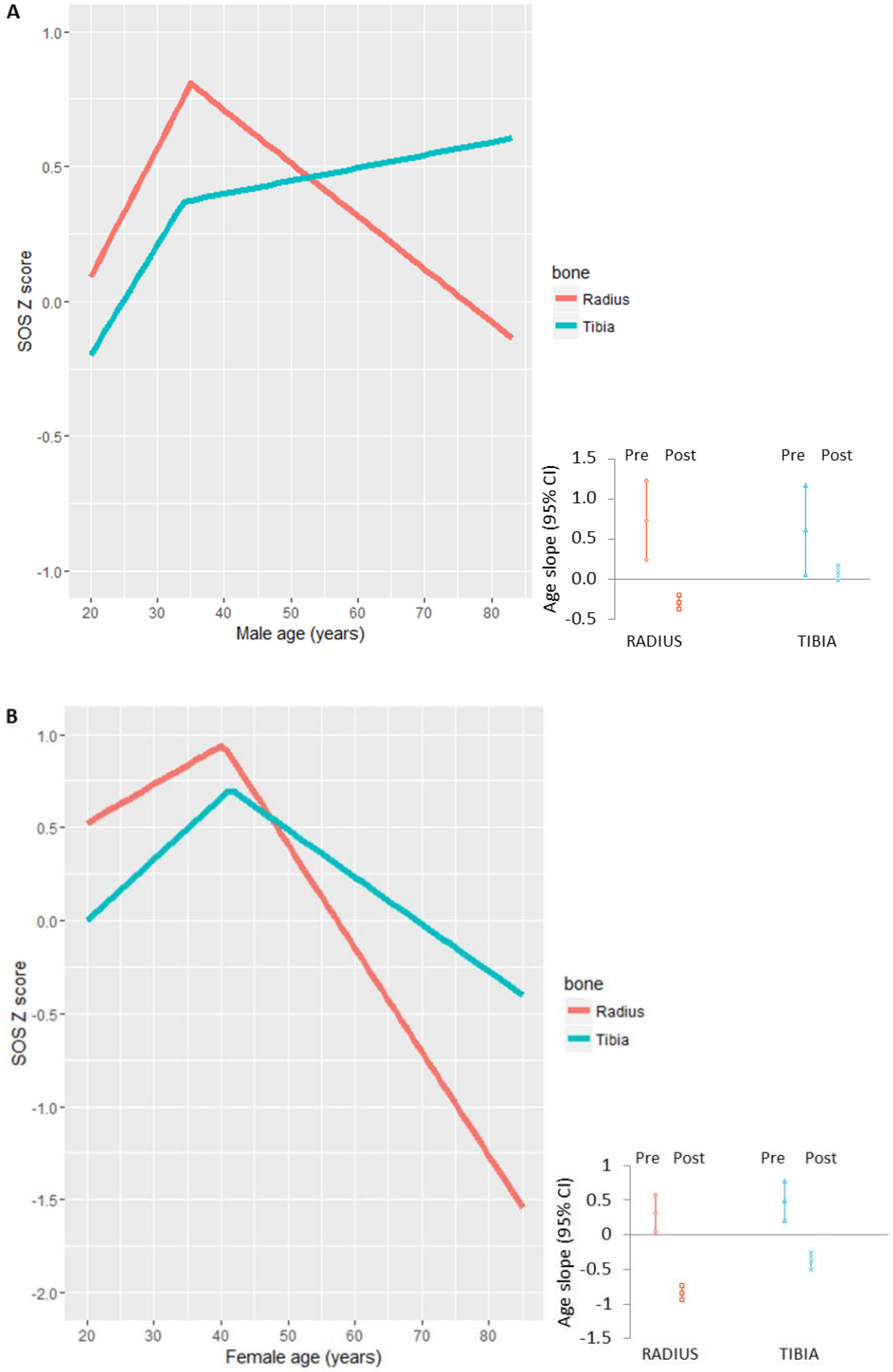
[b]Left leg

[^]p≤0.1 [*]p≤0.05 [**]p≤0.01 [***]p≤0.001

Abbreviations: qUS: quantitative ultrasound; SOS: speed of sound (m/s)

Is age-related SOS decline greater for the radius versus tibia (P1)? Yes.

Figure S3. Estimated age at breakpoint in bone status for men (A) and women (B) from segmented linear regression. Pre- and post-breakpoint age slopes are shown in the lower right (Std. βs with 95% CIs; see Table 2 for values).



Is greater time allocation to physically intensive subsistence activities earlier in life associated with greater later-life bone status (P2)? Partially.

Table S3. Weighted least-squares regressions of the effect of earlier-life time allocation to work and leisure on later-life bone status (mean±SD time lag [years] between behavioural observation and ultrasound=12±1 years; mean±SD age at ultrasound=49±15). Effect sizes (95% CIs) represent the difference in SOS for individuals in the upper quartile of time allocation to a given task (specific to each sex) compared to all others. Each row represents a different regression, and models are weighted by number of instantaneous scans/person (mean±SD number of scans/person=89±28). For all models of radial SOS, controls include age and time lag; additional controls for models combining sexes (i.e. where n=116) include age^2, sex and sex*age^2. Height, weight and other anthropometrics (i.e. adiposity and fat-free mass) at the time of ultrasound are omitted from models of radial SOS as these variables are not significant (as main effects or interacted with sex). For all models of tibial SOS, controls include age, height, weight and time lag; additional controls for models combining sexes include sex, sex*age and sex*height. Inclusion of random effects of village region (1=river, 2=near town, 3=forest) or season (1=wet, 0=dry) at the time of ultrasound does not improve model fit, and these random terms are thus omitted from all models. Significant (p≤0.05) associations appear in bold. P-values are not adjusted using a Bonferroni or other correction because tests are not independent (i.e. time allocation to work and leisure negatively co-vary), and there is no standard correction involving dependent p-values.

Activity macro-category	Task (% adult time[a])	Task description	N	Effect on radial SOS (Z-score)	Effect on tibial SOS (Z-score)
Work-food acquisition	Horticulture (7.7%)	Chop tree, clear brush, burn, plant, weed, harvest	116	**0.48**** **(0.11-0.86)**	0.09 (-0.25-0.43)
	Fish (5.7%)	With bow, hook/line, net, poison, dam, knife	116	0.11 (-0.20-0.42)	0.04 (-0.24-0.32)
	Hunt (men only, 9.9%)	With bow, gun or slingshot	59	0.03 (-0.35-0.42)	0.20 (-0.18-0.58)
	Other food acquisition (3.6%)	Forage (e.g. for fruit, honey, nuts), domestic animal care, buy/sell food	116	-0.28$^{\wedge}$ (-0.57-0.01)	0.01 (-0.26-0.28)
Work-domestic	Food process (10.2%)	Butcher, cut, degrain, grind, mash, peel, pound, scrape, shell, sift, strain, cook, serve	116	0.12 (-0.19-0.42)	-0.05 (-0.32-0.23)
	Manufacture (7.0%)	Weave (e.g. mat, bag, fan, thatch roof panel), spin thread, build (e.g. arrow, house, chair), repair (e.g. canoe, tools), get materials	116	0.07 (-0.24-0.38)	0.12 (-0.15-0.40)
	Other domestic (6.1%)	Clean (e.g. sweep, wash), tend fire, get firewood and water	116	-0.02 (-0.32-0.28)	-0.03 (-0.30-0.24)
Leisure-sedentary	Personal (21.5%)	Drink, eat, excrete, bathe, groom, attend class	116	0.04 (-0.28-0.37)	-0.03 (-0.31-0.26)
	Socialize (18.4%)	Talk, visit, attend meeting or party	116	-0.27$^{\wedge}$ (-0.56-0.02)	-0.15 (-0.42-0.12)
	Idle (8.0%)	Lie down, fidget, sit, sleep	116	**-0.33*** **(-0.64 - -0.03)**	0.06 (-0.22-0.33)

[a]Includes both sexes unless otherwise noted.

**p≤0.01 *p≤0.05 $^{\wedge}$p≤0.1

Table S4. Descriptive statistics for male (A) and female (B) time allocation sample (upper quartile vs. all others, n=116) by task. Values represent proportion of time allocated to each task.

A) MEN (n=59)		Upper quartile prop'n of time				All others			
Activity macro-category	Task	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.
Work-food acquisition	Horticulture	0.25	0.08	0.13	0.41	0.03	0.04	0.00	0.12
	Fish	0.18	0.06	0.13	0.28	0.04	0.04	0.00	0.12
	Hunt	0.22	0.08	0.15	0.48	0.06	0.05	0.00	0.14
	Other food acquisition	0.09	0.04	0.05	0.17	0.01	0.02	0.00	0.04
Work-domestic	Food process	0.09	0.04	0.06	0.18	0.02	0.02	0.00	0.05
	Manufacture	0.19	0.08	0.10	0.31	0.04	0.03	0.00	0.09
	Other domestic	0.09	0.03	0.06	0.18	0.02	0.02	0.00	0.05
Leisure-sedentary	Personal	0.33	0.06	0.26	0.42	0.17	0.05	0.07	0.25
	Socialize	0.31	0.08	0.23	0.53	0.14	0.06	0.02	0.22
	Idle	0.18	0.06	0.12	0.32	0.05	0.03	0.00	0.11

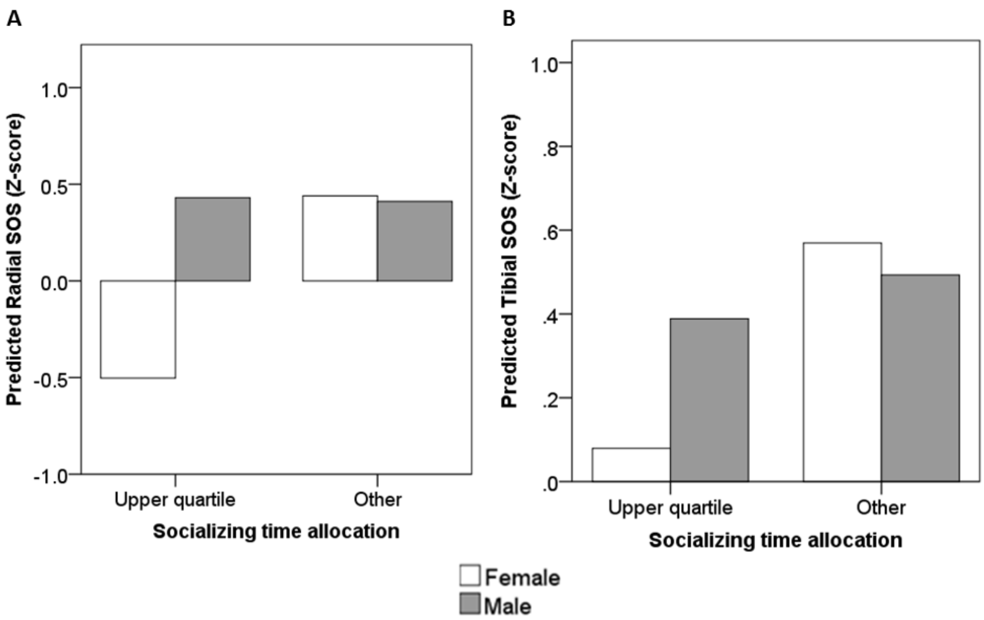
B) WOMEN (n=57)		Upper quartile prop'n of time				All others			
Activity macro-category	Task	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.
Work-food acquisition	Horticulture	0.20	0.06	0.14	0.31	0.03	0.03	0.00	0.11
	Fish	0.12	0.06	0.07	0.25	0.02	0.02	0.00	0.06
	Hunt	-----	-----	-----	-----	-----	-----	-----	-----
	Other food acquisition	0.10	0.05	0.05	0.23	0.01	0.01	0.00	0.04
Work-domestic	Food process	0.32	0.06	0.26	0.46	0.13	0.08	0.01	0.25
	Manufacture	0.17	0.06	0.10	0.30	0.04	0.03	0.00	0.09
	Other domestic	0.14	0.03	0.11	0.20	0.07	0.03	0.00	0.10
Leisure-sedentary	Personal	0.35	0.09	0.26	0.55	0.18	0.04	0.07	0.25
	Socialize	0.29	0.06	0.23	0.41	0.13	0.05	0.02	0.22
	Idle	0.19	0.06	0.13	0.33	0.05	0.03	0.00	0.10

Table S5. Results of χ^2 tests indicating whether membership in task-specific time allocation groups (upper quartile vs. all others) co-varies across tasks. Bold text in yellow (or green) highlight indicates a negative (or positive) significant association ($p \leq 0.05$). Results for women are below the diagonal and for men above.

Task	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Horticulture (1)	-----	NS	NS	NS	NS	NS	NS	NS	NS	**Fisher's Exact p=0.025**
Fish (2)	NS	-----	NS	NS	**Fisher's Exact p=0.014**	NS	**Fisher's Exact p=0.009**	NS	NS	NS
Hunt (men only, 3)	-----	-----	-----	NS	NS	NS	NS	NS	NS	**Fisher's Exact p=0.035**
Other food acquisition (4)	NS	**Fisher's Exact p=0.042**	-----	-----	NS	NS	NS	NS	NS	NS
Food process (5)	NS	NS	-----	**Fisher's Exact p=0.041**	-----	NS	NS	NS	NS	NS
Manufacture (6)	NS	NS	-----	NS	NS	-----	NS	**Fisher's Exact p=0.026**	**Fisher's Exact p=0.007**	NS
Other domestic (7)	NS	NS	-----	NS	NS	NS	-----	NS	NS	NS
Personal (8)	NS	NS	-----	NS	NS	**Fisher's Exact p=0.020**	NS	-----	**Fisher's Exact p=0.018**	**Fisher's Exact p=0.035**
Socialize (9)	**Fisher's Exact p=0.042**	NS	-----	NS	NS	NS	NS	NS	-----	NS
Idle (10)	NS	NS	-----	NS	**Fisher's Exact p=0.015**	NS	NS	**Fisher's Exact p=0.016**	NS	-----

Abbreviations: NS, not significant

Figure S4. Predicted radial (A) and tibial (B) SOS by time spent socializing and sex. Estimates are derived from least-squares regressions weighted by number of instantaneous scans/person. Predictors of radial SOS include main effects of age, age^2, sex, time lag and socializing time allocation (1=upper quartile, 0=other), and sex*age^2 and sex*socializing time allocation interactions. Predictors of tibial SOS include main effects of age, sex, height, weight, time lag and socializing time allocation, and sex*age, sex*height and sex*socializing time allocation interactions.



Are predicted associations from P2 stronger for the radius versus tibia (P3)? Yes.

Table S6. Effect of earlier-life time allocation to work and leisure on later-life bone status from multivariate analyses of covariance (MANCOVA). Membership in the upper quartile of time allocation to horticulture (and idling) is associated with significantly greater (and reduced) radial SOS. Tibial SOS, in contrast, is not significantly associated with earlier-life time allocation to any activity. Each row represents a different MANCOVA, and models are weighted by number of instantaneous scans/person. For models including both sexes, controls include age, age^2, sex, sex*age^2, height, sex*height, weight and time lag between behavioural observation and ultrasound. To model the effect of hunting time allocation on SOS (men only), we include as controls age, height, weight and time lag. Significant ($p \leq 0.05$) associations appear in bold.

		Radial SOS					Tibial SOS				
Activity macro-category	Task	df	F-value	p-value	Partial η^2	Adj. R^2	df	F-value	p-value	Partial η^2	Adj. R^2
Work-food acquisition	Horticulture	**1,106**	**6.849**	**0.010**	**0.061**	**0.276**	1,106	0.249	0.619	0.002	0.062
	Fish	1,106	0.462	0.498	0.004	0.232	1,106	0.077	0.783	0.001	0.061
	Hunt (men only)	1,53	0.005	0.941	<0.001	0.103	1,53	1.124	0.294	0.021	0.105
	Other food acquisition	1,106	3.616	0.060	0.033	0.254	1,106	0.016	0.900	<0.001	0.060
Work-domestic	Food process	1,106	0.457	0.501	0.004	0.232	1,106	0.209	0.648	0.002	0.062
	Manufacture	1,106	0.207	0.650	0.002	0.230	1,106	0.719	0.398	0.007	0.066
	Other domestic	1,106	0.017	0.896	<0.001	0.229	1,106	0.040	0.842	<0.001	0.060
Leisure-sedentary	Personal	1,106	0.074	0.786	0.001	0.229	1,106	<0.001	0.990	<0.001	0.060
	Socialize	1,106	3.255	0.074	0.030	0.252	1,106	1.338	0.250	0.012	0.072
	Idle	**1,106**	**4.503**	**0.036**	**0.041**	**0.260**	1,106	0.224	0.637	0.002	0.062

Is earlier-life time allocation associated with later-life activity levels? No.

The negative effect of earlier-life idle time allocation on later-life radial SOS is no longer significant after controlling for later-life 24-hour PAEE (β_{Idle}=0.339, 95% CI: -0.665-1.343, p=0.492, also controlling for age, age^2, sex, sex*age^2 and time lag, n=32), but the negative effect of socializing time allocation on radial SOS remains marginally significant ($\beta_{Socialize}$= -0.461, 95% CI: -0.998-0.075, p=0.088, same controls). Controlling for season of accelerometry data collection does not affect these results, and seasonality does not significantly predict PAEE.

Table S7. 24-hour physical activity energy expenditure (PAEE; Z-scores), estimated via accelerometry counts, by task-specific time allocation (upper quartile vs. all others). Mann-Whitney U tests across time allocation groups reveal no significant differences in 24-hour PAEE (all p's>0.2). Similar results were obtained for 12-hour daytime and 12-hour non-daytime PAEE (not shown). Mean±SD age at PAEE assessment=54.5±9.6 years, min=43, max=77; mean±SD age at behavioural observation=44.1±9.9 years, min=31, max=66.

Activity macro-category	Task	PAEE: upper quartile prop'n of time (n)	PAEE: all others (n)
Work-food acquisition	Horticulture	0.124 (8)	-0.041 (24)
	Fish	-0.072 (7)	0.020 (25)
	Hunt (men only)	0.477 (5)	0.208 (13)
	Other food acquisition	-0.224 (9)	0.088 (23)
Work-domestic	Food process	-0.036 (10)	0.017 (22)
	Manufacture	-0.091 (10)	0.042 (22)
	Other domestic	0.006 (11)	-0.003 (21)
All Work	-----	-0.118 (11)	0.062 (21)
Leisure-sedentary	Personal	0.475 (4)	-0.068 (28)
	Socialize	-0.084 (9)	0.033 (23)
	Idle	0.168 (5)	-0.031 (27)
All leisure	-----	0.498 (5)	-0.092 (27)

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