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Bone Health Parameters in Young Adult Female Handball Players

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Introduction

- Bones, in general, reach 90% of their peak mass in people aged 20 years. Therefore, a possible solution could be making sure there is maximal acquisition of bone mineral content (BMC) to compensate for the age-related bone loss.
- There are a lot of effective preventive tools to prevent osteoporosis.
- One of the most effective strategies against osteoporosis is physical activity (PA) practice.

Introduction

- The best diagnosis known for osteoporosis is done by performing dual-energy X-ray absorptiometry (DXA) scan which measures BMD, and this is considered to be the reference standard for diagnosis.
  - DXA can also measure geometric indices of bone resistance that can be evaluated in the area of the femoral neck (FN); these indices include cross-sectional area [CSA], cross-sectional moment of inertia [CSMI], section modulus [Z], buckling ratio [BR] and strength index [SI])
  - DXA can also evaluate composite indices of femoral neck strength (compression strength index [CSI], bending strength index [BSI], and impact strength index [ISI])

Introduction

- The aim of the present study was to compare bone health parameters (BMC, BMD, geometric indices of FN strength [CSA, CSMI, Z, BR, SI] and composite indices of FN strength [CSI, BSI and ISI]) in young adult inactive women and young female handball players.
  - We hypothesized that young adult women who practice handball have greater bone health parameters compared to inactive females.

Material and methods

- The subjects who accepted to be in the present study are young adult women.
- They were 38 volunteers between the ages of 20 and 32.
  - one group of 18 inactive women and another group of 20 female handball players.
- None of the subjects smoked, and none of them suffered from any considerable orthopedic problem or any disorder such as diabetes known to affect bone metabolism.

Material and methods

- Body composition and bone measurements:
  - Lean mass and fat mass
  - BMC and BMD
  - Geometric indices of hip bone strength (CSA, CSMI, Z, SI and BR)
  - Composite indices of femoral neck strength (CSI, BSI and ISI)

Material and methods

- **Procedures of Physical Performance Tests:**
  - **Maximal aerobic velocity**
  - **Jumping performances**
  - Force-velocity power (FV) on cycle ergometer
  - Sprinting performance
  - Maximal strength measurements

Material and methods

- Questionnaires:
  - **Sleep Quality**
  - **Daily Calcium and Protein Intakes**
  - **Physical Activity**

Results

Table 1. Clinical characteristics and bone variables ofthe study population.

	Handball players (n = 20)	Controls (n = 18)	p-value
	Mean ± SD	Mean ± SD	
Age (years)	25.9 ± 3.7	24.2 ± 1.9	0.101
Weight (kg)	64.8 ± 9.4	67.6 ± 8.8	0.352
Height (cm)	**164.3 ± 5.3**	**168.2 ± 3.7**	**0.013**
BMI (kg/m^2)	24.0 ± 3.5	23.9 ± 3.1	0.902
Lean mass (Kg)	**38.990 ± 3.223**	**31.046 ± 2.457**	**<0.001**
Fat mass (Kg)	24.604 ± 5.629	25.858 ± 1.939	0.376
Fat mass (%)	**34.6 ± 3.3**	**38.4 ± 1.4**	**<0.001**
WB BMC (g)	**2358 ± 234**	**2183 ± 235**	**0.028**
WB BMD (g/cm^2)	**1.152 ± 0.084**	**1.054 ± 0.107**	**0.003**
L1-L4 BMD (g/cm^2)	**1.247 ± 0.106**	**1.098 ± 0.079**	**<0.001**
TH BMD (g/cm^2)	**1.064 ± 0.064**	**0.961 ± 0.021**	**<0.001**
FN BMD (g/cm^2)	**1.072 ± 0.101**	**0.942 ± 0.024**	**<0.001**
CSA (mm^2)	155 ± 16	149 ± 5	0.123
CSMI (mm^4)	**10.93 ± 1.07**	**9.85 ± 1.37**	**0.010**
Z (mm^3)	**649 ± 71**	**590 ± 35**	**0.003**
BR	**2.61 ± 0.33**	**3.97 ± 0.94**	**<0.001**
SI	1.84 ± 0.34	1.68 ± 0.07	0.068
CSI (g/kg-m)	5.14 ± 0.82	5.06 ± 0.55	0.722
BSI (g/kg-m)	1.58 ± 0.26	1.66 ± 0.16	0.255
ISI (g/kg-m)	0.312 ± 0.046	0.328 ± 0.035	0.237
1-RM bench press (kg)	**28.750 ± 3.837**	**12.944 ± 1.474**	**<0.001**
1-RM leg extension (kg)	**37.750 ± 3.864**	**13.333 ± 1.534**	**<0.001**
1-RM leg curl (kg)	**28.100 ± 4.303**	**8.944 ± 1.830**	**<0.001**
1-RM squat (kg)	**59.650 ± 5.537**	**22.056 ± 3.404**	**<0.001**
1-RM deadlift (kg)	**58.250 ± 5.098**	**33.056 ± 2.838**	**<0.001**
VJ (cm)	**33.000 ± 4.365**	**22.000 ± 1.372**	**<0.001**
HJ (m)	**1.567 ± 0.0863**	**1.158 ± 0.0618**	**<0.001**
20 m sprint (s)	**3.878 ± 0.048**	**4.009 ± 0.050**	**<0.001**
Throwing velocity (km/h)	**32.400 ± 1.818**	**27.833 ± 0.786**	**<0.001**
FV power (watts)	**567.150 ± 27.410**	**471.167 ± 16.797**	**<0.001**
MAV (km/h)	**10.800 ± 0.696**	**8.333 ± 0.485**	**<0.001**
SJ (cm)	**19.515 ± 1.695**	**11.782 ± 0.464**	**<0.001**
CMJ (cm)	**27.330 ± 1.677**	**17.166 ± 0.306**	**<0.001**
DPI (g/day)	**95.6 ± 6.7**	**63.5 ± 9.0**	**<0.001**
DCI (mg/day)	**1064.0 ± 89.8**	**870.3 ± 63.3**	**<0.001**
PSQI	9.0 ± 2.1	9.1 ± 0.3	0.751

SD, standard deviation; BMI, body mass index; WB, whole body; BMC, bone mineral content; BMD, bone mineral density; L1–L4, Lumbar spine; TH, total hip; FN, femoral neck; CSA, cross-sectional area; CSMI, cross-sectional moment of inertia; Z, section modulus; BR, buckling ratio; SI, strength index; CSI, compression strength index; BSI, bending strength index; ISI, impact strength index; RM, repetition maximum; VJ, vertical jump; HJ, horizontal jump; FV, force-velocity; CMJ, counter movement jump; DPI, daily protein intake; DCI, daily calcium intake; PSQI, Pittsburgh sleep quality index. In bold, significant differences between the 2 groups.

Results

Table 2. Correlations between clinical characteristics and bone variables in the whole population.

	WB BMC (g)	WB BMD (g/cm^2)	L1–L4 BMD (g/cm^2)	TH BMD (g/cm^2)	FN BMD (g/cm^2)	CSA (mm^2)	CSMI (mm^4)	Z (mm^3)	BR	SI	CSI (g/kg−m)	BSI (g/kg−m)	ISI (g/kg−m)
Age (yr)	0.38 *	0.48 **	0.55 ***	0.59 ***	0.61 ***	0.52 ***	0.12	0.42 **	−0.38 *	0.47 **	0.28	0.20	0.19
Weight (kg)	0.22	0.22	−0.12	−0.04	−0.05	0.17	−0.18	0.19	0.02	−0.37 *	−0.77 ***	−0.57 ***	−0.74 ***
Height (m)	−0.42 **	0.49 **	0.61 ***	−0.47 **	−0.25	0.08	0.05	−0.003	0.33 *	−0.08	0.01	0.29	−0.02
BMI (kg/m^2)	0.41 **	0.42 **	0.14	0.16	0.05	0.13	−0.20	0.19	−0.11	−0.34 *	−0.78 ***	−0.70 ***	−0.73 ***
Lean mass (Kg)	0.35 *	0.43 **	0.53 ***	0.61 ***	0.55 ***	0.26	0.08	0.44 **	−0.65 ***	0.21	−0.06	−0.25	−0.30
Fat mass (Kg)	0.40 *	0.18	0.01	0.04	−0.05	0.19	−0.34 *	0.06	0.02	−0.41 **	−0.58 ***	−0.48 **	−0.50 **
Fat mass %	−0.04	−0.22	−0.37 *	−0.42 **	−0.44 **	−0.08	−0.38 *	−0.25	0.38 *	−0.41 *	−0.44 **	−0.24	−0.27
1-RM bench press (kg)	0.40 *	0.55 ***	0.69 ***	0.83 ***	0.81 ***	0.39 *	0.40 *	0.58 ***	−0.73 ***	0.38 *	0.18	−0.03	−0.08
1-RM leg extension (kg)	0.43 **	0.54 ***	0.71 ***	0.82 ***	0.76 ***	0.32 *	0.41 **	0.51 ***	−0.73 ***	0.36 *	0.14	−0.10	−0.10
1-RM leg curl (kg)	0.44 **	0.56 ***	0.73 ***	0.84 ***	0.78 ***	0.37 *	0.39 *	0.53 ***	−0.71 ***	0.37 *	0.15	−0.08	−0.10
1-RM half-squat (kg)	0.40 *	0.50 **	0.69 ***	0.79 ***	0.71 ***	0.26	0.36 *	0.45 **	−0.72 ***	0.33 *	0.06	−0.18 *	−0.17
1-RM deadlift (kg)	0.42 **	0.58 ***	0.73 ***	0.84 ***	0.77 ***	0.34 *	0.36 *	0.51 ***	−0.74 ***	0.37 *	0.08	−0.14	−0.15
VJ (cm)	0.10	0.30	0.53 ***	0.57 ***	0.46 **	−0.03	0.18	0.13	−0.61 ***	0.42 **	0.15	−0.12	−0.05

Results

Table 2. (*continued*)

	WB BMC (g)	WB BMD (g/cm^2)	L1–L4 BMD (g/cm^2)	TH BMD (g/cm^2)	FN BMD (g/cm^2)	CSA (mm^2)	CSMI (mm^4)	Z (mm^3)	BR	SI	CSI (g/kg−m)	BSI (g/kg−m)	ISI (g/kg−m)
HJ (m)	0.28	0.39 *	0.59 ***	0.63 ***	0.52 ***	0.05	0.38 *	0.30	−0.63 ***	0.34 *	0.14	−0.15	−0.07
20 m Sprint (s)	−0.31	−0.40 *	−0.65 ***	−0.74 ***	−0.66 ***	−0.23	−0.34 *	−0.30	0.78 ***	−0.26	−0.18	0.09	−0.02
Throwing velocity (Km/h)	0.61 ***	0.68 ***	0.81 ***	0.91 ***	0.82 ***	0.47 **	0.40 *	0.59 ***	−0.75 ***	0.27	0.06	−0.15	−0.14
FV power (watts)	0.54 ***	0.60 ***	0.72 ***	0.84 ***	0.77 ***	0.42 **	0.46 **	0.58 ***	−0.74 ***	0.25	0.03	−0.19	−0.21
MAV (km/h)	0.28	0.44 **	0.60 ***	0.66 ***	0.60 ***	0.11	0.24	0.36 *	−0.67 ***	0.25	0.11	−0.13	−0.12
SJ (cm)	0.24	0.41 *	0.60 ***	0.67 ***	0.58 ***	0.10	0.34 *	0.31	−0.68 ***	0.41 **	0.14	−0.13	−0.09
CMJ (cm)	0.27	0.41 **	0.61 ***	0.69 ***	0.61 ***	0.13	0.36 *	0.36 *	−0.69 ***	0.38 *	0.14	−0.13	−0.10
ST (h/day)	−0.39 *	−0.39 *	−0.55 ***	−0.70 ***	−0.64 ***	−0.26	−0.43 **	−0.46 **	0.73 ***	−0.11	0.00	0.20	0.25
PA (h/week)	0.33 *	0.39 *	0.52 ***	0.61 ***	0.54 ***	0.14	0.39 *	0.41 **	−0.67 ***	0.16	−0.05	−0.27	−0.30
DPI (g/day)	0.42 **	0.56 ***	0.60 ***	0.73 ***	0.64 ***	0.30	0.27	0.50 **	−0.65 ***	0.18	−0.17	−0.38 *	−0.40 *
DCI (g/day)	0.40 *	0.42 **	0.61 ***	0.64 ***	0.60 ***	0.27	0.28	0.40 *	−0.49 **	0.17	0.17	−0.04	−0.00
PSQI	−0.26	−0.10	−0.10	−0.08	−0.10	−0.13	−0.09	−0.16	0.06	0.26	0.03	0.02	−0.00

BMI, body mass index; WB, whole body; BMC, bone mineral content; BMD, bone mineral density; L1–L4, Lumbar spine; TH, total hip; FN, femoral neck; CSA, cross sectional area; CSMI, cross-sectional moment of inertia; Z, section modulus; BR, buckling ratio; SI, strength index; CSI, compression strength index; BSI, bending strength index; ISI, impact strength index; RM, repetition maximum; VJ, vertical jump; HJ, horizontal jump; FV, force-velocity; SJ, squat-jump; CMJ, counter movement jump; ST, siting time; PA, physical activity; DPI, daily protein intake; DCI, daily calcium intake; PSQI, Pittsburgh sleep quality index. *$p < 0.05$. **$p < 0.01$. ***$p < 0.001$.

Discussion

- In the present study, two groups of young adult women were compared (handball players vs. inactive young adult women).
- We noticed a clear difference in the results regarding various bone health parameters such as WB BMC, BMD and Z which had a remarkably greater value in female handball players compared to inactive women.
- Similarly, LM, PA,DPI and DCI had a remarkably greater value in handball players compared to inactive women.
- In contrast, FM percentage, BR and ST had a remarkably greater value in inactive women compared to handball players.
- However, age, weight, BMI, FM, CSA, SI, CSI, BSI, ISI and sleep quality did not show any significant differences when comparing the 2 groups.

Discussion

- Our results showed clear differences in several physical performance variables. 1-RM bench press, 1-RM leg extension, 1-RM leg curl, 1-RM squat, 1-RM deadlift, VJ, HJ, throwing velocity, FV power, MAV, SJ and CMJ had a remarkably greater value for the handball players compared to inactive women.
- These results seem to be logical since practicing handball improves jumping performance, lower limb strength and upper limb strength.
- On the other hand, 20 m sprint duration (seconds) yielded a higher score in inactive women compared to handball players.

Discussion

- FM was positively correlated to WB BMC but negatively correlated to SI, CSI, BSI and ISI.
- FM percentage was positively correlated to BR but negatively correlated to L1–L4 BMD, TH BMD, FN BMD, SI and CSI.
- Our results are in accordance with the results of many preceding studies which were done on young adults that have showed that body weight, BMI and FM were negatively associated to composite indices of FN strength.
- The excess of FM may negatively affect FN strength composite indices.
- For this reason, the implementation of strategies aiming at reducing FM excess should be done to prevent the incidents of fractures associated to in a later phase of life to osteoporosis.

Discussion

- DPI and DCI were positively correlated to WB BMC, BMD and Z but negatively correlated to BR.
- The associations between DPI and DCI with bone variables have been demonstrated by two previous studies conducted on young adults.
- The yielded results affirm the importance of protein and daily calcium intakes for bone health.

Discussion

- Strong correlations between maximal strength parameters and BMD values.
- Strong correlations between MAV and BMD values.
- Strong correlations between absolute power and BMD values
- Strong correlations between jumping performances and BMD values.
- Correlations between sprinting performance and BMD values.

Limitations

- The first limitation is that the study's nature is cross-sectional, and therefore, a causal relationship between handball practice and bone health parameters cannot be confirmed.
- The second limitation is that the number of subjects is low in both groups; however, there were enough power values which made running the analyses and testing the differences between the 2 groups regarding bone health parameters possible and credible.
- The third limitation is that we did not assess many bone health correlates (such as hormones and vitamin D levels).
- The fourth limitation of our study is that visceral FM was not evaluated. It is well known that visceral fat has a deleterious effect on bone health parameters.
- The last limitation was the lack of use of a specific PA questionnaire to measure the effect of mechanical strain on BMD.

Originality

- Nevertheless, based on our knowledge, comparing bone health parameters (BMC, BMD, geometric indices of FN strength [CSA, CSMI, Z, BR, SI] and composite indices of FN strength [CSI, BSI, and ISI]) in inactive young adult women and young female handball players has been done for the first time in the current study.

Conclusions

- To conclude, our study suggests that handball training is affiliated with greater bone health parameters in young adult women.
- As a result, practicing handball during young adulthood years could protect from the risk of contracting osteoporotic fractures later in life.
- Finally, selecting proper training programs in the duration of young adult years ought to be adapted accordingly.

THANK YOU FOR YOUR ATTENTION