Original Article

Sonographic appearance of fluid in peripheral joints and bursae of healthy asymptomatic Chinese population

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Background: High frequency ultrasound is often used to measure the thickness of fluid in peripheral joints and bursae of healthy asymptomatic populations. Two major steps critical to this procedure are obtaining the detection rates and analyzing the relevant factors.

Methods: Healthy Chinese adult volunteers with no history of arthritis, past trauma or surgery and joint pain were enrolled in this study. Ultrasonography was performed on the bilateral shoulders, elbows, wrists, metacarpophalangeal joints (MCP) 1–5, proximal interphalangeal joints (PIP) 1–5, distal interphalangeal joints (DIP) 2–5, suprapatellar knees, ankles, metatarsophalangeal joints (MTP) 1–5, subacromial and subdeltoid bursae, deep infrapatellar bursae, retrocalcaneal bursae and long biceps tendons in B mode. Average size of fluid thickness and detection rate were calculated and correlated with demographic parameters. Mean + 1.64 SD was defined as the upper limit of the 95% reference range.

Results: One hundred and fifty-two volunteers (71 males and 81 females) with mean age of 48.0± 14.1 years were enrolled. Both the highest detection rate and the thickest fluid were found in the suprapatellar knee (82.9%, 3.7±1.7 mm). There was no significant difference between the left and right side of the same structure in the detection rate and the fluid thickness. Females had a higher detection rate and fluid thickness than males in most examined structures, especially in the upper-limb joints. The greatest number of examined structures was found to be affected by age, and all of the correlations were positive (r from 0.118 to 0.510, $P<0.05$). Positive correlations were found in the long biceps tendon and MTP1 between detection rate and body mass index (BMI) ($r=0.251$ and 0.123, respectively, $P<0.05$), and in the long biceps tendon between effusion thickness and BMI ($r=0.228$, $P<0.05$). The upper limits of the 95% reference range for peripheral joints and bursae were determined.

Conclusions: Fluid in certain peripheral joints of healthy asymptomatic populations can be associated with gender, age or BMI. This study provided reference values for future comparisons with pathological conditions among Chinese populations.

Keywords: Healthy volunteers; effusion; ultrasound; joints

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Introduction

High frequency ultrasound has been increasingly used in musculoskeletal diseases, such as rheumatoid arthritis, for diagnostic purposes and to evaluate disease activity or drug response (1-4). Although MRI can detect lesions of minor joint structures, such as triangular fibrocartilage complex (TFCC) tears (5), high resolution ultrasound has become an important complement to musculoskeletal imaging beyond MRI. Ultrasound manifestation of inflammatory joints may include bone erosion, synovial hyperplasia, synovial vascularization and synovial fluid (2,3,6). Synovial fluid can also be found in certain joints under normal conditions, and can be visualized on sonography (7-9).

Assessing the ultrasound appearance of peripheral joints, bursae and tendon sheaths in a healthy asymptomatic population may provide insights into interpreting ultrasound exams in pathologic cases. It is important for clinicians to differentiate between effusion—the excess fluid in joints—and physiologic fluid accumulation, as the latter does not need clinical intervention. Therefore, in this study, we aimed to (I) use ultrasound to measure the thickness of fluid in peripheral joints, bursae and tendon sheaths in regards to situation, gender, age and BMI (US); (II) calculate the upper limit of the 95% reference range, in order to better understand both normal and pathologic conditions of joints and bursae fluids.

Methods

The study was approved by the local Ethics Committee. Informed consent was obtained from the volunteers for the acquisition, analysis and reporting of imaging data at the time of their examinations.

This study was conducted with healthy adult Chinese volunteers between January 2017 and June 2017, who were consecutively included from (I) healthcare medical, paramedical and administrative staff of the local hospital, (II) medical students at the same hospital, (III) healthy relatives visiting or accompanying patients and (IV) volunteers enrolled through online announcement of the study.

Inclusion criteria were age from 18 to 90 years, and free consensus to participate in the study. Exclusion criteria were the following: (I) history of rheumatoid arthritis, diabetes mellitus, hypothyroidism, hemophilia, trauma, surgery, symptomatic osteoarthritis, or septic arthritis in any studied joint; (II) any kind of joint pain experienced during any time in the previous month; (III) pregnant or breast-feeding women. Patient's age, sex, height and weight data were collected as demographic characteristics and body mass index (BMI) was subsequently calculated later.

US examinations were performed using Philips IU22 with a 9–12 MHz linear array transducer. Musculoskeletal (MSK) presetting was selected with the standard default mode. The transducer, coupled with several millimeters of ultrasound gel, was smoothly placed perpendicular to the skin to avoid anisotropic artifacts. All examinations were performed by 2 experienced radiologists (QL and TYJ) with more than 8 years of experience in musculoskeletal ultrasonography, and US examination was done by QL or TYJ at random in our study. Schmidt *et al.* have shown excellent inter- and intra-observer agreement (both lager than 0.8) when using similar ultrasound measurement methods (10). According to the OMERACT definition (11), the presence of fluid was defined as an anechoic displaceable and compressible intracapsular area in B mode, and which does not exhibit Doppler signal (*Figure 1*). US examination was performed in peripheral joints, bursae and tendon sheaths based on standard scans (12), and displayed in *Table 1*. Scanning planes showed the maximum amount of joint fluid selected and the three consecutive US measurements were performed for every location to obtain the average value.

SPSS software was used for statistical analysis (SPSS, version 19.0, Chicago III). Descriptive statistics were expressed as means ± standard deviations. Categorical data were described using counts, percentages and 95% confidence intervals. Chi-squared test was used for comparison in detection rate. Independent-sample's t test was used for comparison in fluid thickness. We correlated detection rate and fluid thickness with demographic characters using Spearman correlation analysis. Correlation index (r) was interpreted as 0.8–1.0 strong correlation, 0.5–0.8 moderate correlation, 0.3–0.5 low correlation, and <0.3 weak correlation. Two-sided statistical significance was defined as $P<0.05$. Increase of fluid is considered to be pathological, so we only calculated the upper limit of 95% reference range using the equation: the upper limit = mean + 1.64 SD.

Results

A total of 152 healthy asymptomatic Chinese volunteers were included. The mean age was 48.0±14.1 years with a range of 20–75 years. The mean BMI was 22.58±3.15 kg/m^2 with a range of 15.82-31.51 kg/m^2. Seventy-one participants were male and 81 were female. None of the recruited volunteers were excluded for further analysis. There was detectable ultrasonic fluid in all the 24 kinds of joints, 3 bursae and 1 tendon sheath studied.

Fluid was found in suprapatellar knees in 252/304 (82.9%), which made it the highest one among all the studied structures. Weak positive correlations ($r<0.3$) between detection rate and both age and BMI were found in 21.4% and 7.1% of all the 28 structures studied respectively (*Table S1*). There was no situational (right or left) difference found in detection rate. Gender difference was found in the 2nd, 3rd and 4th PIPs, with the detection rates in these

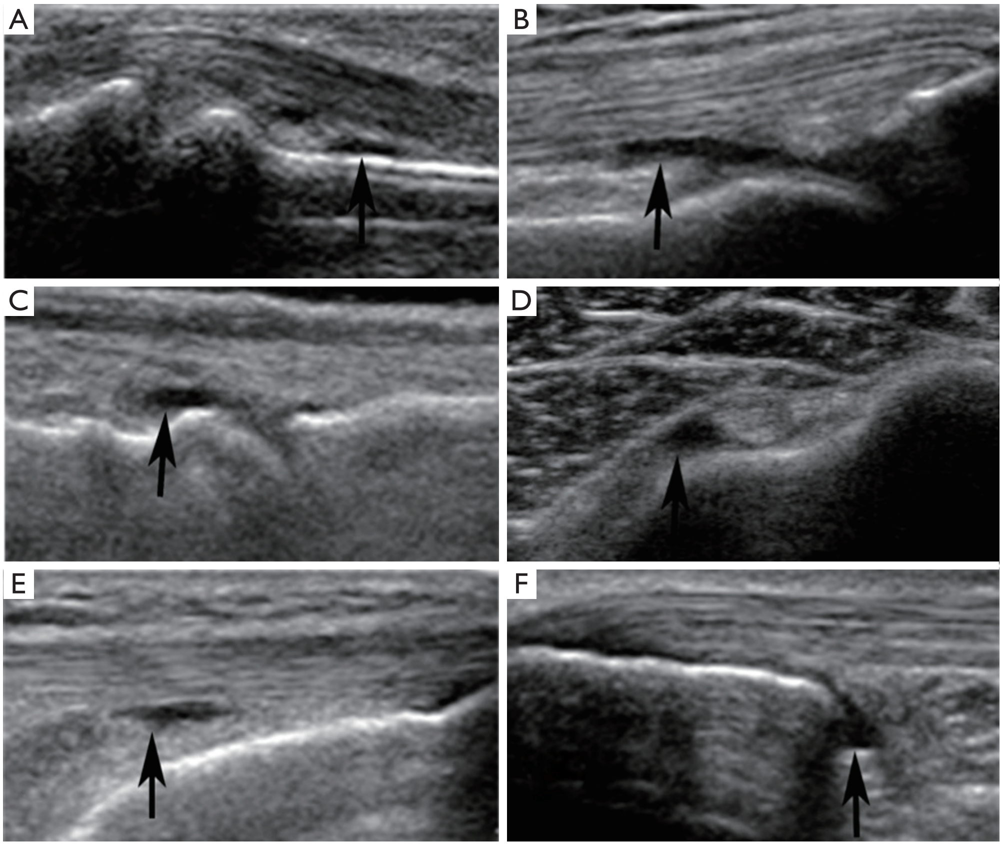

Figure 1 Ultrasound appearance of fluid in a 25-year-old healthy female (arrow). (A) Fluid in PIP 3; (B) fluid in suprapatellar knee; (C) fluid in MTP 1; (D) fluid in tendon sheath of long biceps tendon; (E) fluid in deep infrapatellar bursa; (F) fluid in retrocalcaneal bursa.

PIPs being higher in female subjects (*Table S2*).

The thickest fluid was also found in the suprapatellar knee, and its average fluid thickness was 3.7±1.7 mm. Moderate positive correlation was found between fluid thickness and age in MCP 5 (r=0.510, P<0.05). Low positive correlations were found between fluid thickness and age in the retrocalcaneal bursae, and between fluid thickness and BMI in the long biceps tendon (r=0.398 and 0.228, respectively, both P<0.05). The positive correlation between fluid thickness and age was weak in long the biceps tendon (r=0.181, P<0.05) (*Table S3*). There was no significant difference found between the right and left side in fluid thickness (P>0.05) (*Table S4*). As for gender, fluid thickness was higher in women in wrists, MCP5, PIP 4, retrocalcaneal bursae and long biceps tendon (P<0.05). Conversely, the fluid thickness of PIP 2 and deep infrapatellar bursae was higher in male subjects (P<0.05).

Reference values differed among different joints (*Table 2*). Overall, the upper limits of the 95% reference range for lower limb joints were larger than upper limb joints. For example, the upper limits in the shoulder (gleno-humeral joint), elbow and wrist are ≤3.9, ≤3.5 and ≤3.9 mm, respectively; whereas the suprapatellar knee and ankle are ≤6.6 and ≤5.4 mm, respectively. As for the hands, the upper limits were over 1mm in PIPs and DIPs with larger fluid thickness found in MCPs (approximately 2 mm). Changeable upper limits were found in the feet, and were ≤0.8 mm for MCP5 to ≤4.1 mm for MTP1.

Discussion

High-frequency ultrasound has proven its diagnostic power in musculoskeletal diseases; however, identifying differences between normal and pathologic conditions is still difficult. A previous study (7) which included 46 healthy subjects indicated that fluid was present in 20.9% of PIPs, but less frequent in DIPs (3% DIPs). Schmidt *et al.* reported that fluid in bursae and joints were common findings in healthy

Table 1 US scanning plane and measurement location of fluid in joints, bursa and tendon sheath

Structure	Positioning	Scanning plane	Measurement location
Shoulder (gleno-humeral joint)	Sitting position; 90° flexion of the elbow joint with hand positioned in supination on top of the volunteer's thigh	Anterior and posterior space	Maximum bone-capsule distance
Elbow (radial, coronoid, annular and posterior recess)	Sitting position; Full extension of the elbow joint (ventral scans); flexion of the elbow joint in a 90° angle (dorsal scans)	Longitudinal and transverse	
Wrist (radiocarpal, innercarpal and ulnocarpal joints), MCP 1–5, PIP 1–5, DIP 2–5, MTP 1–5	Sitting position; positioning of the hand on an examining bed	Palmar and dorsal, longitudinal	
Knee (Suprapatellar recess), Ankle (tibio-talar joint)	Supine position with knee joint in neutral position and 30° flexion (Knee); Prone position with hip and knee joints in neutral position (Ankle)	Anterior, longitudinal and transverse	
Deep infrapatellar bursa, retro-calcaneal bursa	Supine position with knee joint in neutral position and 30° flexion (deep infrapatellar bursa); Prone position with hip and knee joints in neutral position (retro-calcaneal bursa)	Longitudinal	Maximum capsule-capsule distance
Subacromial-subdeltoid bursa	See shoulder joint	Longitudinal and transverse	
Long biceps tendon	See shoulder joint	Transverse	Maximum tendon-peritendineum distance at the bicipital groove

MCP, metacarpophalangeal joint; PIP, proximal interphalangeal joint; DIP, distal interphalangeal joint; MTP, metatarsophalangeal joint.

people (10). Our results also suggest that all asymptomatic joints, bursae and tendon sheaths examined in our study have ultrasound-detectable accumulation of synovial fluid, of which the detection rate and fluid thickness vary in different structures. The mean thickness of fluid found in asymptomatic joints is listed in the following descending order: suprapatellar knee (3.7 mm), ankle (3.3 mm), shoulder (2.2 mm), elbow (2.2 mm), wrist (2.1 mm), MTPs (0.7–2.4 mm), MCPs (1.2–1.9 mm), PIPs (0.8–1.2 mm), DIPs (0.8 mm).

Similar to previous studies (7,10,13) which reported no significant difference between the dominant and non-dominant side, we similarly found no difference between the left and right side in both detection rate and fluid rate. These results may indicate that symmetrical parts of healthy subjects have the same anatomical structure, and that there would not be significant difference between the left and right side of a structure under normal conditions. Therefore, through examining and comparing joints on both sides, we can recognize unilateral lesion and assess its severity.

We observed that females had a higher detection rate and fluid thickness than males in most examined structures, especially in upper-limb joints, although many of them did not show statistical difference. According to studies about gender impact on ultrasound measurements, Ellegaard *et al.* suggested that women obtained higher pathological scores than men in healthy small hand joints (14). Poncelet *et al.* determined different deep joint space distance of the acromioclavicular joint between men and women (13). These studies indicate physiological and anatomical differences between men and women, which might be caused by different kinds of labor or exercise. When considering gender influence, it is better to choose the same sex as the normal reference in US examinations of certain structures, especially in the retrocalcaneal bursa, which had a difference between means larger than 1 mm.

Among the studied demographic parameters, the greatest number of examined structures was found to be affected by age, and all of the correlations were positive. We attribute this to the lasting and irreversible degeneration of joints caused by aging which can induce bone changes including spurs and irregularities in the elderly (15). Higher quantitative joint recess measured sonographically

Table 2 Fluid thickness and the upper limits of 95% reference range in healthy asymptomatic population

Location	Mean (mm)	SD (mm)	95% reference range (upper limit, mm)
Shoulder	2.2	1.0	3.9
Elbow	2.2	0.8	3.5
Wrist	2.1	1.1	3.9
MCP1	1.4	1.0	2.9
MCP2	1.9	0.7	3.0
MCP3	1.5	0.6	2.5
MCP4	1.2	0.4	1.9
MCP5	1.2	0.4	1.8
PIP1	0.9	0.3	1.4
PIP2	1.0	0.4	1.7
PIP3	1.2	0.4	1.8
PIP4	1.0	0.4	1.7
PIP5	0.8	0.4	1.4
DIP2	0.8	0.3	1.4
DIP3	0.8	0.2	1.2
DIP4	0.8	0.3	1.3
DIP5	0.8	0.3	1.2
Suprapatellar knee	3.7	1.7	6.6
Ankle	3.3	1.3	5.4
MTP1	2.4	1.1	4.1
MTP2	1.7	0.7	2.9
MTP3	1.4	0.7	2.5
MTP4	1.9	1.2	3.8
MTP5	0.7	0.1	0.8
Subacromial/ subdeltoid bursa	1.5	1.0	3.1
Deep infrapatellar bursa	1.3	0.6	2.2
Retrocalcaneal bursa	2.1	1.3	4.3
Long biceps tendon	2.1	0.8	3.4

has also been reported in older groups (9). Additionally, we found positive correlations with age, especially in small joints like PIP, DIP and MTP, which are similar to results reported by Machado *et al.* whose study detailed a higher percentage of synovial effusion in the hand and foot joints of healthy individuals (9). In our study, we did not exclude the older people with asymptomatic osteoarthritis, because asymptomatic osteoarthritis is of less clinical importance and there is usually no need for intervention. Therefore, when attempting to detect joint fluid in aged but asymptomatic people, we should consider age effects especially in the hand and foot joints.

Positive correlations with BMI were found in the long biceps tendon and MTP1. The long biceps tendon is closely related to motion, and MTP1 is an important weight-bearing joint. Therefore, height and weight might have a greater impact on these two structures. Excessive increases in weight-bearing forces caused by obesity may be detrimental to the lower limbs and feet (16), lead to musculoskeletal pain in the legs, and contribute to overall difficulty of daily movements (17). Obesity can also lead to musculoskeletal disorders in children by promoting biomechanical changes in the lumbar spine and lower extremities (18). Conversely, in patients with rheumatoid arthritis, a higher BMI is associated with a less severe disease outcome (19), and disease activity might also be overestimated in obese patients (20). The above results indicate a close relationship between BMI and joint disease. In our study, the mean BMI was 22.58±3.15 kg/m^2 which was almost within the normal range. Thus, whether an overweight condition affects joint fluid still remains unclear and open for further investigation.

We have found some difference in reference values compared with Schmidt's study (10). The most important influencing factor is that we use mean + 1.64 SD to define the upper limit of the 95% reference range, while they use mean ± 2 SD to calculate the standard reference values. As we supposed that only excessive accumulation of fluid in joints is pathological, it is suitable for us to calculate the upper limit. Another reason for this phenomenon might be different the study populations included. As we have calculated the reference values for healthy asymptomatic people, we might be able to help radiologists and clinicians to better distinguish between normal and abnormal conditions, which is of great importance in clinical practice because excessive fluid accumulation may lead to further examinations or treatments. Our study may also provide normal controls for future comparative studied in patients with rheumatoid arthritis or other diseases. There are also some limitations in our study. First, we did not study all the ultrasound-detectable peripheral joints and their sonographic findings, such as bone erosion, bursa effusion or tendinopathy. Second, by design, this study lacked Doppler analysis. The strengths of our study include a relatively large number of patients.

Conclusions

Fluid in the peripheral joints, bursae and tendon sheaths of healthy asymptomatic populations can be frequently found by US. The detection rate and fluid thickness vary in different structures. Some of the fluid thickness and detection rates are associated with gender, age or BMI, but no difference has been found between the left and right side joints. While making diagnoses of joint diseases, it is important to choose suitable control groups regarding the relevant factors. Additionally, reference values provided in this study might be helpful to recognize effusion in the healthy asymptomatic Chinese population. Further multi-center studies are still necessary to determine more generally applicable standard reference values.

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Footnote

Conflicts of Interest: The authors have no conflicts of interests to declare.

Ethical Statement: The study was approved by the West China Hospital of Sichuan University Ethics Committee. Informed consent was obtained from all volunteers.

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Supplementary

Table S1 Detection rate in healthy asymptomatic population and correlations with age and BMI

Location	Detection number	Detection rate (%) (95% CI)	r	
			Age	BMI
Shoulder	6	2.0 (0.4–3.5)	0.014	–0.044
Elbow	117	38.5 (33.0–44.0)	0.100	–0.060
Wrist	125	41.1 (35.6–46.7)	0.080	–0.106
MCP1	4	1.3 (0–2.6)	0.036	0.014
MCP2	18	5.9 (3.3–8.6)	0.051	–0.345
MCP3	20	6.6 (3.8–9.4)	–0.019	0.029
MCP4	30	9.9 (6.5–13.2)	0.024	0.045
MCP5	25	8.2 (5.1–11.3)	–0.088	0.037
PIP1	9	3.0 (1.0–4.9)	0.099	–0.079
PIP2	53	17.4 (13.1–21.7)	0.004	0.010
PIP3	94	30.9 (25.7–36.1)	0.140*	–0.013
PIP4	61	20.1 (15.5–24.6)	0.152**	–0.024
PIP5	21	6.9 (4.0–9.8)	0.020	0.055
DIP2	7	2.3 (0.6–4.0)	–0.006	–0.012
DIP3	22	7.2 (4.3–10.2)	0.118*	–0.043
DIP4	11	3.6 (1.5–5.7)	0.069	–0.030
DIP5	4	1.3 (0–2.6)	0.042	–0.055
Suprapatellar knee	252	82.9 (78.6–87.2)	0.272*	0.049
Ankle	140	46.1 (40.4–51.7)	0.036	–0.004
MTP1	99	32.6 (27.3–37.9)	0.118*	0.123*
MTP2	16	5.3 (2.7–7.8)	0.106	0.031
MTP3	11	3.6 (1.5–5.7)	–0.035	–0.021
MTP4	3	0.7 (0–1.6)	0.019	0.083
MTP5	3	0.7 (0–1.6)	–0.025	0.061
Subacromial/subdeltoid bursa	35	11.5 (7.9–15.1)	0.061	–0.040
Deep infrapatellar bursa	75	24.7 (19.8–29.5)	–0.041	0.024
Retrocalcaneal bursa	42	13.8 (9.9–17.7)	–0.016	–0.030
Long biceps tendon	125	41.4 (35.6–46.7)	0.165*	0.251*

*P<0.05; **P<0.01. MCP, metacarpophalangeal joint; PIP, proximal interphalangeal joint; DIP, distal interphalangeal joint; MTP, metatarsophalangeal joint.

Table S2 Comparisons of detection rate between right and left sides, and between females and males

Location	Detection rate (%)			Detection rate (%)		
	Right	Left	P value	Female	Male	P value
Shoulder	2.0	2.0	1.000	3.1	0.7	0.220
Elbow	37.5	39.5	0.814	37.0	40.1	0.637
Wrist	40.8	41.4	1.000	43.2	38.7	0.484
MCP1	2.6	0	0.123	0.6	2.1	0.343
MCP2	5.3	6.6	0.809	6.8	4.9	0.628
MCP3	5.9	7.2	0.818	7.4	5.6	0.645
MCP4	11.2	8.6	0.565	8.6	11.3	0.449
MCP5	6.6	9.9	0.404	10.5	5.6	0.146
PIP1	3.3	2.6	1.000	2.5	3.5	0.738
PIP2	20.4	14.5	0.226	23.5	10.6	0.004*
PIP3	32.9	28.9	0.535	38.3	22.5	0.004*
PIP4	19.1	21.1	0.775	25.3	14.1	0.015*
PIP5	6.6	7.2	1.000	8.0	5.6	0.499
DIP2	2.6	2.0	1.000	3.7	0.7	0.126
DIP3	6.6	7.9	0.825	8.0	6.3	0.660
DIP4	3.9	3.3	1.000	4.3	2.8	0.551
DIP5	1.3	1.3	1.000	1.9	0.7	0.626
Suprapatellar knee	84.2	81.6	0.648	83.3	82.4	0.879
Ankle	48.7	43.4	0.421	43.2	49.3	0.301
MTP1	32.9	32.2	1.000	28.4	37.3	0.111
MTP2	4.6	5.9	0.798	4.9	5.6	0.803
MTP3	3.9	3.3	1.000	3.1	4.2	0.760
MTP4	1.3	0.0	0.498	0.6	0.7	1.000
MTP5	0.7	0.7	1.000	0.6	0.7	1.000
Subacromial/subdeltoid bursa	13.8	9.2	0.281	9.3	14.1	0.210
Deep infrapatellar bursa	23.0	26.3	0.595	21.6	28.2	0.230
Retrocalcaneal bursa	15.1	12.5	0.618	14.2	13.4	0.869
Long biceps tendon	40.8	41.1	1.000	44.4	37.3	0.243

MCP, metacarpophalangeal joint; PIP, proximal interphalangeal joint; DIP, distal interphalangeal joint; MTP, metatarsophalangeal joint.

Table S3 Fluid thickness in healthy asymptomatic population and correlations with age and BMI

Location	Mean (mm)	SD (mm)	r	
			Age	BMI
Shoulder	2.2	1.0	–0.412	–0.358
Elbow	2.2	0.8	0.163	0.069
Wrist	2.1	1.1	–0.058	–0.170
MCP1	1.4	1.0	–0.500	–0.105
MCP2	1.9	0.7	0.034	–0.206
MCP3	1.5	0.6	0.014	–0.352
MCP4	1.2	0.4	0.196	–0.206
MCP5	1.2	0.4	0.510**	–0.293
PIP1	0.9	0.3	0.008	–0.308
PIP2	1.0	0.4	0.137	0.056
PIP3	1.2	0.4	0.167	0.087
PIP4	1.0	0.4	0.187	0.035
PIP5	0.8	0.4	0.227	0.029
DIP2	0.8	0.3	–0.199	0.218
DIP3	0.8	0.2	–0.023	0.153
DIP4	0.8	0.3	0.194	0.460
DIP5	0.8	0.3	0.949	0.316
Suprapatellar knee	3.7	1.7	–0.025	0.083
Ankle	3.3	1.3	0.007	–0.030
MTP1	2.4	1.1	0.011	0.024
MTP2	1.7	0.7	0.173	0.355
MTP3	1.4	0.7	–0.128	–0.192
MTP4	1.9	1.2	–1.000	–1.000
MTP5	0.7	0.1	–1.000	–1.000
Subacromial/subdeltoid bursa	1.5	1.0	–0.001	–0.091
Deep infrapatellar bursa	1.3	0.6	0.207	0.176
Retrocalcaneal bursa	2.1	1.3	0.398*	–0.045
Long biceps tendon	2.1	0.8	0.181*	0.228*

*P<0.05; **P<0.01. MCP, metacarpophalangeal joint; PIP, proximal interphalangeal joint; DIP, distal interphalangeal joint; MTP, metatarsophalangeal joint.

Table S4 Comparisons of fluid thickness between right and left sides, and between females and males

Location	Fluid thickness (mm)			Fluid thickness (mm)		
	Right	Left	P value	Female	Male	P value
Shoulder	2.4±1.5	1.9±0.4	0.608	2.2±1.1	2.3[a]	0.916
Elbow	2.2±0.8	2.3±0.7	0.828	2.34±0.8	2.1±0.7	0.106
Wrist	2.2±1.1	2.0±1.1	0.501	2.3±1.3	1.9±0.7	0.025*
MCP1	1.4±1.0	—	—	0.8[a]	1.5±1.1	0.622
MCP2	2.0±0.7	1.8±0.7	0.673	2.1±0.8	1.5±0.3	0.073
MCP3	1.6±0.9	1.3±0.4	0.293	1.5±0.8	1.4±0.3	0.708
MCP4	1.3±0.4	1.2±0.4	0.450	1.3±0.4	1.2±0.3	0.279
MCP5	1.1±0.4	1.2±0.4	0.276	1.3±0.4	1.0±0.2	0.009*
PIP1	0.8±0.2	1.1±0.3	0.193	1.0±0.4	0.9±0.2	0.538
PIP2	1.0±0.4	1.1±0.4	0.606	1.0±0.3	1.3±0.5	0.049*
PIP3	1.2±0.3	1.20±0.4	0.975	1.2±0.3	1.1±0.4	0.376
PIP4	1.1±0.4	0.9±0.4	0.228	1.1±0.5	0.8±0.2	0.005*
PIP5	0.8±0.5	0.8±0.2	0.669	0.8±0.4	0.8±0.3	0.644
DIP2	0.9±0.4	0.7±0.3	0.484	0.9±0.3	0.4[a]	0.204
DIP3	0.9±0.3	0.8±0.2	0.607	0.8±0.2	1.0±0.3	0.054
DIP4	0.9±0.3	0.7±0.2	0.185	0.9±0.3	0.8±0.1	0.579
DIP5	0.9±0.3	0.7±0.2	0.423	0.8±0.3	0.7[a]	0.800
Suprapatellar knee	3.8±1.8	3.7±1.6	0.731	3.7±1.8	3.7±1.7	0.924
Ankle	3.4±1.4	3.1±1.2	0.112	3.4±1.3	3.2±1.4	0.524
MTP1	2.5±1.2	2.2±1.0	0.199	2.2±1.2	2.5±1.0	0.121
MTP2	1.9±0.7	1.5±0.7	0.304	1.6±0.7	1.8±0.8	0.612
MTP3	1.7±0.7	1.1±0.4	0.130	1.2±0.7	1.6±0.6	0.310
MTP4	1.9±1.2	—	—	2.7[a]	1.0[a]	—
MTP5	0.6[a]	0.7[a]	—	0.6[a]	0.7[a]	—
Subacromial/subdeltoid bursa	1.7±1.1	1.4±0.9	0.371	1.5±1.0	1.6±1.0	0.942
Deep infrapatellar bursa	1.4±0.6	1.3±0.5	0.389	1.1±0.4	1.5±0.6	<0.001*
Retrocalcaneal bursa	2.1±1.4	2.2±1.3	0.832	2.6±1.5	1.5±0.7	0.004*
Long biceps tendon	2.1±0.8	2.0±0.8	0.759	2.2±0.9	1.8±0.6	0.002*

*P<0.05. [a], only Mean has been displayed; —, cannot be calculated due to small sample size. MCP, metacarpophalangeal joint; PIP, proximal interphalangeal joint; DIP, distal interphalangeal joint; MTP, metatarsophalangeal joint.