Appendix 1

### Cardiac magnetic resonance (CMR) acquisition

The cardiovascular imaging protocol consisted of cine sequences, late gadolinium enhancement (LGE) sequences and T1 mapping technique. The feature tracking CMR (FT-CMR) protocol is described in *Figure S1*.

A stack of short-axis and long-axis planes (including two-, three-, and four-chamber views) cine images were obtained with the electrocardiogram (ECG)-gated balanced steady-state free precession (bSSFP) sequences. The detailed parameters were as follows: field of view, 230 mm × 230 mm; voxels, 2 mm × 2 mm × 8 mm; repetition time, 3.0–3.2 ms; echo time, 1.5–1.6 ms; sense factor, 2; minimum inversion time, 105 ms; and flip angle, 45°.

LGE was acquired s by using a tack of short-axis phase sensitive inversion recovery sequences (inversion time according to Look-Locker scout, acquired voxels 2 mm × 2mm × 8 mm, repetition time/echo time/flip angle 6.0 ms/3.0 ms/25°) about 10–11 min after the administration of contrast [0.2 mmol/kg gadopentetate dimeglumine [Consun Pharmaceutical Co., Ltd.)] to identify any pattern of replacement fibrosis.

Results

To control the influence of confounding factors, we performed further intergroup analysis of several variables that may affect LV structure parameters, including hypertension and obese. Each grouping method includes a table of demographics and sleep study data, and a CMR data table, like *Table 1* and *Table 2*. In *Table S1* and *Table S2* (hypertension grouping method), all subjects were included in the analysis (n=51). In the obese grouping method, after eliminating no OSA while with obese group (n=7), the sample size included in the analysis was 44.
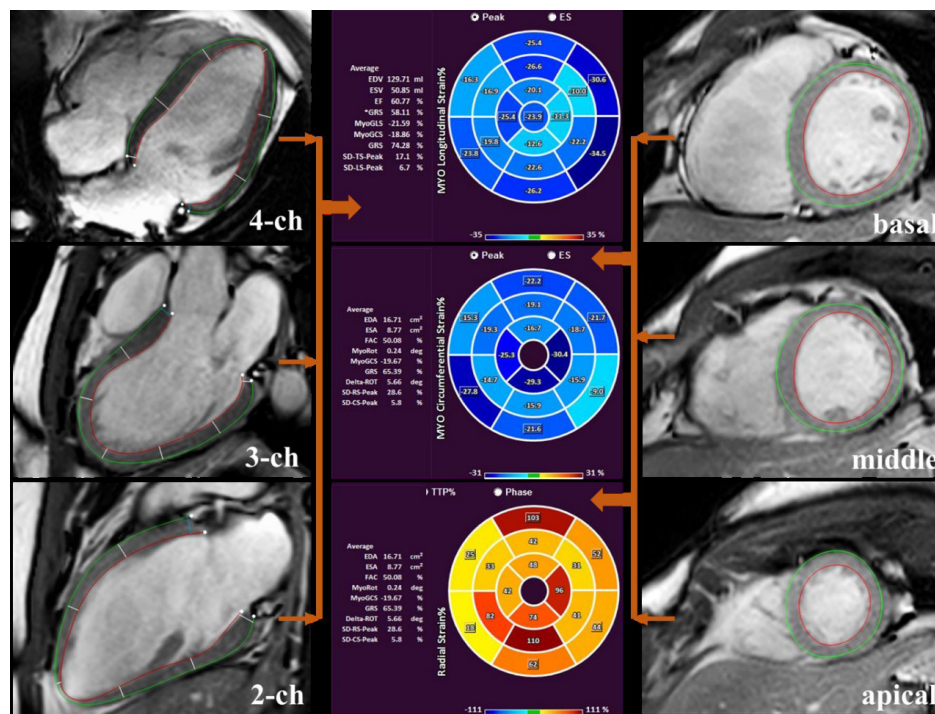
Figure S1 The measurement method of feature tracking CMR. Feature tracking CMR in a healthy control. For calculating peak GLS (top middle image), sketching endocardial and epicardial borders on four-, three-, and two-chamber views in the end-diastolic and end-systolic phase respectively. Basal, middle, and apical planes of the LV short-axis view are used for peak GCS (central image) and GRS (bottom middle image) measurements like the method of GLS acquirement. CMR, cardiovascular magnetic resonance; GLS, global longitudinal strain; GCS, global circumferential strain; GRS, global radial strain; EDV, end-diastolic volume; ESV, end-systolic volume; EF, ejection fraction; MyoGLS, global myocardial longitudinal strain; MyoGCS, global myocardial circular strain; SD-TS, standard deviation of transverse strain; SD-LS, standard deviation of longitudinal strain; SD-RS, standard deviation of radial strain; SD-CS, standard deviation of circumferential strain; ES, end-systole; EDA, end-diastolic area; ESA, end-systolic area; FAC, fraction area change; MyoRot, myocardial rotation; Delta-ROT, delta-rotation; TTP, time to peak; ch, chamber.

Table S1 Patient demographics and sleep study data as grouped according to OSA and hypertension states

Variables	No OSA and no hypertension (n=19)	OSA without hypertension (n=21)	OSA with hypertension (n=11)	All patients without hypertension (n=40)	P value[1]	P value[2]
Age (years)	40.7±8.0	42.5±9.7	42.6±12.6	41.7±8.9	0.789	0.811
Male	12 (63.2)	17 (81.0)	9 (81.8)	29 (72.5)	0.706	0.422
BMI (kg/m^2)	24.3 [21.6, 25.4]	26.3 [23.8, 28.0]$^\#$	26.3 [24.2, 28.7]*	25.2 [22.9, 26.9]	0.238	0.025
BSA (m^2)	1.76±0.16	1.88±0.19	1.89±0.18	1.82±0.18	0.290	0.067
SBP (mmHg)	120.0±7.1	118.8±7.3	141.5±9.6*$^\Delta$	119.3±7.2	<0.001	<0.001
DBP (mmHg)	80 [77, 86]	80 [75, 83]	90 [85, 103]	80 [75, 85]	<0.001	<0.001
Heart rate (beats/min)	71.3±8.8	74.8±9.9	75.1±13.2	73.1±9.4	0.651	0.493
Hyperlipidemia	12 (63.2)	11 (52.4)	8 (72.7)	23 (57.5)	0.493	0.537
Smoking history	2 (10.5)	3 (14.3)	3 (27.3)	5 (12.5)	0.346	0.481
Hematocrit (%)	42.1±3.6	42.8±3.3	42.5±3.5	43.7±3.7	0.299	0.474
Duration of snoring (years)	1.5 [0.1, 4.5]	9.0 [4.0, 20.5]$^\#$	10.5 [7.0, 14.0]*	4.0 [1.5, 10.0]	0.032	<0.001
PSG parameters						
AHI (events/h)	1.5 [1.1, 2.5]	35.8 [16.6, 52.1]$^\#$	44.7 [18.4, 50.9]*	8.8 [1.5, 42.3]	0.010	<0.001
ODI (events/h)	1.2 [0.8, 1.9]	21.9 [16.1, 50.8]$^\#$	31.2 [16.0, 50.0]*	5.2 [1.2, 30.2]	0.012	<0.001
Overall arousal index	16.9 [9.9, 23.9]	18.7 [14.3, 39.7]	22.7 [12.7, 25.8]	16.9 [10.6, 25.6]	0.292	0.200
A-SPO$_2$ (%)	96 [96, 97]	94 [92, 95]$^\#$	94 [93, 95]*	94 [96, 96]	0.016	<0.001
M-SPO$_2$ (%)	90 [89, 92]	78 [66, 84]$^\#$	76 [72, 82]*	87 [76, 91]	0.018	<0.001
Sleep duration (min)	448 [390, 496]	428 [391, 464]	405 [340, 428]	431 [391, 486]	0.082	0.131

Data are mean ± standard deviation for normally distributed continuous variables, median [interquartile range] for skewed variables, and n (%) for binary variables. [1], comparison between all-patients-without-hypertension group and the OSA-with-hypertension group; [2], comparison within the no-OSA-and-no-hypertension, the OSA-without-hypertension and the OSA-with-hypertension groups; *, P<0.05 between OSA-with-hypertension and no-OSA-and-no-hypertension groups; $^\Delta$, P<0.05 between the OSA-with-hypertension and the OSA-without-hypertension groups; $^\#$, P<0.05 between the OSA-without-hypertension and the no-OSA-and-no-hypertension groups. OSA, obstructive sleep apnea; BMI, body mass index; BSA, body surface area; SBP, systolic blood pressure; DBP, diastolic blood pressure; PSG, polysomnography; AHI, apnea-hypopnea index; ODI, oxygen desaturation index; A-SPO$_2$, average oxygen saturation; M-SPO$_2$, minimum oxygen saturation.

Table S2 Patient demographics and sleep study data as grouped according to OSA and obese states

Variables	No OSA and no obese (n=12)	OSA without obese (n=11)	OSA with obese (n=21)	All patients without obese (n=23)	P value[1]	P value[2]
Age (years)	38.8±8.2	49.0±10.0$^\#$	39.1±9.4$^\Delta$	43.7±10.3	0.134	0.013
Male	7 (58.2)	7 (63.6)	19 (90.5)	14 (60.9)	0.023	0.077
BMI (kg/m^2)	22.1 [21.5, 24.3]	23.4 [22.4, 24.2]	27.8 [26.3, 29.2]*$^\Delta$	23.1 [21.6, 24.2]	<0.001	<0.001
BSA (m^2)	1.71±0.14	1.70±0.11	1.98±0.14*$^\Delta$	1.70±0.12	<0.001	<0.001
Hypertension	0 (0)	4 (36.4)	7 (33.3)	4 (17.4)	0.223	0.042
SBP (mmHg)	120 [113, 125]	121 [116, 143]	125 [117, 139]	121 [114, 125]	0.158	0.210
DBP (mmHg)	81.5±7.3	80.4±7.0	86.1±12.0	81.0±7.0	0.087	0.226
Heart rate (beats/min)	70.8±9.9	69.6±12.2	77.6±9.3	70.3±10.8	0.021	0.068
Hyperlipidemia	6 (50.0)	6 (54.5)	14 (66.7)	11 (47.8)	0.208	0.441
Smoking history	2 (16.7)	0 (0)	6 (28.6)	2 (8.7)	0.126	0.160
Hematocrit (%)	41.0±3.5	42.5±4.2	43.5±3.0	41.7±3.8	0.095	0.154
Duration of snoring (years)	1.5 [0.1, 4.0]	9.0 [4.0, 16.0]$^\#$	10.5 [3.5, 20.5]*	4.0 [1.5, 9.5]	0.022	<0.001
PSG parameters						
AHI (events/h)	1.4 [1.0, 2.4]	32.1 [18.6, 45.9]$^\#$	44.7 [16.6, 54.8]*	4.6 [1.2, 32.1]	0.001	<0.001
ODI (events/h)	1.1 [0.7, 1.4]	20.5 [12.8, 40.2]$^\#$	32.9 [16.2, 52.5]*	4.3 [1.0, 20.5]	<0.001	<0.001
Overall arousal index	16.9 [12.6, 27.0]	18.7 [13.8, 22.7]	20.9 [13.6, 43.1]	16.9 [13.8, 22.7]	0.240	0.499
A-SPO$_2$ (%)	96 [96, 97]	95 [93, 96]$^\#$	94 [92, 95]*	96 [95, 96]	0.001	<0.001
M-SPO$_2$ (%)	91 [90, 93]	75 [72, 83]$^\#$	80 [68, 84]*	88 [75, 91]	0.006	<0.001
Sleep duration (min)	440 [397, 498]	405 [395, 455]	426 [370, 452]	420 [395, 494]	0.235	0.349

Data are mean ± standard deviation for normally distributed continuous variables, median [interquartile range] for skewed variables, and n (%) for binary variables. Obese was defined as BMI ≥25 kg/m^2. [1], comparison between all-patients-without-obese group and the OSA-with-obese group; [2], comparison within the no-OSA-and-no-obese, the OSA-without-obese and the OSA-with-obese groups; *, P<0.05 between the OSA-with-obese and the no-OSA-and-no-obese groups; $^\Delta$, P<0.05 between the OSA-with-obese and the OSA-without-obese groups; $^\#$, P<0.05 between the OSA-without-obese and the no-OSA-and-no-obese groups. OSA, obstructive sleep apnea; BMI, body mass index; BSA, body surface area; SBP, systolic blood pressure; DBP, diastolic blood pressure; PSG, polysomnography; AHI, apnea-hypopnea index; ODI, oxygen desaturation index; A-SPO$_2$, average oxygen saturation; M-SPO$_2$, minimum oxygen saturation.

Table S3 CMR parameters as grouped according to OSA and hypertension states

Variables	No OSA and no hypertension (n=19)	OSA without hypertension (n=21)	OSA with hypertension (n=11)	All patients without hypertension (n=40)	P value[1]	P value[2]
Function and structure						
LVEDVi (mL/m^2)	78.6±10.1	76.6±7.3	78.9±7.7	77.6±8.7	0.650	0.699
LVESVi (mL/m^2)	30.9±7.2	30.4±5.5	30.1±6.8	30.6±6.3	0.763	0.948
LVEF (%)	61.1±5.1	60.4±5.1	62.0±7.1	60.7±5.0	0.510	0.756
LVSVi (mL/m^2)	47.7±4.9	46.2±5.0	48.8±6.4	46.9±5.0	0.308	0.404
LVCi (L/min per m^2)	3.2 [3.0, 3.5]	3.2 [2.8, 3.4]	3.6 [3.2, 3.9]$^\Delta$	3.2 [2.9, 3.4]	0.021	0.053
LVM (g)	66.5±18.4	81.0±17.4$^\#$	97.1±16.5*	74.1±19.1	0.001	<0.001
LVMI (g/m$^{2.7}$)	16.4±3.1	19.7±3.4$^\#$	23.4±3.3*$^\Delta$	18.1±3.6	<0.001	<0.001
LVMVR (g/mL)	0.45 [0.39, 0.52]	0.54 [0.47, 0.64]$^\#$	0.64 [0.58, 0.73]*$^\Delta$	0.50 [0.44, 0.61]	0.001	<0.001
MWT (mm)	9.7±1.2	10.2±1.6	12.2±2.1*$^\Delta$	10.0±1.4	<0.001	<0.001
RVEDVi (mL/m^2)	83.2±11.8	85.5±15.7	80.7±11.2	84.4±13.9	0.421	0.626
RVESVi (mL/m^2)	40.6±8.1	41.5±11.2	39.5±9.6	41.1±9.8	0.628	0.851
RVEF (%)	50.2 [47.4, 53.3]	50.8 [47.5, 56.5]	48.7 [45.1, 62.2]	50.8 [47.5, 55.2]	0.410	0.689
RVSVi (mL/m^2)	41.6 [38.0, 47.6]	43.8 [37.9, 50.2]	38.0 [34.7, 46.3]	42.2 [38.1, 49.4]	0.177	0.370
RVCi (L/min per m^2)	3.0±0.3	3.3±0.6	3.1±0.7	3.1±0.5	0.659	0.249
T1 mapping parameters						
Native T1 (ms)	1,257.7±38.6	1,254.8±37.4	1,246.3±16.7	1,256.2±37.5	0.360	0.682
Post T1 (ms)	591.0±44.0	605.8±43.7	608.9±37.3	598.8±43.9	0.488	0.433
ECV (%)	26.2±2.5	24.4±1.9$^\#$	24.5±1.8	25.3±2.4	0.333	0.022
iECV (mL/m$^{2.7}$)	4.1±0.6	4.5±0.7	5.4±0.7*$^\Delta$	4.3±0.7	<0.001	<0.001
iCV (mL/m$^{2.7}$)	11.6±2.4	14.2±2.6$^\#$	16.9±2.6*$^\Delta$	13.0±2.8	<0.001	<0.001
iCV-iECV (mL/m$^{2.7}$)	7.5±2.0	9.7±2.0$^\#$	11.4±2.1*	8.6±2.3	0.001	<0.001
LV strain						
GLS (%)	−22.5 [−23.9, −21.8]	−21.5 [−24.0, −20.0]	−21.2, [−23.6, −20.3]	−22.4 [−23.9, −21.1]	0.982	0.316
GCS (%)	−21.5±2.8	−20.0±2.5	−20.5±3.6	−20.6±2.8	0.924	0.124
GRS (%)	93.3±31.2	77.8±24.6	79.4±13.3	85.1±28.7	0.348	0.139
GLS rate (s^{-1})	−1.0 [−1.1, −1.0]	−1.0 [−1.1, −0.9]	−1.0 [−1.1, −1.0]	−1.0 [−1.1, −0.9]	0.982	0.513
GCS rate (s^{-1})	−1.0 [−1.2, −0.9]	−1.0 [−1.1, −0.9]	−1.0 [−1.4, −0.9]	−1.0 [−1.2, −0.9]	0.909	0.557
GRS rate (s^{-1})	2.3±0.5	2.2±0.5	2.5±0.5	2.2±0.5	0.132	0.271

Data are mean ± standard deviation for normally distributed continuous variables and median [interquartile range] for skewed variables. [1], comparison between all-patients-without-hypertension group and the OSA-with-hypertension group; [2], comparison within the no-OSA-and-no-hypertension, the OSA-without-hypertension and the OSA-with-hypertension groups; *, P<0.05 between OSA-with-hypertension and no-OSA-and-no-hypertension groups; $^\Delta$, P<0.05 between the OSA-with-hypertension and the OSA without-hypertension groups; $^\#$, P<0.05 between the OSA-without-hypertension and the no-OSA-and-no-hypertension groups. CMR, cardiac magnetic resonance; OSA, obstructive sleep apnea; LV, left ventricle; RV, right ventricle; LVEDVi, LV end-diastolic volume index; LVESVi, LV end-systolic volume index; LVEF, LV ejection fraction; SVi, stroke volume index; Ci, cardiac index; LVM, LV mass; LVMI, LV mass indexed to height$^{2.7}$; LVMVR, left ventricular mass/volume ratio; MWT, maximal wall thickness; ECV, extracellular volume; iECV, indexed extracellular volume; iCV, indexed cellular volume; GLS, global longitudinal strain; GCS, global circumferential strain; GRS, global radial strain.

Table S4 CMR parameters as grouped according to OSA and obese states

Variables	No OSA and no obese (n=12)	OSA without obese (n=11)	OSA with obese (n=21)	All patients without obese (n=23)	P value[1]	P value[2]
Function and structure						
LVEDVi (mL/m^2)	77.5±10.4	81.3±8.3	75.4±6.2	79.3±9.4	0.111	0.149
LVESVi (mL/m^2)	29.6±6.4	30.9±7.3	30.0±5.2	30.2±6.7	0.925	0.880
LVEF (%)	61.0±3.9	62.3±6.9	60.3±5.1	62.2±5.4	0.236	0.498
LVSVi (mL/m^2)	47.9±5.0	50.5±5.8	45.3±4.6$^\Delta$	49.1±5.4	0.018	0.030
LVCi (L/min per m^2)	3.1 [2.9, 3.4]	3.2 [2.9, 3.8]	3.3 [2.9, 3.5]	3.1 [2.9, 3.6]	0.769	0.751
LVM (g)	64.1±16.2	75.6±15.8	92.3±17.5*$^\Delta$	69.6±16.7	<0.001	<0.001
LVMI (g/m$^{2.7}$)	15.9±2.4	19.4±3.3$^\#$	21.8±3.8*	17.6±3.4	<0.001	<0.001
LVMVR (g/mL)	0.49±0.10	0.55±0.88	0.62±0.12*	0.51±0.10	0.002	0.004
MWT (mm)	9.3±1.1	10.0±1.8	11.4±1.9*	9.6±1.5	0.001	0.003
RVEDVi (mL/m^2)	80.1 [70.3, 90.9]	87.9 [78.2, 95.0]	77.7 [73.1, 87.7]	86.6 [73.9, 91.4]	0.329	0.260
RVESVi (mL/m^2)	38.6±8.2	40.4±10.9	41.0±10.7	39.5±9.4	0.611	0.803
RVEF (%)	50.8 [48.9, 55.2]	50.8 [48.7, 62.2]	48.8 [45.5, 55.2]	50.8 [48.9, 56.0]	0.100	0.238
RVSVi (mL/m^2)	42.3±7.1	47.0±7.8	41.0±6.5	44.5±7.6	0.101	0.077
RVCi (L/min per m^2)	3.0±0.4	3.3±0.8	3.2±0.5	3.1±0.6	0.716	0.387
T1 mapping parameters						
Native T1 (ms)	1272 [1234,1284]	1261 [1229,1269]	1246 [1234,1258]	1263 [1232,1280]	0.088	0.226
Post T1 (ms)	597.5±47.8	621.7±55.0	599.2±30.2	609.1±51.7	0.447	0.301
ECV (%)	27.1±2.2	25.1±2.2$^\#$	24.1±1.6*	26.1±2.4	0.002	0.001
iECV (mL/m$^{2.7}$)	4.1±0.6	4.6±0.8	5.0±0.8*	4.3±0.7	0.008	0.007
iCV (mL/m$^{2.7}$)	11.0±1.8	13.9±2.5$^\#$	15.8±2.9*	12.4±2.6	<0.001	<0.001
iCV-iECV (mL/m$^{2.7}$)	6.9±1.4	9.3±1.9$^\#$	10.8±2.2*	8.1±2.0	<0.001	<0.001
LV strain						
GLS (%)	−23.5±2.2	−22.8±2.4	−21.3±1.9*	−23.2±2.2	0.004	0.012
GCS (%)	−22.6±2.1	−21.2±3.5	−19.3±2.4*	−21.9±2.9	0.002	0.004
GRS (%)	91.5±36.0	77.6±20.2	78.7±22.1	84.8±29.7	0.443	0.341
GLS rate (s^{-1})	−1.0 [−1.2, −1.0]	−1.0 [−1.2, −0.9]	−1.0 [−1.1, −0.9]	−1.0 [−1.2, −1.0]	0.160	0.326
GCS rate (s^{-1})	−1.2 [−1.2, −1.0]	−1.0 [−1.1, −0.8]	−1.0 [−1.1, −0.9]	−1.0 [−1.2, −0.9]	0.540	0.244
GRS rate (s^{-1})	2.2±0.5	2.3±0.7	2.3±0.4	2.3±0.6	0.871	0.894

Data are mean ± standard deviation for normally distributed continuous variables and median [interquartile range] for skewed variables. Obese was defined as BMI ≥25 kg/m^2. BMI, body mass index; CMR, cardiac magnetic resonance; OSA, obstructive sleep apnea; LV, left ventricle; RV, right ventricle; LVEDVi, LV end-diastolic volume index; LVESVi, LV end-systolic volume index; LVEF, LV ejection fraction; SVi, stroke volume index; Ci, cardiac index; LVM, LV mass; LVMI, LV mass indexed to height$^{2.7}$; LVMVR, left ventricular mass/volume ratio; MWT, maximal wall thickness; ECV, extracellular volume; iECV, indexed extracellular volume; iCV, indexed cellular volume; GLS, global longitudinal strain; GCS, global circumferential strain; GRS, global radial strain.