

Left ventricular assessment using speckle-tracking echocardiography in Behçet's disease: a systematic review and meta-analysis

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ABSTRACT

Objective. Behçet's disease (BD) is a multisystem inflammatory disorder associated with increased cardiovascular morbidity. Conventional echocardiography often fails to detect early myocardial involvement. Speckle tracking echocardiography (STE) allows sensitive assessment of left ventricular (LV) myocardial deformation, particularly global longitudinal strain (GLS).

The aim of this study is to systematically evaluate LV systolic function assessed by STE in BD patients and to compare GLS differences with healthy controls.

Methods. PubMed, Scopus and Web of Science databases were searched for studies assessing LV strain by STE in BD. Studies using two- or four-dimensional STE were included. Pooled standardised mean differences (SMD) in LV GLS between BD patients and controls were calculated using random-effects models. Heterogeneity was assessed using I² and Cochrane Q test and was further explored using Baujat plot and leave-one-out analysis. PROSPERO registry number: CRD420251251109.

Results. Eight studies including 373 BD patients and 402 controls were included. LV GLS was not significantly reduced in BD compared to controls (SMD -0.59; 95% CI -1.21 to 0.04; $p=0.06$). Subgroup analyses showed that GLS impairment was more pronounced in patients with non-active disease (SMD -0.9; 95% CI -1.71 to -0.08), while no significant difference was observed in patients with no cardiovascular risk factors ($p=0.20$).

Conclusion. BD patients do not exhibit consistent subclinical LV systolic dysfunction in strain echocardiography. Further studies are required to optimise the use of STE in this population.

Introduction

Behçet's disease (BD) is a chronic multisystem inflammatory vasculitis characterised by recurrent mucocutaneous, ocular, vascular and neurological involvement (1).

While the primary focus of clinical management often lies in controlling systemic inflammation and preventing organ-specific complications, cardiovascular involvement represents a significant contributor to morbidity and mortality in these patients (2). Conventional echocardiography has historically been used to assess cardiac structure and function in BD (3); however, it may fail to detect subclinical myocardial dysfunction, particularly when left ventricular ejection fraction (LVEF) remains preserved.

Recent advances in speckle-tracking echocardiography (STE) have allowed for more sensitive evaluation of myocardial deformation, providing quantitative measures such as left ventricular global longitudinal strain (LV GLS) that can identify subtle ventricular dysfunction before overt changes in conventional echocardiographic parameters occur (4). In addition, LV GLS was also reported as a predictor of cardiovascular mortality (5).

STE findings were studied in various systemic inflammatory diseases (6, 7), as early detection of myocardial involvement is clinically important and may guide risk stratification, prompt closer monitoring, and influence therapeutic strategies. Although several individual studies evaluated LV GLS in patients with BD, the results were heterogeneous, with different imaging modalities (2D vs. 4D STE) and echocardiographic platforms used, various patient populations included (8, 9), and most

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importantly, inconsistent impairment of LV GLS reported (10, 11).

To date, no formal synthesis has comprehensively summarised the evidence on subclinical left ventricular dysfunction in BD using STE; thus, we have conducted a systematic review and meta-analysis to address this gap within literature.

Methods

This systematic review and meta-analysis was conducted in line with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) statement (12) and the MOOSE (Meta-analyses of Observational Studies in Epidemiology) recommendations (13). It was registered in PROSPERO (the International Prospective Register of Systematic Reviews).

Search strategy and data extraction

PubMed, Scopus and Web of Science databases were systematically searched for eligible studies. Medical subject headings were used in combination with Boolean operators, *e.g.* ("Behçet syndrome" OR Behçet) AND (STE OR ("speckle tracking" OR strain) AND echocardiography)). The full search strategy for each database is available in the Supplementary material. Studies were eligible for inclusion if: (i) they enrolled BD patients who were diagnosed according to the International Study Group criteria (14), with no underlying cardiac conditions (including ischaemic heart disease, congestive heart failure, valvular abnormalities, arrhythmias, etc.), (ii) compared them to healthy controls without cardiovascular disease or symptoms, (iii) and assessed cardiac function using speckle tracking echocardiography (STE). Exclusion criteria comprised: studies including BD patients with cardiac manifestations, studies with no healthy control group, studies evaluating cardiac function using imaging techniques other than STE (standard echocardiography, cardiac CT, cardiac MRI), and studies with no relevant STE data. Case reports, review articles, letters to editor, and conference abstracts were also excluded.

Two authors (AB and NB) independent-

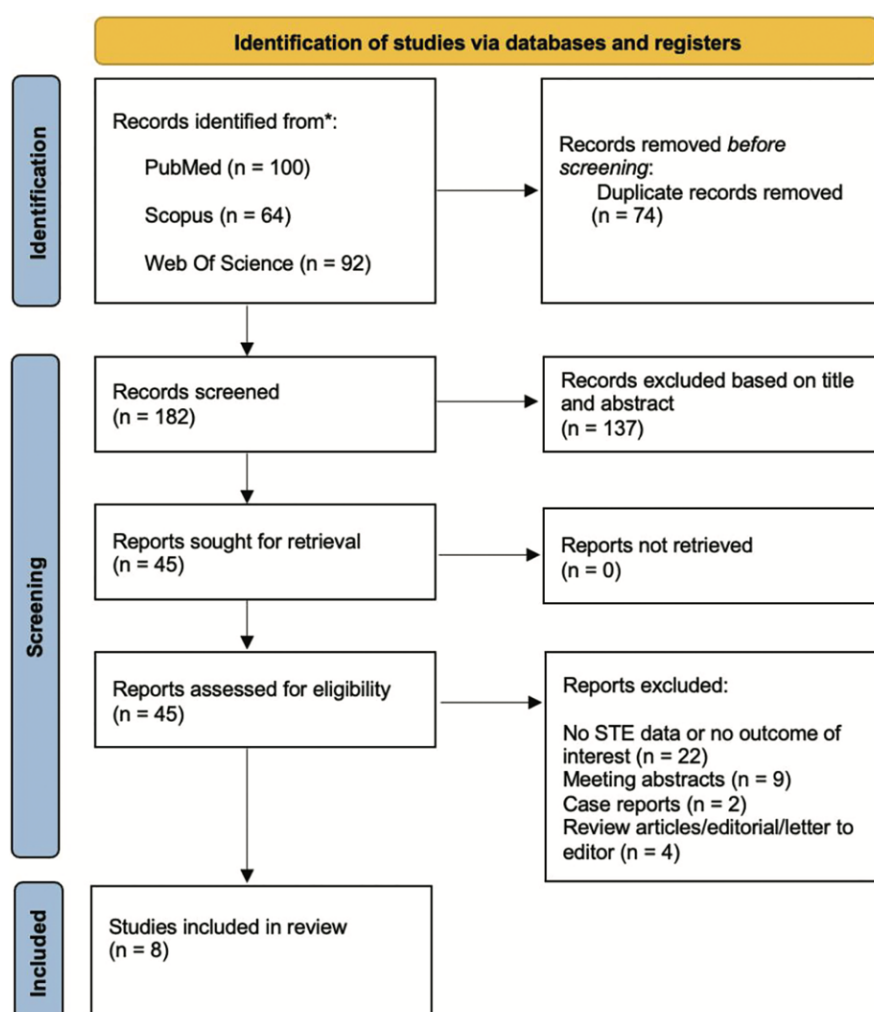


Fig. 1. PRISMA flow diagram of study screening and selection.

ly screened the records and manually extracted the data. Disagreements were resolved by consensus. Data on participants' demographics, cardiovascular risk factors, BD manifestations, treatment modalities, and echocardiography findings were collected. Vendor-specific reporting was noted but not used for pooling due to insufficient data.

Risk of bias assessment

Two authors (AB and NB) independently assessed the risk of bias in the included studies using the Joanna Briggs Institute (JBI) critical appraisal checklist for case-control studies (15). The checklist consisted of ten questions addressing selection, measurement, confounding, and statistical analysis. Studies were then qualified as low, moderate, or high risk of bias. Disagreements between authors were resolved by consensus.

Statistical analysis

R software (v. 4.5.1) was used for all statistical analyses. Using the "meta" package (v. 8.2-1), continuous outcomes were synthesised as standardised mean differences (SMD) with 95% confidence intervals when the pooled studies measured the LV GLS using different techniques (2D STE and 4D STE). When the included studies used the same standard 2D STE, mean differences (MD) were calculated as the effect measure. LV GLS measurements were converted to absolute values, so lower values meant worse strain parameters. Heterogeneity was assessed using I^2 statistics and Cochrane's Q test. Given the variability of the echocardiography performer, platform, and strain software, random-effects model was used. The between-study variance was estimated using the REML (Restricted Maximum Likelihood) method. Con-

Table I. Clinical characteristics of subjects in the included studies.

Study	Yagmur <i>et al.</i> (16)			Demirelli <i>et al.</i> (10)			Sun <i>et al.</i> (8)			Hidayet <i>et al.</i> (9)			Sunbul <i>et al.</i> (17)			Asarekli <i>et al.</i> (18)			Manzari <i>et al.</i> (19)			Tan <i>et al.</i> (11)		
	BD	C		BD	C		BD	C		BD	C		BD	C		BD	C		BD	C		BD	C	
Year	2011			2014			2018			2020			2022			2022			2023			2026		
Age (Years)	35.4 ± 8.9	36.4 ± 8.3		28.4 ± 7	27.7 ± 4.9		51 ± 11	51 ± 12		36 ± 8.5	38.1 ± 10.1		41 ± 9.2	41.8 ± 6.5		40.3 ± 9.6	41.8 ± 8.9		38.1 ± 10.1	38.3 ± 10.5		39 ± 10	43 ± 9	
Female n (%)	13 (40%)	8 (29%)		20 (66%)	16 (64%)		59 (73%)	105 (72%)		21 (52%)	21 (52%)		32 (40%)	20 (50%)		25 (55%)	26 (58%)		21 (55%)	21 (55%)		15 (55%)	17 (50%)	
BMI (kg/m ²)	24.2 ± 4	25.3 ± 3.6		NA	NA		22.7 ± 2.7	NA		NA	NA		NA	NA		26.5 ± 3.5	26.1 ± 3.9		NA	NA		26.7 ± 5.8	26.8 ± 4.2	
Hypertension n (%)	0	0		0	0		9 (11%)	NA		0	0		10 (12%)	5 (12%)		0	0		0	0		2 (7%)	2 (6%)	
Serum total cholesterol (mg/dL)	171 ± 32.6	193.2 ± 50.1		0	0		182 ± 40	NA		169 ± 32.1	NA		NA	NA		NA	NA		NA	NA		206 ± 98	210 ± 41	
Diabetes n (%)	0	0		0	0		6 (7%)	NA		0	0		4 (5%)	1 (2.5%)		0	0		0	0		1 (4%)	1 (3%)	
Smoking n (%)	NA	NA		0	0		3 (4%)	NA		NA	0		19 (23%)	14 (35%)		11 (24%)	11 (24%)		0	0		NA	NA	
Disease duration (years)	5.3 ± 5.5	8.8 ± 5.9					NA	NA		5.9 ± 3.37	NA		NA	NA		5* (3–15)	5* (3–15)		4* (1–15)	4* (1–15)		12.19 ± 7.7	12.19 ± 7.7	
Major organ involvement n (%)	6 (19%)			0			6 (7%)			NA			46 (57%)			0			NA			NA		
Vascular	NA			NA			3 (4%)			NA			40 (50%)			NA			NA			NA		
Neurologic	NA			NA			16 (20%)			NA			31 (38%)			14 (31%)			18 (47%)			15 (55%)		
Ocular	NA			NA			11 (14%)			NA			3 (4%)			NA			NA			NA		
Intestinal	NA			NA			73 (90%)			64 (100%)			34 (42%)			37 (82%)			NA			21 (78%)		
Treatment n (%)	22 (68%)			NA			NA			NA			NA			NA			NA			NA		
Colchicine	NA			0			36 (44%)			0			35 (44%)			7 (15%)			NA			3 (11%)		
Corticosteroids	NA			0			41 (51%)			0			71 (89%)			14 (31%)			NA			11 (40%)		
Immunosuppressives	NA			0			NA			0			19 (24%)			1 (2%)			NA			3 (11%)		
TNF inhibitors	NA			0			NA			0			NA			1 (2%)			NA			NA		

BD: Behçet's disease patients; C: healthy controls; BMI: body mass index; *: median value; NA: not available/reported.

Table II. Echocardiographic parameters in the included studies.

Study	Yagnur <i>et al.</i> (16)		Demirelli <i>et al.</i> (10)		Sun <i>et al.</i> (8)		Hidayet <i>et al.</i> (9)		Sunbul <i>et al.</i> (17)		Asarcikli <i>et al.</i> (18)		Manzari <i>et al.</i> (19)		Tan <i>et al.</i> (11)	
	BD	C	BD	C	BD	C	BD*	C	BD	C	BD	C	BD	C	BD	C
Year	2011		2014		2018		2020		2022		2022		2023		2026	
Platform	Philips IE-33 machine (Philips, Bothell, USA) equipped with broadband S5-1 transducer		by Vivid 7 Dimension® (GE Vingmed Ultrasound AS, Horten, Norway) echocardiography device using 2.5 MHz transducer		Vivid E9 system (GE Healthcare, Waukesha, WI, USA)		Vivid E95 system (GE Healthcare, Oslo, Norway)		Philips Epiq 7 echocardiography device (Philips Medical Systems, Andover, Massachusetts) and a S5-1 transducer		Epiq 7 ultrasound system with S5-1 transducer (Philips, The Netherlands)		Philips IE33 Scanner (Boholl, WA, USA) with the Standard Probe matrix X5-1		Philips EPIQ CVx platform, Philips Healthcare, USA	
LV GLS technique	2D STE; apical 4C views, 7 segments		2D STE; apical 4C, 2C and long-axis views		2D STE; apical 4C, 2C and long axis views, 17 segments		4D STE; automatically recorded with EchoPAC software		2D STE; apical 2C, 3C and 4C views.		2D STE; apical 4C, 2C and 3C views.		2D STE		2D STE; apical 4C, 2C and long-axis views	
Intra/inter-observer variability	NA		5.7%/5.7%		4.8%/5.1%		2.8%/3.6%		NA		NA		NA		NA	
LV EF (%)	64.91 ± 4.95	65.22 ± 4.32	65.1 ± 1.1	65.3 ± 1.7	64 ± 5	63 ± 5	63.8 ± 3.9	63.3 ± 3.3	58.3 ± 6.2	59.7 ± 8.0	70.8 ± 7.0	69.8 ± 5.5	57.84 ± 2.87	58.50 ± 2.51	63.7 ± 2.0	62.6 ± 2.5
LV EDD (mm)	45.38 ± 3.30	45.67 ± 3.25	NA	NA	45 ± 5	NA	NA	NA	47.1 ± 4.5	46.9 ± 4.7	42.6 ± 3.9	45 ± 3	NA	NA	NA	NA
LV ESD (mm)	NA	NA	NA	NA	29 ± 4	NA	NA	NA	28.8 ± 3.9	28.9 ± 3.8	25.6 ± 4.2	27 ± 3.2	NA	NA	NA	NA
E (cm/s)	NA	NA	75.6 ± 12.7	94 ± 12.8	NA	NA	NA	NA	82 ± 16	80 ± 17	75.3 ± 16.6	80 ± 17.2	75 ± 17	76 ± 17	84 ± 20	75 ± 19
A (cm/s)	NA	NA	69.2 ± 9.4	64.3 ± 9.0	NA	NA	NA	NA	64 ± 14	68 ± 14	63.2 ± 17.5	66.6 ± 18.5	63 ± 22	65 ± 22	65 ± 16	63 ± 11
E/A	1.31 ± 0.26	1.40 ± 0.16	NA	NA	NA	NA	1.37 ± 0.27	1.39 ± 0.19	NA	NA	1.26 ± 0.37	1.26 ± 0.35	NA	NA	1.67 ± 2.03	1.20 ± 0.33
E/E'	7.20 ± 1.55	7.01 ± 1.09	NA	NA	8.8 ± 3.1	NA	6 ± 2.6	7 ± 1	6.0 ± 2.0	5.6 ± 1.7	7.1 ± 2.0	7.3 ± 2.1	8.14 ± 2.26	7.28 ± 1.92	6.5 ± 2.48	6.68 ± 2.03
Aortic diameter (mm)	30.28 ± 3.77	29.51 ± 3.14	29.1 ± 3.0	29.0 ± 2.3	30 ± 4	NA	NA	NA	NA	NA	NA	NA	28.2 ± 3.3	27.5 ± 3.1	NA	NA

BD: Behçet's disease patients; C: healthy controls; LV: left ventricle; GLS: global longitudinal strain; EF: ejection fraction; LV EDD: LV end-diastolic diameter; LV ESD: LV end-systolic diameter; E: early diastolic mitral flow velocity; E': early diastolic velocity of the mitral annulus; NA: not available/reported.

* We presented the parameters of BD patients without neurologic involvement within the study.

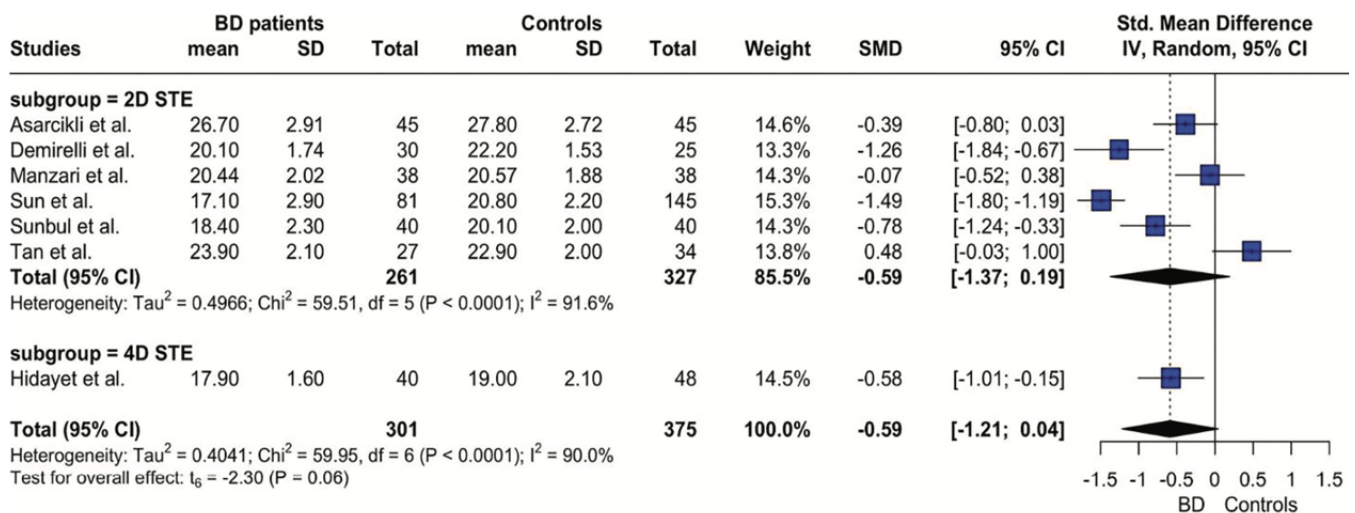


Fig. 2. Forest plot summarising meta-analysis results of LV GLS difference between Behçet's disease (BD) patients and healthy controls. A subgroup analysis by STE technique was conducted (two-dimensional 2D and four-dimensional 4D STE). Each black diamond indicates the pooled standardised mean difference (SMD) for the respective subgroup or overall analysis.

Blue squares represent study weight, and the horizontal lines crossing them indicate the 95% confidence intervals.

SD: standard deviation, CI: confidence interval.

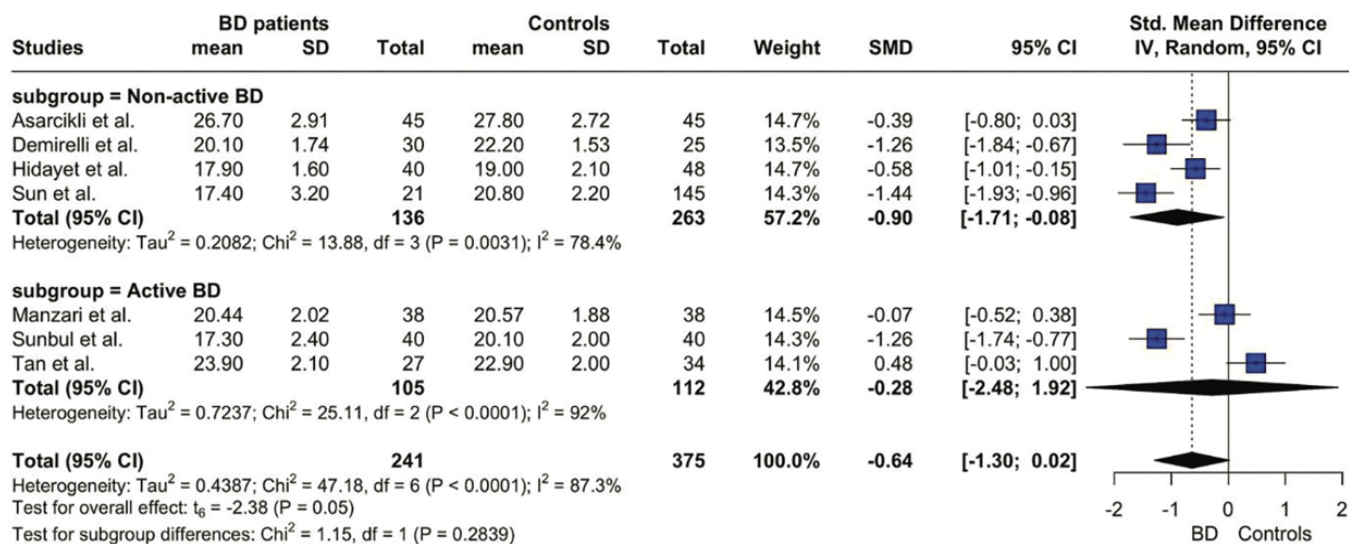


Fig. 3. Forest plot summarising meta-analysis results of LV GLS difference based on disease activity. Each black diamond indicates the pooled standardised mean difference (SMD) for the respective subgroup or overall analysis. Blue squares represent study weight, and the horizontal lines crossing them indicate the 95% confidence intervals.

The test for subgroup differences was not statistically significant ($p=0.2839$).

SD: standard deviation; CI: confidence interval.

fidence intervals were calculated using Hartung-Knapp/Sidik-Jonkman (HKSJ) method. Results were considered statistically significant for $p < 0.05$. Subgroup analyses based on imaging techniques, disease activity and cardiovascular risk were performed.

Leave-one-out sensitivity analysis was performed to evaluate the influence of individual studies on pooled estimates and heterogeneity (I^2), a recommended approach to detect outliers and robust-

ness. Besides, a Baujat plot was performed.

Results

Study selection and characteristics of the included studies

The search strategy yielded a total of 256 records. After removing the duplicates and screening the results based on title and abstracts, 45 publications were retrieved for full-text eligibility assessment. Of these, 8 studies met the

inclusion criteria and were included in the final analysis (Fig. 1). The included studies evaluated left ventricular strain parameters using speckle-tracking echography (STE) in 373 BD patients and 402 controls from Turkey (9-11, 16-18), South Korea (8) and Iran (19). Most studies included patients with no cardiovascular risk factors. Disease activity among the included BD patients varied across studies, depending on individual studies inclusion criteria.

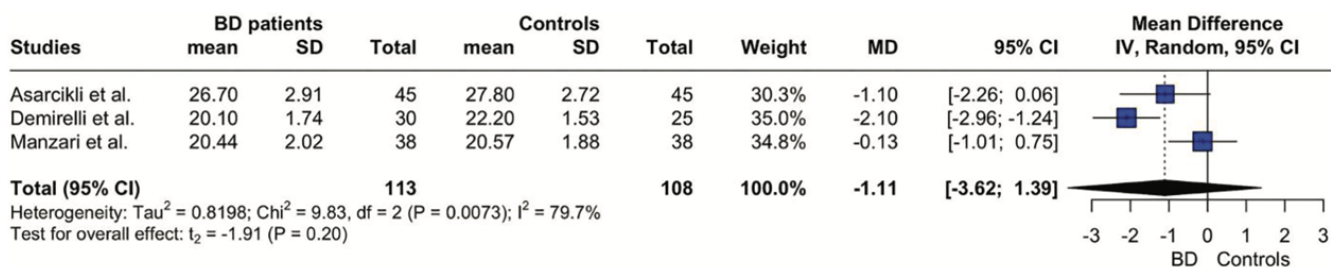


Fig. 4. Forest plot summarising meta-analysis results of LV GLS in BD patients with no cardiovascular risk factors, vs. healthy controls, using 2D STE. Blue squares represent study weight, and the horizontal lines crossing them indicate the 95% confidence intervals. The pooled effect measure was mean difference (MD).

SD: standard deviation; CI: confidence interval.

Studies enrolling patients with major organ involvement consequently reported a higher use of immunosuppressive agents and biologic treatment (8, 17). In the study by Hidayet *et al.* (9), BD patients were divided into two arms based on the absence (-) or the presence (+) of fragmented QRS (f QRS) in the electrocardiogram, and we only included the f QRS (-) arm in our analysis. Table I summarises the epidemiological data, cardiovascular risk factors, BD major clinical involvement and treatment. Table II summarises the echocardiographic settings and findings of the studies. Only one study used a four dimensional STE (3D + time) (9). Although the study by Yagmur *et al.* (16) used a two-dimensional (2D) STE, LV longitudinal strain was estimated from a single apical 4 chambers view, unlike the other standard 2D STE studies that used the apical 4 chambers, 2 chambers, and 3 chambers views. Therefore, it was not included in the quantitative analysis. Diastolic parameters (E/A and E/E') were largely normal across the different studies, and LVEF was preserved in the patients and the controls.

Left ventricular (LV) and global longitudinal strain (GLS)

The meta-analysis showed that LV GLS is not significantly different in BD patients compared to healthy controls (SMD -0.59; 95% CI -1.21 to 0.04; $p=0.06$) (Fig. 2). However, the $I^2=90\%$ and the Cochrane Q test ($p<0.0001$) revealed high interstudy heterogeneity. A subgroup analysis of studies using 2D STE revealed a non-significant -1.31% difference of LV GLS between BD patients and healthy controls (MD

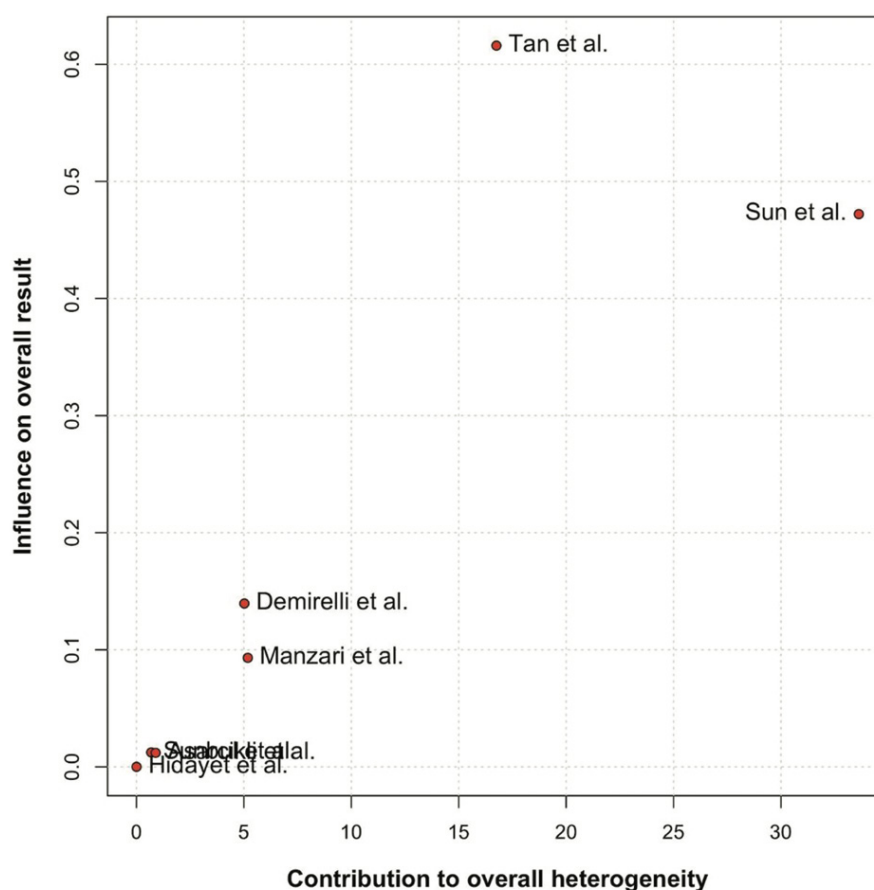


Fig. 5. Baujat plot of the included studies in the primary analysis. The horizontal axis represents the contribution of each study in the overall heterogeneity and the vertical axis represents the influence of each study on the pooled results.

-1.31%; 95% CI -3.03 to 0.41; $p=0.11$) (Supplementary Fig. S1).

In another subgroup analysis, patients with non-active BD manifestations demonstrated significantly lower LV GLS (SMD -0.9; 95% CI -1.71 to -0.08) (Fig. 3). However, no statistical difference was observed between the active and the non-active BD subgroups (test for subgroup differences $p=0.2839$) (Fig. 3). For BD patients with no cardio-vascular risk factors

(no history of hypertension, diabetes or obesity), strain values were not statistically different compared to healthy controls, using 2D STE (MD -1.11; 95% CI -3.62 to 1.39; $p=0.20$) (Fig. 4).

Heterogeneity assessment

To explore the high interstudy heterogeneity ($I^2=90\%$), a Baujat plot was performed (Fig. 5). The visual interpretation revealed the studies by Sun *et al.* and Tan *et al.* as potential influ-

tial studies because of their high contribution to the overall heterogeneity and influence on the overall result (8, 11). Nonetheless, and given the limited number of the included studies in the Baujat plot, we further explored the heterogeneity using a leave-one-out analysis (Fig. 6). The omission of two studies, one at a time, did not substantially reduce the overall heterogeneity (I² from 90% to 80.1% and 86.4% after the removal of the studies by Sun *et al.* and Tan *et al.* respectively).

Importantly, the pooled effect estimate became statistically significant ($p=0.0182$) after the omission of the study by Tan *et al.* (11), indicating a probable outlier status. Other than that, the leave-one-out analysis exhibited consistent results following the sequential exclusion of the remaining studies.

Risk of bias assessment

JBI critical appraisal checklist was used to assess the risk of bias. Of the eight included studies, four were considered to be at low risk of bias and four at moderate risk. All the studies clearly defined inclusion criteria. Studies that did not account for inter and intra-observer variability were considered at higher risk of bias. Because of the lack of follow-up, the effect of the exposure period on the outcomes of interest remained unclear. A detailed assessment of each study is provided in Supplementary table S1.

Discussion

Although cardiac involvement in BD is considered to be rare (20), previous meta-analyses have shown that BD is associated with an increased risk of ischaemic heart disease and diastolic dysfunction (21, 22). BD patients also exhibited subclinical abnormalities on cardiac magnetic resonance imaging (23), underscoring the potential need for systemic cardiac evaluation even in asymptomatic patients. Thus, we conducted a systematic review and meta-analysis to investigate the utility of STE in BD patients without known cardiac disease, with the aim of informing future recommendations for cardiac screening in this population. While individual studies reported subclinical

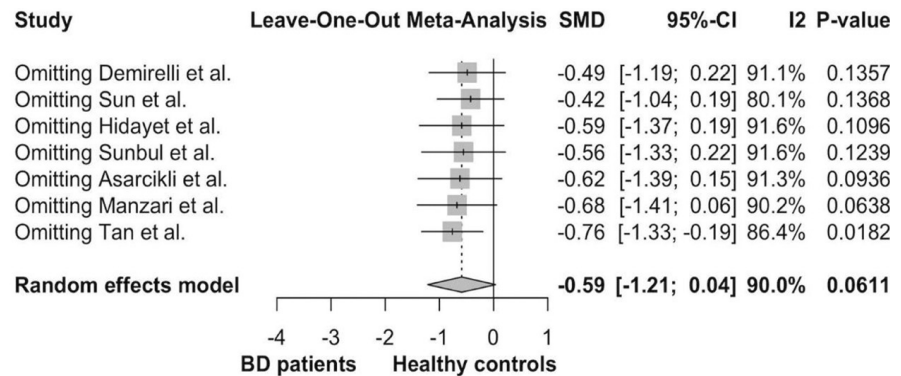


Fig. 6. Leave-one-out analysis: pooled GLS SMD after excluding each study. Turkish cohort (n=85) was highly influential, suggesting regional differences.

LV dysfunction in BD patients using STE, our meta-analysis highlights that the LV GLS impairment is not consistent (SMD -0.59; 95% CI -1.21 to 0.04; $p=0.06$) (Fig. 2). Our findings are limited by the high inter-study heterogeneity ($I^2 = 90\%$; Cochrane Q test $p<0.0001$), which is firstly due to the different imaging techniques. Although most studies relied on conventional 2D STE (8, 10, 11, 17-19), the study by Hidayet *et al.* employed 4D STE, providing a fully volumetric assessment of myocardial deformation (9). While 4D STE may reduce through-plane motion and geometric assumptions (24), its limited availability currently restricts its comparability with standard 2D STE. In addition, the included studies had different inclusion criteria. The study by Hidayet *et al.* (9) example enrolled BD patients with fragmented QRS; an electric sign associated with cardiac disease including coronary artery stenosis (25), while other studies required a normal ECG for inclusion (18). We addressed this limitation by only including the f QRS (-) arm and running different subgroup analyses. Patients with active disease manifestations have been reported to exhibit lower GLS values (8), and a similar pattern was observed among those with major organ involvement (17). However, the study by Sun *et al.* demonstrated no significant differences in GLS according to systemic disease activity. Our subgroup analysis also showed that patients with non-active BD still exhibited lower GLS values, which reinforces the hypothesis that myocardial deformation may be relatively independent from the intensity of

disease activity and the extent of systemic inflammation. In addition, GLS values did not differ significantly between BD patients without cardiovascular risk factors and healthy controls, highlighting the potential confounding influence of traditional cardiovascular risk factors.

Unlike RA (meta-analytic SMD -1.8 for GLS) or SSc (-2.4), BD showed no consistent LV systolic impairment when pooling different studies (26, 27). Importantly, the absence of a consistent strain alteration in BD does not imply that strain is never impaired; rather, it indicates that the available studies are too heterogeneous (in populations, disease phases, definitions, and echo protocols) to yield a stable, pooling-compatible effect size.

This may reflect both the variable BD cardiac phenotype, and it calls for larger prospective standardised strain-based studies to clarify whether subgroups are more prone to subtle myocardial dysfunction.

Emerging data suggest LA strain may detect earlier cardiac involvement in neuro-Behçet's subsets. Two studies reported GLS-LA reductions (-19.2% vs. -22.1% controls; $p=0.04$) in BD patients with neurological complications, potentially reflecting elevated LV filling pressures from brainstem-mediated autonomic dysfunction. Larger prospective studies are warranted (10, 28). We also explored heterogeneity further by performing a Baujat plot and a leave-one-out analysis. LV GLS difference reached statistical significance after the omission of the study by Tan *et al.* (11). Although the study enrolled

patients with cardiovascular risk factors and active BD manifestations, we did not identify clear methodological or clinical features explaining its outlier status. This finding may suggest variability in the performance of STE in asymptomatic BD patients. Further prospective studies are needed to clarify this inconsistency. Our systematic review and meta-analysis revealed other limitations within the literature. The association between LV GLS and disease duration was not explored. In addition, the clinical outcomes of the LV GLS impairment were not reported, due to the lack of follow-up, and the data on other strain parameters (like the global radial and circumferential strains) are scarce and limited. Another important limitation is the lack of consistent reporting on echocardiography vendors across studies. Strain measurements exhibit significant inter-vendor discrepancies due to differences in speckle-tracking algorithms, with GLS values varying by 4–6% between GE and Siemens platforms in head-to-head comparisons. Although GLS is considered relatively robust and reproducible compared with other strain parameters, absolute values may still vary across vendors. Therefore, pooled estimates should be interpreted with caution, particularly regarding their magnitude. Importantly, despite these methodological differences, the consistent direction of GLS impairment across studies supports the robustness of our findings and reinforces the evidence of subclinical myocardial involvement in BD. This heterogeneity likely contributes to our observed $I^2=72\%$ for GLS. Future meta-analyses and primary studies should mandate vendor disclosure and consider normalised Z-scores to mitigate this bias.

Conclusion

Current evidence does not support a consistent impairment of left ventricular global longitudinal strain in patients with BD without overt cardiac involvement. These findings indicate that LV GLS alone may have limited value as a universal screening tool in this population. Nevertheless, myocardial deformation imaging remains relevant in

selected clinical contexts. Prospective studies using standardised strain protocols and longitudinal follow-up are warranted to clarify the clinical and prognostic significance of atrial and ventricular parameters.

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