Effect of Aficamten on Health Status Outcomes in Obstructive Hypertrophic Cardiomyopathy

Results from SEQUOIA-HCM

Charles F. Sherrod IV, MD, MSc,[a,b] Sara Saberi, MD,[c] Michael E. Nassif, MD,[a,b] Brian L. Claggett, PhD,[d]
Caroline J. Coats, MD, PhD,[e] Pablo Garcia-Pavia, MD, PhD,[f] James L. Januzzi, MD,[g,h] Gregory D. Lewis, MD,[g]
Changsheng Ma, MD,[i] Martin S. Maron, MD,[j] Zi Michael Miao, MS,[d] Iacopo Olivotto, MD,[k] Josef Veselka, MD, PhD,[l]
Michael Butzner, DrPH, MPH,[m] Daniel L. Jacoby, MD,[m] Stephen B. Heitner, MD,[m] Stuart Kupfer, MD,[m]
Fady I. Malik, MD, PhD,[m] Lisa Meng, PhD,[m] Amy Wohltman, ME,[m] John A. Spertus, MD, MPH[a,b]

ABSTRACT

BACKGROUND A primary goal in treating obstructive hypertrophic cardiomyopathy (oHCM) is to improve patients' health status: their symptoms, function, and quality of life. The health status benefits of aficamten, a novel cardiac myosin inhibitor, have not been comprehensively described.

OBJECTIVES This study sought to determine the effect of aficamten on patient-reported health status, including symptoms of fatigue, shortness of breath, chest pain, physical and social limitations, and quality of life.

METHODS SEQUOIA-HCM (Phase 3 Trial to Evaluate the Efficacy and Safety of Aficamten Compared to Placebo in Adults With Symptomatic oHCM) randomized symptomatic adults with oHCM to 24 weeks of aficamten (n = 142) or placebo (n = 140), followed by a 4-week washout. The Kansas City Cardiomyopathy Questionnaire (KCCQ) and Seattle Angina Questionnaire 7-item (SAQ7) were serially administered. Changes in mean KCCQ—Overall Summary Score (KCCQ-OSS) and SAQ7—Summary Score (SAQ7-SS) from baseline to 24 weeks and following treatment withdrawal were compared using linear regression adjusted for baseline scores and randomization strata. Proportions of patients with clinically important changes were compared.

RESULTS Among 282 participants, the mean age was 59 ± 13 years, 115 (41%) were female, and 223 (79%) were White. Baseline KCCQ-OSS (69.3 ± 20.1 vs 67.3 ± 18.8) and SAQ7-SS (72.0 ± 21.0 vs 72.4 ± 18.3) were similar between afi-camten and placebo groups. Treatment with aficamten, compared with placebo, improved both the mean KCCQ-OSS (13.3 ± 16.3 vs 6.1 ± 12.6; mean difference: 7.9; 95% CI: 4.8-11.0; $P < 0.001$) and SAQ7-SS (11.6 ± 17.4 vs 3.8 ± 14.4; mean difference: 7.8; 95% CI: 4.7-11.0; $P < 0.001$) at 24 weeks, with benefits emerging within 4 weeks. No heterogeneity in treatment effect was found across subgroups. A much larger proportion of participants experienced a very large health status improvement (≥20 points) with aficamten vs placebo (KCCQ-OSS: 29.7% vs 12.4%, number needed to treat: 5.8; SAQ7-SS: 31.2% vs 13.9%, number needed to treat: 5.8). Participants' health status worsened significantly more after withdrawal from aficamten than placebo (KCCQ-OSS: −16.2 ± 19.0 vs −3.0 ± 9.6; $P < 0.001$; SAQ7-SS: −17.4 ± 21.4 vs −2.5 ± 13.3), further confirming a causal effect of aficamten.

CONCLUSIONS In patients with symptomatic oHCM, treatment with aficamten resulted in markedly improved health status, including significant improvement in chest pain-related health status, than placebo. (Phase 3 Trial to Evaluate the Efficacy and Safety of Aficamten Compared to Placebo in Adults With Symptomatic oHCM [SEQUOIA-HCM]; NCT05186818) (JACC. 2024;■:■-■) © 2024 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

From the [a]University of Missouri-Kansas City's Healthcare Institute for Innovations in Quality, Kansas City, Missouri, USA;
[b]Saint Luke's Mid America Heart Institute, Kansas City, Missouri, USA; [c]Department of Internal Medicine, Division of Cardio-vascular Medicine, University of Michigan, Ann Arbor, Michigan, USA; [d]Cardiovascular Division, Brigham and Women's Hospital, Harvard Medical School, Boston, Massachusetts, USA; [e]School of Cardiovascular and Metabolic Health, University of Glasgow,

ABBREVIATIONS AND ACRONYMS

KCCQ = Kansas City Cardiomyopathy Questionnaire

LV = left ventricular

LVEF = left ventricular ejection fraction

LVOT = left ventricular outflow tract

LVOT-G = left ventricular outflow tract gradient

NNT = number needed to treat

oHCM = obstructive hypertrophic cardiomyopathy

OSS = Overall Summary Score

SAQ7 = Seattle Angina Questionnaire 7-item

SS = Summary Score

Obstructive hypertrophic cardiomyopathy (oHCM) is a condition characterized by excessive actin-myosin cross-bridges, resulting in left ventricular (LV) hypercontractility, LV hypertrophy, myocardial fibrosis, and obstruction of the left ventricular outflow tract (LVOT).[1] Abnormal myocardial structure and function also affect coronary blood flow through distal vessel compression and impaired microcirculation.[2,3] Accordingly, those living with oHCM frequently experience shortness of breath, palpitations, fatigue, and chest pain that can affect their function and quality of life.[4] A primary goal in managing oHCM is to improve patients' health status. However, medical therapies, aside from mavacamten,[5] the first-in-class cardiac myosin inhibitor, have limited data and uncertain clinically meaningful effects on health status.

Aficamten, a next-in-class small-molecule cardiac myosin inhibitor, reduces actin-myosin cross-bridging and relieves myocardial hypercontractility.[6] In early phase studies, aficamten demonstrated important reductions in left ventricular outflow tract gradients (LVOT-Gs) and markedly improved patients' symptoms.[7-9] More recently, the SEQUOIA-HCM (Phase 3 Trial to Evaluate the Efficacy and Safety of Aficamten Compared to Placebo in Adults With Symptomatic oHCM; NCT05186818) study demonstrated that aficamten significantly improved measures of exercise capacity (peak VO₂), as measured by cardiopulmonary exercise testing.[10] The 23-item Kansas City Cardiomyopathy Questionnaire (KCCQ)–Overall Summary Score (OSS) and the 7-item Seattle Angina Questionnaire (SAQ7)–Summary Score (SS) were collected to better understand the impact of treatment from patients' perspectives. While the KCCQ-OSS has been validated in oHCM and quantifies the severity and frequency of fatigue, shortness of breath, and swelling, along with their impact on physical and social function and patients' disease-specific quality of life, it does not capture frequency and impact of chest pain, which were assessed by the SAQ7-SS. This prespecified report provides the first in-depth analyses of the health status outcomes of aficamten, along with patient-centered descriptions of the clinical magnitude of these effects, so that patients and providers can have a better understanding of treatment benefit from patients' perspectives.

METHODS

SEQUOIA-HCM was a phase 3, multicenter, randomized, double-blind, placebo-controlled trial that enrolled adult participants with symptomatic oHCM. Details of the study design have previously been published.[11] Participants were randomized 1:1 to either aficamten or placebo with the KCCQ, SAQ7, and other measures of disease burden collected at each study visit. Doses of aficamten (range 5-20 mg) or matching placebo were adjusted during the first 6 weeks of the study according to site-interpreted echocardiographic criteria with goal of reducing LVOT-Gs while maintaining left ventricular ejection fraction (LVEF) at ≥50%. Key inclusion criteria were LV septal hypertrophy ≥15 mm, or ≥13 if genetic testing or family history were indicative of oHCM, an LVOT-G ≥30 mm Hg at rest and ≥50 mm Hg with Valsalva physiology, and an LVEF ≥60%. Participants were excluded if they had significant valvular heart disease other than mitral regurgitation caused by systolic anterior motion, ventricular hypertrophy from infiltrative diseases, uncontrolled atrial or ventricular arrhythmias, prior or planned septal reduction therapies, inability to complete cardiopulmonary exercise testing, or prior cardiac myosin inhibitors treatment. Ethical approval of the study was approved institutionally by the Internal Review Board at each participating site and each participant signed informed consent prior to randomization.

Glasgow, United Kingdom; fHospital Universitario Puerta de Hierro Majadahonda, Instituto de Investigación Sanitaria Puerta de Hierro-Segovia de Arana (IDIPHISA), Centro de Investigación Biomédica en Red Enfermedades Cardiovasculares (CIBERCV), Centro Nacional de Investigaciones Cardiovasculares (CNIC), Madrid, Spain; gDivision of Cardiology, Department of Medicine, Massachusetts General Hospital, Harvard Medical School, Boston, Massachusetts, USA; hBaim Institute for Clinical Research, Boston, Massachusetts, USA; iBeijing Anzhen Hospital, Capital Medical University, Beijing, China; jLahey Hospital and Medical Center, Burlington, Massachusetts, USA; kMeyer Children's Hospital, Istituto di Ricovero e Cura a Carattere Scientifico, Florence, Italy; lDepartment of Cardiology, Angiology and Intensive Care, Klinikum Chemnitz gGmbH, Medical Campus Chemnitz of the Technische Universität Dresden, Dresden, Germany; and mCytokinetics, Incorporated, South San Francisco, California, USA.

PATIENT-REPORTED OUTCOMES. The KCCQ is a 23-item patient-reported outcome, originally developed for patients with heart failure to quantify symptoms, function, and quality of life[12] and has recently been validated in the oHCM population.[13] Individual KCCQ domains measure symptoms, physical and social limitations, and quality of life and are combined into a Clinical Summary Score (the average of the total symptom and physical limitation domains) and an OSS (including all 4 domains) to provide a more complete description of patients' health status.[14] The KCCQ has a 2-week recall period and was collected at baseline and 2, 4, 6, 8, 12, 16, 20, 24, and 28 weeks.

Although the KCCQ captures many of the key symptoms experienced by those with oHCM, it does not quantify chest pain (angina).[4] The SAQ7 is a 7-item patient-reported outcome that was collected to capture the frequency and impact of chest pain on participants' health status.[15] Like the KCCQ, the SAQ7 includes the frequency of chest pain, the physical limitations associated with chest pain, and its impact on patients' quality of life. Domains are combined into the SS (SAQ7-SS) that most comprehensively quantifies the impact of chest pain on patients' health status.[16] Although not yet validated in oHCM, it was included to provide a more comprehensive assessment of aficamten on clinical outcomes important to patients with oHCM, given the prevalence and relevance of chest pain on patients' quality of life.[4] The SAQ7 has a 4-week recall period and was collected at baseline and 4, 8, 12, 16, 20, 24, and 28 weeks.

Both the KCCQ and SAQ7 range from 0 to 100, with higher scores indicating better health status. Scores from 0 to 24 represent very poor to poor health status, from 25 to 49 are poor to fair, from 50 to 74 are fair to good, and from 75 to 100 are good to excellent.[12,16] For the SAQ7–Angina Frequency Score, scores from 0 to 30 reflect daily chest pain, 31 to 60 indicate weekly symptoms, 61 to 99 monthly chest pain, and a score of 100 indicates no chest pain over the prior month.[16]

When assessing the magnitude of treatment benefit for an individual participant, decreases in scores ≤ -5 points indicate clinically important deterioration; scores between -5 and <5 represent clinical stability; 5 and <10 reflect small but important improvements; and 10 and <15 suggest a moderately large improvement; changes in scores of 15 to <20 are a large improvement; and improvements by ≥ 20 are very large changes from both patients' and clinicians' perspectives.[17] These thresholds were selected because they have been validated for the KCCQ in oHCM,[13] but thresholds for interpreting the SAQ7 are extrapolated from its use in chronic epicardial coronary disease. Because the majority of chest pain in oHCM is due to increased wall stress and microvascular disfunction, data relating SAQ7 scores to myocardial blood flow reserve and those with microvascular disease support its application to the oHCM population.[18,19] Culturally and linguistically appropriate versions of each questionnaire were used in each country.[20]

STATISTICAL ANALYSIS. Participants were included in this prespecified analysis if they had baseline and follow-up patient-reported outcome data. Whereas the KCCQ-Clinical Summary Score was a prespecified secondary endpoint in SEQUOIA-HCM given its qualification by the U.S. Food and Drug Administration, the OSS includes the Social Limitation Score and Quality of Life score to more completely quantify the impact of treatment on patients' symptoms, function, and quality of life. Accordingly, for this analysis, the primary endpoints were the change in KCCQ-OSS and SAQ7-SS from baseline to week 24. We additionally analyzed the impact of treatment withdrawal between weeks 24 and 28 on patients' health status.

Baseline characteristics by treatment group were summarized using mean $\pm$ SD or median (Q1-Q3) for continuous variables, as well as counts and percentages for categorical variables. To evaluate the treatment effect of aficamten, changes in KCCQ-OSS and SAQ7-SS were evaluated using linear regression models adjusted for the baseline and randomization stratification variables (beta-blocker use, cardiopulmonary exercise test modality). This method was chosen given the low prevalence of missing data. Heterogeneity of treatment benefit was explored among predefined patient characteristics (sex, age, body mass index, LVEF, N-terminal pro–B-type natriuretic peptide, peak VO_2, cardiopulmonary exercise test modality, baseline oHCM treatment, and baseline health status) and tested with interaction terms as exploratory endpoints. Effect sizes are reported as point estimates with 95% CIs. A prespecified α of <0.05 was used to define statistical significance, without adjustment for multiple comparisons.

To quantify the patient-level impact of treatment, we also examined the proportions of patients who experienced clinically important changes from baseline, as described.[12] The number needed to treat (NNT) was estimated by calculating the reciprocal of the absolute difference between the aficamten and placebo groups.

Because the missingness of the patient-reported outcomes was negligible ($<3\%$ across all time points), no imputations or sensitivity analyses were performed. Analyses were performed by an

TABLE 1 Baseline Characteristics By Treatment Group		
	Placebo (n = 140)	Aficamten (n = 142)
Demographics		
Age, y	59.0 ± 13.3	59.2 ± 12.6
Female	59 (42.1)	56 (39.4)
White	115 (82.1)	108 (76.1)
Asian	25 (17.9)	29 (20.4)
Black	0 (0)	3 (2.1)
Other	0 (0)	2 (1.4)
North American	45 (32.1)	49 (34.5)
Chinese	22 (15.7)	24 (16.9)
European and/or Israeli	73 (52.1)	69 (48.6)
Medical history		
Hypertension	70 (50.0)	75 (52.8)
Known pathogenic sarcomere variant	25 (17.9)	24 (16.9)
Family history of HCM	34 (24.3)	41 (28.9)
Paroxysmal atrial fibrillation	20 (14.3)	21 (14.8)
Coronary artery disease	16 (11.4)	19 (13.4)
Diabetes mellitus	9 (6.4)	14 (9.9)
Permanent atrial fibrillation	1 (0.7)	2 (1.4)
BMI at baseline, kg/m^2	28.2 ± 3.7	28.0 ± 3.8
Baseline HCM therapy		
Beta-blocker	87 (62.1)	86 (60.6)
Calcium-channel blocker	36 (25.7)	45 (31.7)
Disopyramide	20 (14.3)	16 (11.3)
Implantable cardioverter-defibrillator	17 (12.1)	22 (15.5)
Baseline measures of HCM severity		
NYHA functional class		
II	106 (75.7)	108 (76.1)
III	33 (23.6)	34 (23.9)
IV	1 (0.7)	0 (0.0)
NT-proBNP, pg/mL	692 (335-1,795)	818 (377-1,630)
hs-cTnI, ng/L	12 (8, 25)	13 (8, 34)
Peak LVOT-G at rest, mm Hg	55 ± 32	55 ± 27
Peak LVOT-G with Valsalva, mm Hg	83.3 ± 32	82.9 ± 32
LVEF, %	75 ± 6	74.8 ± 5.5
LV maximal wall thickness, cm	2.1 ± 0.3	2.1 ± 0.3
Cardiopulmonary exercise testing		
CPET modality: cycle ergometer	63 (45.0)	64 (45.1)
CPET modality: treadmill	77 (55.0)	78 (54.9)
Total workload, W	125 ± 42	120 ± 39
Peak VO$_2$. mL/kg/min	18.6 ± 4.5	18.4 ± 4.4
Predicted oxygen uptake, %	57.6 ± 13.0	56.2 ± 10.6
Peak respiratory exchange ratio	1.18 ± 0.09	1.19 ± 0.11
Baseline health status		
KCCQ		
OSS	67.3 ± 18.8	69.3 ± 20.1
CSS	73.7 ± 17.6	75.6 ± 18.4
TSS	73.7 ± 19.6	76.6 ± 19.9
PLS	73.7 ± 18.2	74.6 ± 19.3
SLS	67.7 ± 24.1	68.6 ± 24.3
QOL	53.7 ± 22.6	56.8 ± 26.4

independent academic research group using STATA version 18 (StataCorp LLC). No statistical adjustments were made for the multiple comparisons, given the high correlation among the health status outcomes.[21]

RESULTS

TRIAL POPULATION. A total of 282 participants were randomized and subsequently included in the analyses, of whom 142 (50.3%) received aficamten. The mean age was 59.2 ± 12.6 years and 115 (40.8%) were women. The overall baseline characteristics were similar between treatment arms, including baseline KCCQ-OSS (69.3 ± 20.1 vs 67.3 ± 18.8) and SAQ7-SS (72.0 ± 21.0 vs 72.4 ± 18.3) and their domain scores (Table 1).

TREATMENT EFFECTS. The mean ± SD KCCQ-OSS and SAQ7-SS by study visit and treatment assignment are shown in Figure 1. The KCCQ-OSS (Figure 1A, Central Illustration) increased in both aficamten and placebo groups, but diverged in magnitude of improvement early during drug titration. Changes were sustained with statistically significant improvements until week 24, the end of the treatment period. The change in KCCQ-OSS from baseline to week 24 was 13.3 ± 16.3 in aficamten vs 6.1 ± 12.6 in placebo-treated participants (mean difference: 7.9; 95% CI: 4.8-11.0; $P < 0.001$). Similarly, the SAQ7-SS (Figure 1B, Central Illustration) improved more in those treated with aficamten (11.6 ± 17.4) than those treated with placebo (3.8 ± 14.4; mean difference: 7.8; 95% CI: 4.7-11.0; $p < 0.001$). The health status differences over time between aficamten and placebo for all domains of the KCCQ and SAQ7 are similar and are included in Supplemental Tables 1 to 8.

EFFECTS OF TREATMENT WITHDRAWAL. When treatment was withdrawn between weeks 24 and 28 (Figure 1), a decline in the health status of both treatment groups was observed, with much larger decrements in those who had been treated with aficamten. Compared with week 24, those in the aficamten arm experienced greater decreases in their KCCQ-OSS ($-16.2 ± 19.0$ vs $3.0 ± 9.6$; $P < 0.001$) and SAQ7-SS ($-17.4 ± 21.4$ vs $2.5 ± 13.3$; $P < 0.001$).

RESPONDER ANALYSES OF PATIENT-LEVEL, CLINICALLY IMPORTANT HEALTH STATUS CHANGES. The proportions of the population experiencing different magnitudes of KCCQ-OSS and SAQ7-SS changes from baseline to week 24 are shown in Figure 2 and the Central Illustration. The largest differences in these distributions for the KCCQ-OSS were for those who experienced very large health status improvements (≥20 points). Of those treated with aficamten, 41 (29.7%) as compared with 17 (12.4%) of those treated with placebo experienced a ≥20 point improvement. This absolute difference of 17.3% equates to an estimated NNT of 5.8 (95% CI: 3.7-12.7) for 1 patient treated with aficamten to feel markedly better after

24 weeks, as compared with placebo treatment. These results were similar for the SAQ7-SS, with 43 (31.2%) of those assigned to aficamten experiencing a very large (≥20 point) improvement compared with 19 (13.9%) of those assigned to placebo. These differences also equate to an NNT of 5.8 (95% CI: 3.7-13.1) for 1 patient to have a very large improvement in SAQ7-SS with aficamten as compared with placebo.

SUBGROUP ANALYSES. Figures 3A and 3B demonstrates the treatment benefit of aficamten across subgroups for the KCCQ-OS and SAQ7-SS, respectively. No heterogeneity of treatment benefit was observed by participants' demographics (ie, sex, age, body mass index), echocardiographic characteristics

TABLE 1 Continued		
	Placebo (n = 140)	Aficamten (n = 142)
SAQ7		
SS	72.4 ± 18.3	72.0 ± 21.0
AF	83.5 ± 16.5	83.3 ± 15.7
PLS	71.4 ± 23.8	72.0 ± 24.9
QOL	61.5 ± 28.5	60.5 ± 29.8

Values are mean ± SD, n (%), or median (Q1-Q3).

AF = Angina Frequency Score; BMI = body mass index; CPET= cardiopulmonary exercise test; CSS= Clinical Summary Score; HCM = hypertrophic cardiomyopathy; hs-cTnI = high-sensitivity cardiac troponin I; KCCQ = Kansas City Cardiomyopathy Questionnaire; LV = left ventricular; LVEF = left ventricular ejection fraction; LVOT-G = left ventricular outflow tract gradient; NT-proBNP = N-terminal pro–B-type natriuretic peptide; OSS = Overall Summary Score; PLS = Physical Limitation Score; QOL = Quality of Life Score; SAQ7 = Seattle Angina Questionnaire 7-item; SLS = Social Limitation Score; SS = Summary Score; TSS = Total Symptom Score.

FIGURE 1 KCCQ and SAQ7 Scores
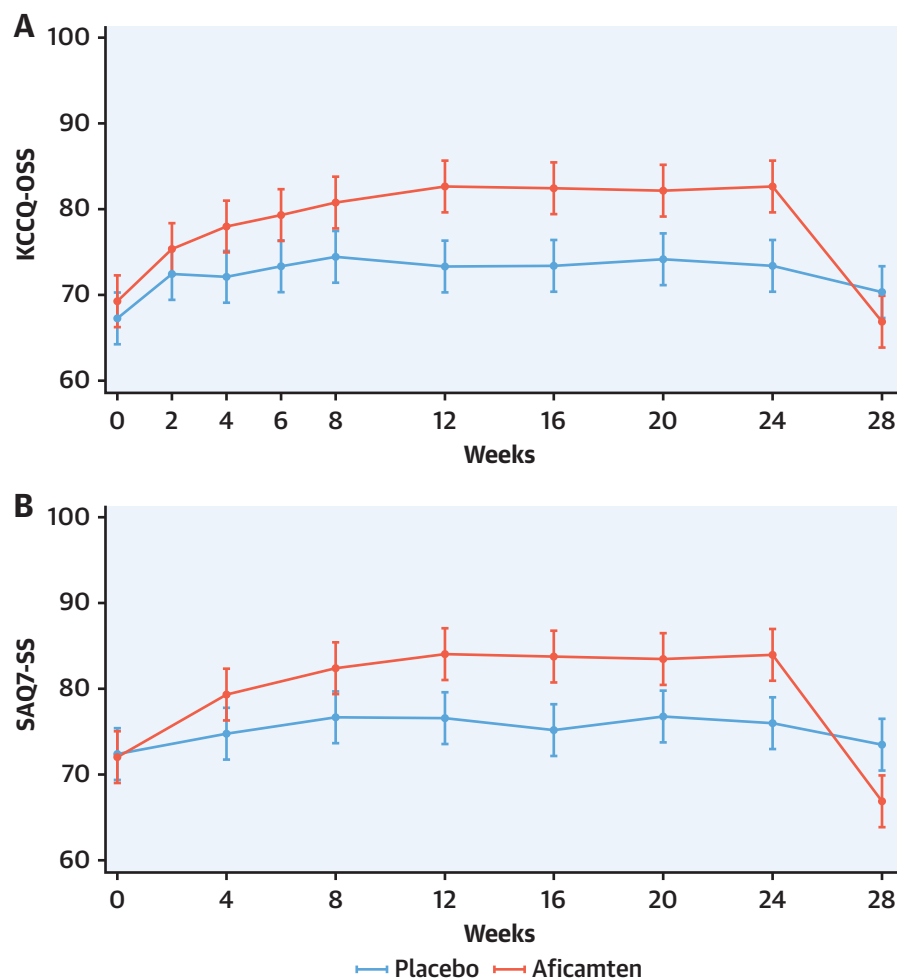
Mean Kansas City Cardiomyopathy Questionnaire—Overall Summary Score (KCCQ-OSS) (A) and Seattle Angina Questionnaire 7-item—Summary Score (SAQ7-SS) (B) are shown from baseline until study completion. Titration occurred between week 0 and week 6. Drug discontinuation occurred at week 24 and washed-out by week 28.

CENTRAL ILLUSTRATION Effect of Aficamten on Health Status Outcomes in Obstructive Hypertrophic Cardiomyopathy: Results From SEQUOIA-HCM

In the SEQUOIA-HCM trial, patients with obstructive hypertrophic cardiomyopathy on aficamten vs placebo for 24 weeks were more likely to have:

Reduced shortness of breath

Reduced chest pain

Reduced fatigue

Very large improvements in health status: NNT <6

Mean Kansas City Cardiomyopathy Questionnaire Overall Summary Scores (KCCQ-OSS)

ΔKCCQ-OSS = 7.9 (95% CI: 4.8-11.0)
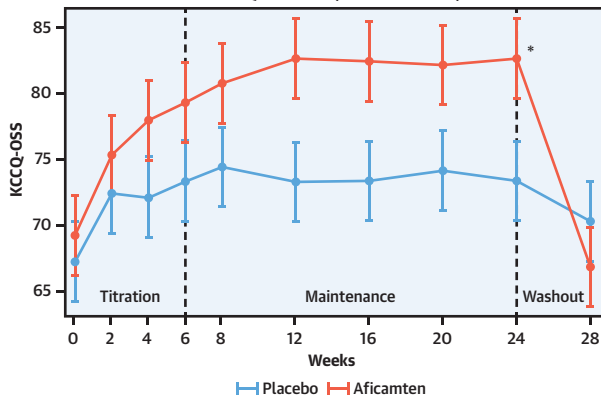
*P < 0.001 for between group difference in mean change from baseline to week 24

Distribution of Participants Changing by Clinically Important KCCQ-OSS Thresholds at 24 Weeks
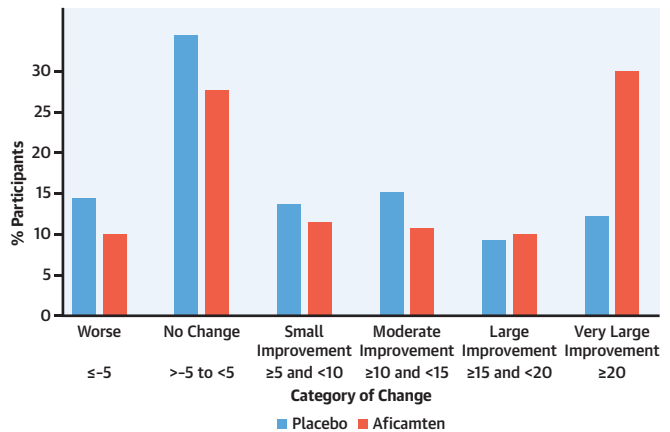
Mean Seattle Angina Questionnaire Summary Scores (SAQ7-SS)

ΔSAQ7-SS = 7.8 (95% CI: 4.7-11.0)
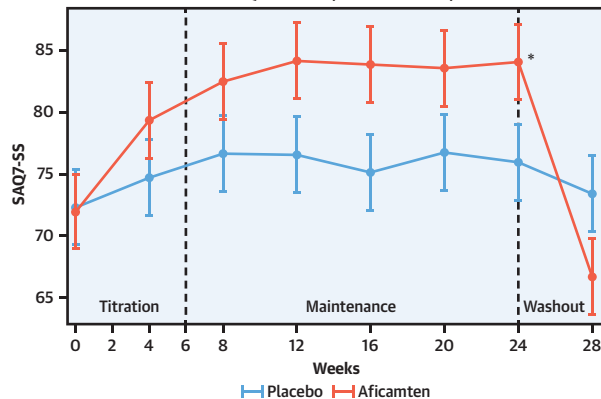
*P < 0.001 for between group difference in mean change from baseline to week 24

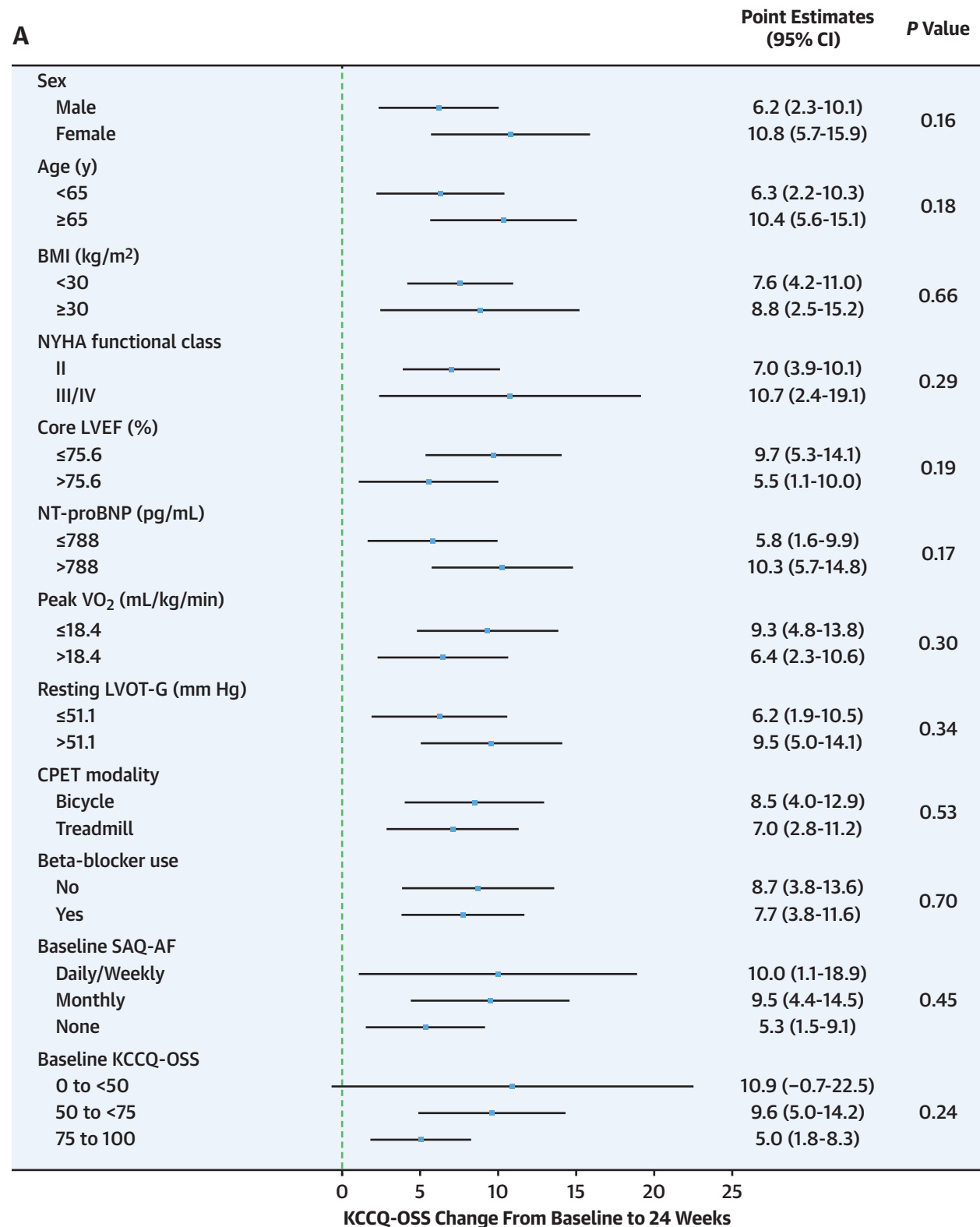Distribution of Participants Changing by Clinically Important SAQ7-SS Thresholds at 24 Weeks
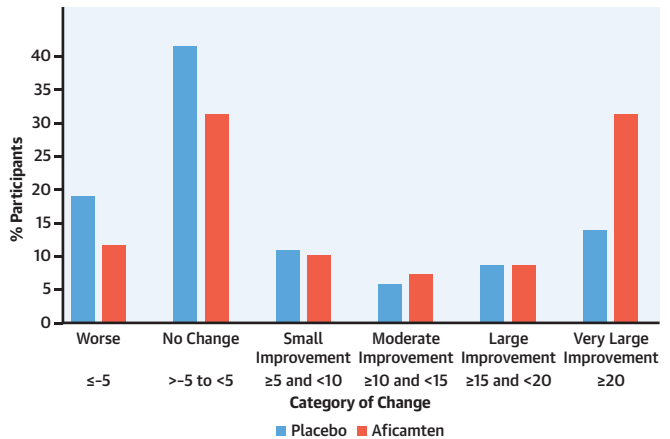
Sherrod IV, CF, et al. JACC. 2024;■(■):■–■.

Mean KCCQ-OSS and SAQ7-SS scores over time and distributions of clinically important changes. KCCQ-OSS = Kansas City Cardiomyopathy Questionnaire—Overall Summary Score; NNT = number needed to treat; SAQ7-SS = Seattle Angina Questionnaire 7-item—Summary Score; SEQUOIA-HCM = Phase 3 Trial to Evaluate the Efficacy and Safety of Aficamten Compared to Placebo in Adults With Symptomatic oHCM.

FIGURE 2   KCCQ and SAQ Responder Analyses

A   KCCQ-OSS Responder Analysis - 24 Weeks

B   SAQ-SS Responder Analysis - 24 Weeks
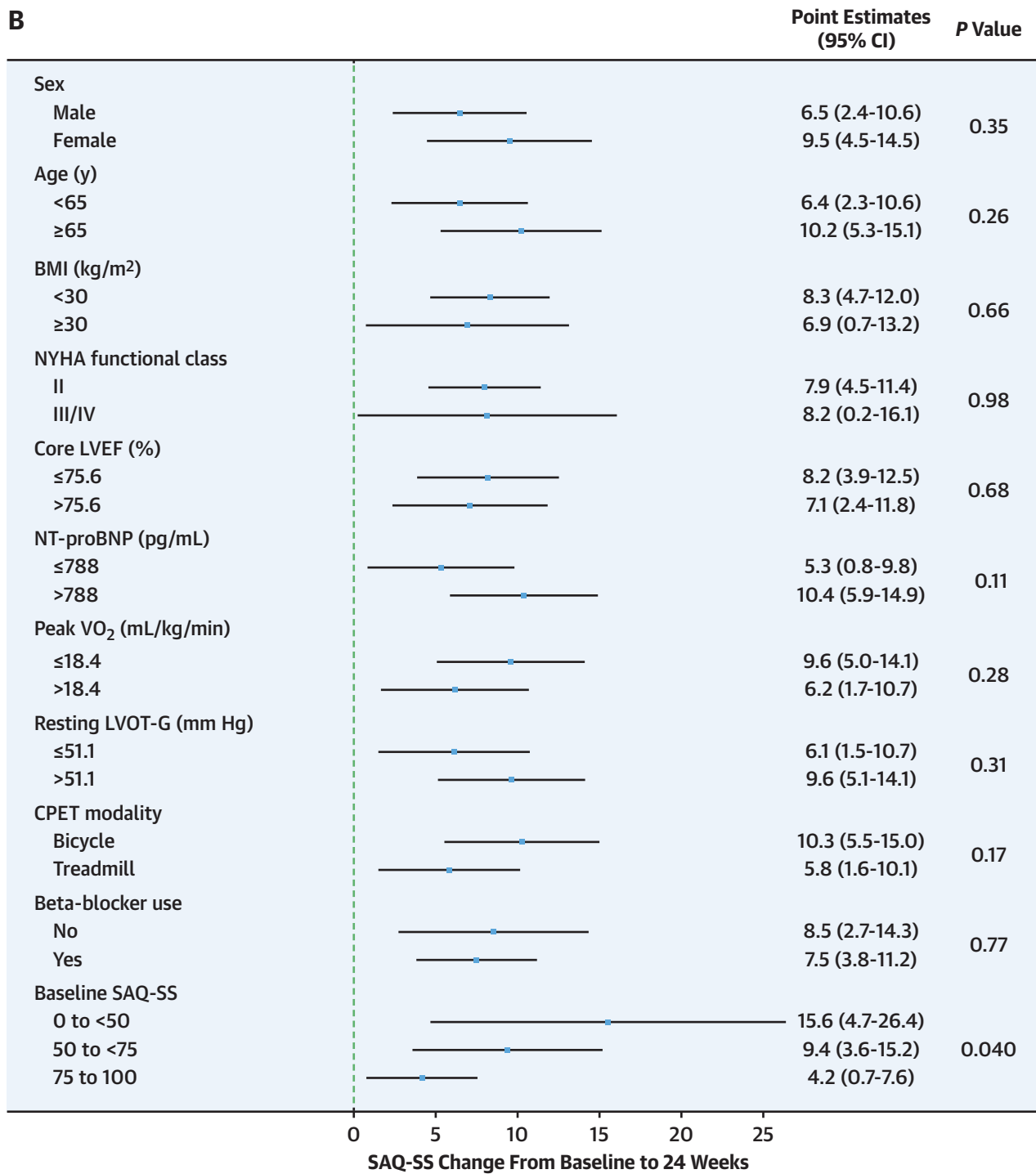
■ Placebo   ■ Aficamten
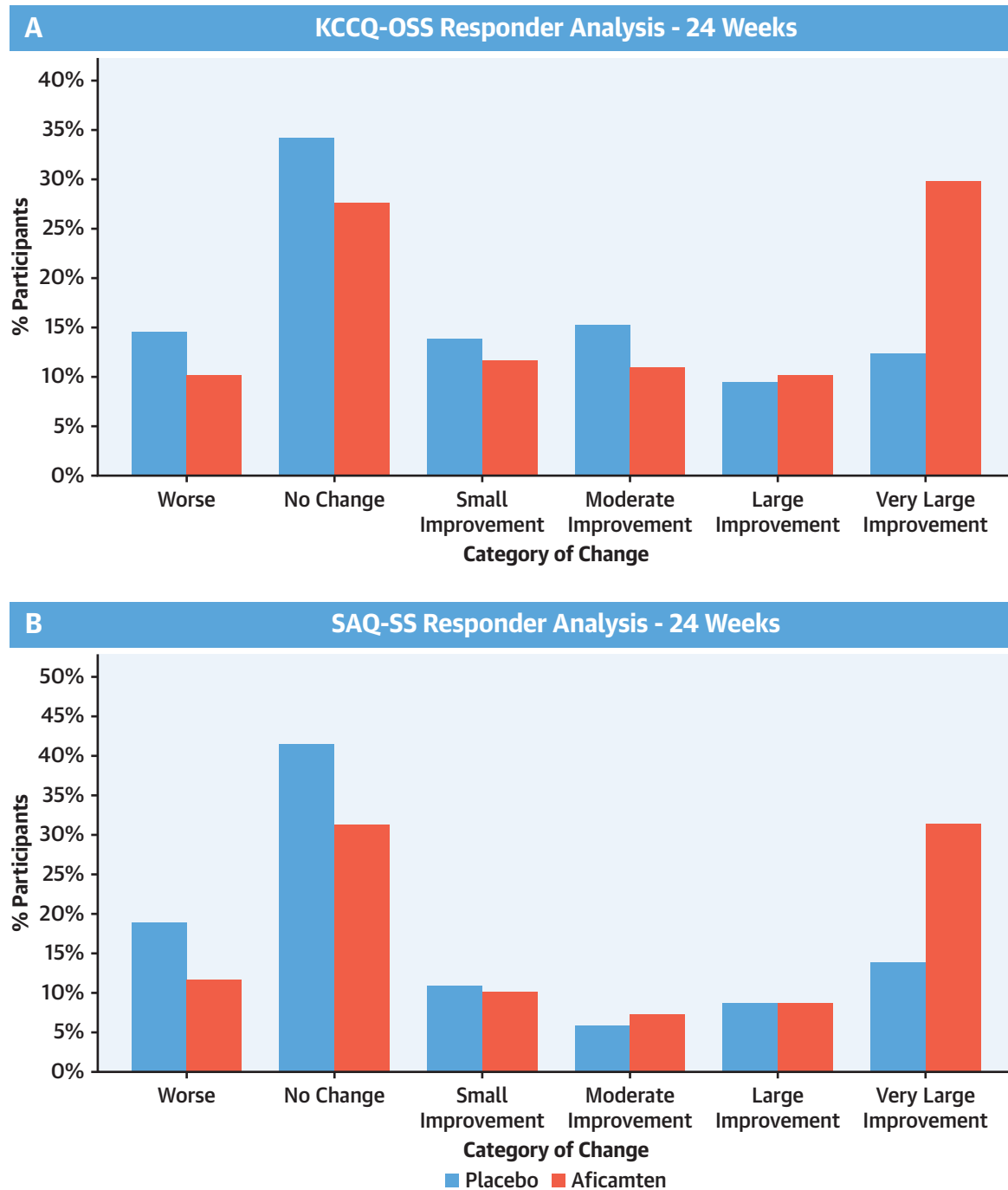
Proportions of clinically meaningful changes are described from baseline to week 24 for KCCQ-OSS (A) and SAQ7-SS (B). Changes in participants' health status were categorized as deteriorated (≤ −5), no clinically important change (> −5 to <5), small to moderate improvement (≥5 and <10), moderate to large improvement (≥10 and <15), large improvement (≥15 to <20), or very large improvement (≥20). Abbreviations as in Figure 1.

FIGURE 3 KCCQ and SAQ Subgroup Analyses

A	Point Estimates (95% CI)	P Value
Sex		
Male	6.2 (2.3-10.1)	0.16
Female	10.8 (5.7-15.9)	
Age (y)		
<65	6.3 (2.2-10.3)	0.18
≥65	10.4 (5.6-15.1)	
BMI (kg/m^2)		
<30	7.6 (4.2-11.0)	0.66
≥30	8.8 (2.5-15.2)	
NYHA functional class		
II	7.0 (3.9-10.1)	0.29
III/IV	10.7 (2.4-19.1)	
Core LVEF (%)		
≤75.6	9.7 (5.3-14.1)	0.19
>75.6	5.5 (1.1-10.0)	
NT-proBNP (pg/mL)		
≤788	5.8 (1.6-9.9)	0.17
>788	10.3 (5.7-14.8)	
Peak VO$_2$ (mL/kg/min)		
≤18.4	9.3 (4.8-13.8)	0.30
>18.4	6.4 (2.3-10.6)	
Resting LVOT-G (mm Hg)		
≤51.1	6.2 (1.9-10.5)	0.34
>51.1	9.5 (5.0-14.1)	
CPET modality		
Bicycle	8.5 (4.0-12.9)	0.53
Treadmill	7.0 (2.8-11.2)	
Beta-blocker use		
No	8.7 (3.8-13.6)	0.70
Yes	7.7 (3.8-11.6)	
Baseline SAQ-AF		
Daily/Weekly	10.0 (1.1-18.9)	
Monthly	9.5 (4.4-14.5)	0.45
None	5.3 (1.5-9.1)	
Baseline KCCQ-OSS		
0 to <50	10.9 (−0.7-22.5)	
50 to <75	9.6 (5.0-14.2)	0.24
75 to 100	5.0 (1.8-8.3)	

KCCQ-OSS Change From Baseline to 24 Weeks

Interactions by participants' characteristics are depicted for the KCCQ-OSS (A) and SAQ7-SS (B). AF = Angina Frequency Score; BMI = body mass index; CPET= cardiopulmonary exercise test; LVEF = left ventricular ejection fraction; LVOT-G = left ventricular outflow tract gradient; NT-proBNP = N-terminal pro-B-type natriuretic peptide; Abbreviations as in **Figure 1**.

FIGURE 3 Continued

B

	Point Estimates (95% CI)	P Value
Sex		
Male	6.5 (2.4-10.6)	0.35
Female	9.5 (4.5-14.5)	
Age (y)		
<65	6.4 (2.3-10.6)	0.26
≥65	10.2 (5.3-15.1)	
BMI (kg/m²)		
<30	8.3 (4.7-12.0)	0.66
≥30	6.9 (0.7-13.2)	
NYHA functional class		
II	7.9 (4.5-11.4)	0.98
III/IV	8.2 (0.2-16.1)	
Core LVEF (%)		
≤75.6	8.2 (3.9-12.5)	0.68
>75.6	7.1 (2.4-11.8)	
NT-proBNP (pg/mL)		
≤788	5.3 (0.8-9.8)	0.11
>788	10.4 (5.9-14.9)	
Peak VO₂ (mL/kg/min)		
≤18.4	9.6 (5.0-14.1)	0.28
>18.4	6.2 (1.7-10.7)	
Resting LVOT-G (mm Hg)		
≤51.1	6.1 (1.5-10.7)	0.31
>51.1	9.6 (5.1-14.1)	
CPET modality		
Bicycle	10.3 (5.5-15.0)	0.17
Treadmill	5.8 (1.6-10.1)	
Beta-blocker use		
No	8.5 (2.7-14.3)	0.77
Yes	7.5 (3.8-11.2)	
Baseline SAQ-SS		
0 to <50	15.6 (4.7-26.4)	
50 to <75	9.4 (3.6-15.2)	0.040
75 to 100	4.2 (0.7-7.6)	

SAQ-SS Change From Baseline to 24 Weeks

(ie, LVEF and LVOT-G at rest), exercise capacity (ie, peak VO₂), N-terminal pro-B-type natriuretic peptide levels, randomization strata (beta-blocker use at baseline, cardiopulmonary exercise test modality), or baseline KCCQ-OSS (all $P_{interaction} > 0.05$). Further, the baseline frequency of chest pain did not appear to affect KCCQ benefit. However, there was a signal that those with poor to fair overall angina-related health

status (SAQ7-SS <50) attained greater benefit from aficamten (greater change with aficamten in SAQ7-SS = 15.6 points; 95% CI: 4.7-26.4) than those with good to excellent baseline angina-related health status (SAQ7-SS = 75-100; $P_{interaction}$ = 0.04), although the latter still benefited from treatment (SAQ7-SS improvement with aficamten = 4.2; 95% CI: 0.7-7.6).

DISCUSSION

A primary goal of oHCM treatment is to improve patients' health status. Therefore, understanding the impact of new treatments on symptoms, function, and quality of life from patients' perspectives is essential. This prespecified analysis of the SEQUOIA-HCM trial provides the first comprehensive description of the health status benefits of aficamten, along with insights into the clinical magnitude of these improvements from patients' perspectives, as measured by the KCCQ-OSS and SAQ7-SS. This occurred as early as week 2 with consistent and sustained benefit through 24 weeks of therapy. These improvements were similar across clinical subgroups, with little evidence of heterogeneity in treatment effect. The observed population-level mean treatment effects were driven by a substantially greater proportion of aficamten-treated patients obtaining very large (≥20 points) clinical benefits from myosin inhibition after 24 weeks of therapy. The NNT for 1 patient to obtain this very large improvement in their health status (≥20 points) for both the KCCQ and SAQ7 was between 5 and 6. Further confirming the direct causal effect of aficamten, these health status benefits rapidly dissipated after treatment was stopped. Collectively, these data provide compelling support for aficamten significantly improving the health status of patients with symptomatic oHCM.

These findings support and substantially extend the current published data for oHCM treatment. Although traditional oHCM studies have focused on physiological outcomes, such as exercise capacity and imaging parameters (eg, LVOT-G), these may not reflect patients' lived experiences because patients rarely exert themselves to the limit of their capacity and do not "feel" their anatomy or physiology. This highlights the importance of understanding disease severity from patients' perspectives using patient-reported outcomes. Historically, medical approaches to treating oHCM have been limited to negative inotropic drugs, including beta-blockers, calcium-channel blockers, or disopyramide, where symptoms have generally been quantified from clinicians' rather than patients' perspectives.[22,23] Among these only metoprolol has described a mean greater improvement in the KCCQ-OSS by 2.4 points after 2 weeks of treatment.[24] While septal reduction therapy has been an effective treatment option at high-volume centers,[25,26] only 1 uncontrolled, observational study evaluated its efficacy on the KCCQ.[27,28] The introduction of mavacamten, a first-generation cardiac myosin inhibitor, demonstrated marked improvements in the KCCQ, similar to that observed with aficamten in SEQUIOA-HCM, but suffered from substantially more missing data than in the current study.[29] Moreover, SEQUOIA-HCM also assessed chest pain from patients' perspectives using the SAQ7, which has never been previously described, to our knowledge. Finally, this study extends the original report from SEQUOIA-HCM[10] by providing a more complete assessment of participants' health status, along with the distributions of patient-level change.

The unique insights from the SEQUIOA-HCM trial on chest pain symptoms are important since prior studies have not assessed the effect of treatment on these symptoms. Chest pain is common in oHCM, and potential explanations for aficamten's efficacy in relieving chest pain may be due to improving blood flow in distal epicardial vessels and myocardial microcirculation through attenuation of hypercontractility, reduced wall stress, and oxygen demand due to relief of obstruction or direct aficamten effect on myosin adenosine triphosphatase activity.[2,3] Regardless of the mechanism, because chest pain is an important symptom in those with oHCM,[4] these data provide important insights into the health status benefits of aficamten.

Interpreting the clinical significance of new therapies can be challenging, particularly for anatomical or physiological measures of disease severity. In contrast, patient-reported outcomes, such as the KCCQ and SAQ7, are direct measures of the impact of treatment from patients' perspectives. Nevertheless, focusing on mean treatment differences between groups requires interpreting those mean differences from patients' perspectives by examining the distribution of clinically important changes between groups.[12] The KCCQ categories of intraindividual changes used to reflect clinical significance have been well established in the scientific literature, including among patients with oHCM.[13,17] In this trial, the mean treatment benefits with aficamten were primarily driven by a much greater proportion of patients having very large clinical changes in their health status. When compared with prior work in other cardiomyopathies, aficamten improves population-level scores more similarly to invasive valvular interventions than to traditional pharmacologic therapies.[30,31] Very large improvements (≥20 points) have

an NNT between 5 and 6 for 1 patient to benefit for mitral transcatheter repair and aficamten,[32] whereas with sodium glucose co-transporter 2 inhibitors in the treatment of heart failure (independent of EF), the NNT for very large benefits is between 13 and 14.[33] When looked at collectively, the impact of aficamten on health status is among the most effective pharmacologic therapies across the spectrum of cardiomyopathies.

Several aspects of the SEQUOIA-HCM study design are worth highlighting to guide future implementation of aficamten when treating oHCM. First, this is the largest and most complete study evaluating the effect of cardiac myosin inhibitors on patient-reported health status with very high data completion, supporting the veracity and generalizability of the findings to patients meeting the inclusion and exclusion criteria of SEQUOIA-HCM. Second, although patients with refractory oHCM often needed referral to the few specialty centers that could offer septal reduction therapy, the availability of an effective medical option may enable broader access to treatment that can potentially reduce disparities in care, particularly among rural and socially disadvantaged populations with less access to specialized centers of excellence.[34-36] Third, dosing adjustments were based on site-interpreted, rather than core lab-interpreted, echocardiograms; that is much more practical in routine clinical practice. Finally, not only do the data from this study provide important patient-centered insights to the benefits of treatment, they also highlight the rapidity of benefit and reversal with drug discontinuation, which could potentially enhance treatment adherence, particularly if patient-reported outcomes measures are used to help monitor patients' response to treatment in routine clinical care.

STUDY LIMITATIONS. The SEQUOIA-HCM study extended the insights of aficamten's health status benefits by capturing the chest pain-associated health status impact of oHCM by using the SAQ7 to supplement the KCCQ. However, other patient symptoms, such as lightheadedness and palpitations, were not directly measured. However, prior validation work for the KCCQ suggests a strong association between its domains and these disease manifestations, suggesting that few patients solely have symptoms not captured by the KCCQ.[13] Unlike the KCCQ, where prior work has clarified the clinical importance of individual patients' changes in scores, these data are not available for the SAQ7. Additional analyses are needed to validate the SAQ7 in oHCM and define clinically important thresholds of change.

Further, it is unknown whether aficamten is as effective in pediatric patients or in adult patients without obstruction or those with only exercise-induced obstruction. Ongoing studies in these populations, including ACACIA-HCM (Phase 3 Trial to Evaluate the Efficacy and Safety of Aficamten Compared to Placebo in Adults With Symptomatic nHCM; NCT06081894) and CEDAR-HCM (Clinical Evaluation of Dosing with Aficamten to Reduce Obstruction in a Pediatric Population in HCM), will provide much needed additional data to guide treatment. Lastly, the duration of SEQUOIA-HCM was relatively short, and longer-term studies are needed to better understand whether these health status benefits are sustained, is currently being undertaken with the ongoing FOREST-HCM (Open-label Extension Study to Evaluate the Long-term Safety and Tolerability of Aficamten in Adults; NCT04848506) study.

CONCLUSIONS

In the SEQUOIA-HCM trial, patients with symptomatic oHCM experienced substantial health status benefits, as compared with placebo, early after initiation of aficamten and throughout 24 weeks of therapy, which was consistent across numerous subgroups, including severity of LVOT-G and background oHCM therapy. These benefits, as quantified by KCCQ and SAQ7, were primarily driven by a substantially greater proportion of aficamten-treated patients experiencing very large improvements in their health status, including relief of limiting chest pain, with an estimated NNT of ∼6. Further supporting the direct benefits of aficamten on participant's health status, these benefits were reversed shortly after drug withdrawal. Collectively, these insights provide strong support that aficamten may be an effective treatment option in patients with oHCM to improve their symptoms, function, and quality of life.

ADDRESS FOR CORRESPONDENCE: Dr Charles Fox Sherrod IV, Saint Luke's Mid America Heart Institute, 9th Floor CV Research, 4401 Wornall Road, Kansas City, Missouri 64111, USA. E-mail: csherrod@saint-lukes.org.

PERSPECTIVES

COMPETENCIES IN MEDICAL KNOWLEDGE: Aficamten, a next-in-class cardiac myosin inhibitor, has been shown to improve exercise capacity in oHCM. Given the centrality of patients' health status in the management of oHCM, comprehensively understanding the impact of aficamten on patient-reported health status is essential to support its use. In our analysis of the SEQUOIA-HCM trial, we identified clinically important improvements in patients' symptoms, function, and quality of life in those treated with aficamten, benefits that were lost shortly after drug discontinuation.

TRANSLATIONAL OUTLOOK: Because aficamten markedly improved patient-reported health status in oHCM, there is a need to understand how best to identify patients with symptomatic oHCM, where cardiac myosin inhibitors should be considered to improve their health status. These data can support shared decision-making when patients consider alternative treatment options.

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APPENDIX For supplemental tables, please see the online version of this paper.