UNIVERSITY OF CALIFORNIA SAN DIEGO

SAN DIEGO STATE UNIVERSITY

The Associations of Patient Activation and Self-Management with Diabetes Clinical Control in Diverse Primary Care Patients

A dissertation submitted in partial satisfaction of the
requirements for the degree Doctor of Philosophy

in

Clinical Psychology

by

Julia I. Bravin

Committee in charge:

San Diego State University

Professor Linda C. Gallo, Chair
Professor Scott Roesch
Professor Kristen J. Wells

University of California San Diego

Professor Niloofar Afari
Professor Thomas Rutledge

2021

The dissertation of Julia I. Bravin is approved and it is acceptable in quality and form for publication on microfilm and electronically.

Chair

University of California San Diego

San Diego State University

2021

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ACKNOWLEDGEMENTS

I would like to first thank my graduate advisor, Dr. Linda C. Gallo, for her invaluable support and mentorship over the past few years—it has been a privilege and an honor to learn from you. I would also like to express appreciation to the members of my committee, Drs. Scott Roesch, Kristen Wells, Thomas Rutledge, and Niloofar Afari, for helpful guidance in developing, implementing, and finalizing this project. I would like to thank all the participants, research staff, and my fellow lab members for helping make the MAC trial and this dissertation project possible. Thank you to my JDP cohort and numerous colleagues, who have all taught me how to be a better researcher, clinician, and person. Thank you to my incredible graduate school "sisters"—I am forever grateful for your laughter, encouragement, and support. No matter where life takes us, you will always be in my heart and mind. Last but not least, I want to thank my parents—my dad who taught me to stand tall and work hard at the things I care about and my mom who reminds me there is magic in each of us. I would not be who I am without your collective wisdom and I would not be here without your unconditional love.

FUNDING. The Medical Assistant Health Coaching for Diabetes in Diverse Primary Care Settings trial was carried out with funding provided by the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) of the National Institutes of Health (NIH; R18 DK104250-5, Gallo/Philis-Tsimikas). Support for the current study was obtained via a National Institute of General Medical Science's Supplement to Promote Diversity in Health-Related Research to Parent Grant: Medical Assistant Health Coaching for Diabetes in Diverse Primary Care Settings (3R18DK104250-04S1: Gallo/Philis-Tsimikas) provided by NIDDK/NIH.

VITA

EDUCATION

2020 – present **VA Puget Sound Healthcare System, Seattle Division,** Seattle, WA
Clinical Psychology Doctoral Internship (APA Accredited)
Training Director: Steve McCutcheon, Ph.D.

2015 – 2021 **San Diego State University/University of California San Diego Joint Doctoral Program in Clinical Psychology,** San Diego, CA
Major Area of Study: Behavioral Medicine
Ph.D., Clinical Psychology (expected September 2021)
Dissertation: "The associations of patient activation and self-management with diabetes clinical control in diverse primary care patients"
Dissertation defense date: April 2021
Chair: Linda Gallo, Ph.D.

2014 – 2016 **San Diego State University,** San Diego, CA
M.S. in Clinical Psychology, May 2018
Thesis: "Extra-familial social factors and obesity in the Hispanic Community Health Study/Study of Latino Youth"
Chair: Linda Gallo, Ph.D.

2007 – 2011 **Haverford College,** Haverford, PA
B.A. in Psychology, May 2010
Honors Thesis: "Intergenerational conflict and bicultural identity development in emerging adults"
Advisor: Jennifer Pals-Lilgendahl, Ph.D.

HONORS AND AWARDS

2018 – 2020 **NIH Supplement to Promote Diversity in Health-Related Research to Parent Grant: Medical Assistant Health Coaching for Diabetes in Diverse Primary Care Settings (3R18DK104250-04S1: Philis-Tsimikas & Gallo)**

Training grant aimed at facilitating the recruitment and training of promising scientists from backgrounds underrepresented in the biomedical research workforce. Award used to fund professional development including, health coaching and diabetes care training, scientific conference attendance, and dissertation research (exploring associations of patient activation and diabetes clinical control among primary care patients).

2017 – 2018 **The San Diego State University Graduate Research Fellowship**

Competitive one-year fellowship awarded to excellent Ph.D. graduate students engaged in scholarship advancing the university's goals for research and creative activity. Funding used to support research activities and manuscript publication.

CLINICAL EXPERIENCE

Doctoral Intern

2020 – present **Pain Clinic**
VA Puget Sound Healthcare System, Seattle, WA
Supervisors: Jessica Chen, Ph.D., Jennifer DelVentura, Ph.D., ABPP, Kaitlin Harding, Ph.D., Laura Tuck, Psy.D.

Conducted comprehensive biopsychosocial intake assessments, ongoing case management, and individual/group format evidence-based therapies for chronic pain patients [unified protocol, cognitive behavioral therapy for chronic pain (CBT-CP), acceptance and commitment therapy for chronic pain (ACT-CP), mindfulness-based therapy, self-hypnosis training].

PTSD Outpatient Clinic
VA Puget Sound Healthcare System, Seattle, WA
Supervisors: Jane Luterek Ph.D., Scott Michael, Ph.D.

Provide Veterans assessment and individual/ group format evidence-based therapies (e.g., prolonged exposure, cognitive processing therapy) to treat post-traumatic stress disorder and comorbidities in an outpatient setting.

Mental Health Clinic (planned)
VA Puget Sound Healthcare System, Seattle, WA
Supervisors: Mark Engstrom, Ph.D., Aaron Norr, Ph.D.

Will provide Veterans assessment and individual/ group format evidence-based therapies to Veterans presenting with a wide range concerns (e.g., depression, anxiety, insomnia, trauma, pain, and comorbid medical conditions) in an outpatient context.

Practicum Student

2019 – 2020 **UC San Diego Regional Burn Center**

UC San Diego Medical Center Hillcrest, San Diego, CA
Supervisor: Arpi Minassian, Ph.D.

As part of a multidisciplinary team, conducted rapid psychological/psychiatric evaluation and provided brief evidence-based interventions (e.g., relaxation and mindfulness techniques, sleep hygiene psychoeducation, motivational interviewing for substance use) in English and Spanish to burn patients in a fast-paced trauma care environment.

2018 – 2019 **VA Behavioral Health Integration Program (BHIP) Clinic**
VA San Diego Healthcare System, San Diego, CA
Supervisor: Julie Kangas, Ph.D.

Provided comprehensive intakes and individual/group psychotherapy (ACT, CBT, CBT for insomnia, motivational interviewing) to Veterans presenting varied concerns (e.g., depression, anxiety, insomnia, trauma, pain, and comorbid medical conditions).

2017 – 2018 **VA Weight Control Clinic/Diabetes Management/Chronic Pain**
VA San Diego Healthcare System, San Diego, CA
Supervisor: Thomas Rutledge, Ph.D., ABPP

Provided individual/group format evidence-based psychotherapy (motivational interviewing and CBT) for weight loss and emotional eating; completed comprehensive evaluations for bariatric surgery and candidates for implantable devices (spinal column stimulators, pain pumps).

2016 – 2017 **Psychology Clinic**
San Diego State University, San Diego, CA
Supervisors: Ariel Lang, Ph.D., Kristen J. Wells, Ph.D., MPH

Provided assessment and evidence-based psychotherapy (predominantly CBT) to address mood and adjustment disorders in an outpatient community mental health clinic; Conducted psycho-educational and neuropsychological testing for persons with learning disabilities and/or ADHD.

<u>Inpatient Psychiatry Volunteer</u>

2012 – 2015 **Zuckerberg San Francisco General Hospital Psychiatric Inpatient Unit**
Zuckerberg San Francisco General Hospital, San Francisco, CA
Supervisors: Emily Lee, MD; Eddie Ong, Ph.D.

As part of a multidisciplinary team, conducted brief psychological evaluations of mental status, mood, and cognition of inpatients hospitalized for acute mood and behavioral disturbances (e.g., psychosis, substance

abuse, suicidality) in San Francisco's only Level 1 Trauma Center and a public safety net hospital.

TEACHING & INVITED LECTURES

2019 **Workshop Organizer and Instructor**
South Bay Latino Research Center, Chula Vista, CA
Presentation title: "Diabetes Basics"

Trained community workers and research assistants on the pathophysiology and behavioral/ pharmacological treatment approaches to Type 2 diabetes for an NIH-funded care transitions trial (Mi Puente; R01NR015754-01).

2017, 2018, 2019 **Workshop Organizer and Instructor**
South Bay Latino Research Center, Chula Vista, CA
Presentation title: "Introduction to motivational interviewing"

Trained paraprofessional intervention staff in motivational interviewing to promote health behavior change and chronic disease management skills among patients enrolled in an NIH-funded care transitions trial (Mi Puente; R01NR015754-01); Provided training in English and Spanish.

2017, 2018, 2019 **Workshop Organizer and Instructor**
South Bay Latino Research Center, Chula Vista, CA
Workshop titles: "Preparing to apply to psychology Ph.D. programs"; "Dos and Don'ts after you have applied"; "Attending a research conference"; "Introduction to SPSS"

Organized and co-led a didactic and workshop series to enhance the training and professional development of junior research staff members of the South Bay Latino Research Center.

2016 **Invited Presenter**
Scripps Whittier Diabetes Institute, San Diego, CA
Presentation title: "Cultural beliefs in diabetes"

Provided training in the common cultural beliefs surrounding the etiology and treatment of Type 2 diabetes among Hispanics/Latinx to paraprofessional health coaches serving as interventionists in an NIH-funded health coaching intervention trial (MAC; R18DK104250-01A1).

2014 **Invited Presenter**
Twilio, San Francisco, CA

Presentation title: "Mobile technologies to improve mental health interventions"

Presented to employees at a communications technology company an overview of our lab's research exploring the application of mobile technologies to enhance health behavior interventions.

2012 **Invited Lecturer**
Clinical Psychology Doctoral Program, Palo Alto University, Palo Alto, CA
Presentation title: "Online intervention builders: How to design a study in Qualtrics"

Provided a lecture series on the basics of project development using the online survey platform, Qualtrics, to doctoral students enrolled in the CLIN823: Evidence-Based Internet Interventions.

RESEARCH AND PROFESSIONAL EXPERIENCE

2020 – present **Clinical Psychology Intern**
VA Puget Sound Healthcare System, Seattle, WA
Supervisors: Jennifer DelVentura, Ph.D., ABPP

Assisting in program development and evaluation of a nutrition, inflammation, and pain psychoeducational course for Veterans seen through the Pain Clinic.

2015 – present **Doctoral Student Researcher**
South Bay Latino Research Center
SDSU/UC San Diego Joint Doctoral Program in Clinical Psychology, San Diego, CA
Mentor: Linda Gallo, Ph.D.

Assist in various NIH-funded intervention studies focused on addressing health disparities in Latinx populations. Duties include recruiting Latinx patients hospitalized with chronic conditions into a care transition program; Assisting in clinical protocol and program development, evaluating treatment fidelity, focus group administration, staff training, and IRB protocol submissions; Conducting data analyses and research manuscript development as an affiliate investigator for the Hispanic Community Health Study/Study of Latinos (HCHS/SOL) (HCHS/SOL; HHSN2682013000051).

2013 – 2015 **Staff Research Associate**
Berkeley School of Social Welfare
University of California, Berkeley, Berkeley, CA
Supervisor: Adrian Aguilera, Ph.D.

Conducted usability testing and assisted with IRB preparation and data management for an NIH-funded trial testing a text-messaging intervention for Latinx patients with depression (MoodText; NIH R01MH084757); Co-led Spanish-language CBT groups, administered brief psychological assessment, and trained junior research assistants.

2012 – 2015 **Staff Research Associate**
Institute for International Internet Interventions for Health
Palo Alto University, Palo Alto, CA
Supervisor: Ricardo F. Muñoz, Ph.D.

Managed databases for an Internet-based smoking cessation trial; Evaluated and trained junior research staff on digital platform and usability testing methodology.

2012 – 2013 **Research Assistant**
Latino Mental Health Research Project
University of California, San Francisco, San Francisco, CA
Supervisor: Ricardo F. Muñoz, Ph.D.

Assisted with preparation of grant proposal and protocol development; Assisted with manuscript review, preparation, and submission.

2009 – 2010 **Undergraduate Research Assistant**
Laboratory in Personality Psychology
Department of Psychology, Haverford College, Haverford, PA
Supervisor: Jennifer Pals-Lilgendahl, Ph.D.

Designed and conducted original research regarding the role of intergenerational conflict in bicultural identity formation.

PEER-REVIEWED PUBLICATIONS

1. Savin, K. L., Patel, S. R., Clark, T. L., **Bravin, J. I.**, Roesch, S. C., Sotres-Alvarez, D., Mossavar-Rahmani, Y., Evenson, K. R., Daviglus, M., Ramos, A. R., Zee, P. C., Gellman, M. D., Gallo, L. C. (2020). Relationships of sleep duration and variability with physical and sedentary activity in the Hispanic Community Health Study/Study of Latinos Sueño Ancillary Study. *Behavioral Sleep Medicine*. doi: 10.1080/15402002.2020.1820335. Epub ahead of print.

2. Fortmann A. L., Philis-Tsimikas, A., Euyoque, J. A., Clark, T. L., Vital, D., Sandoval, H., **Bravin, J. I.,** Savin, K. L., Jones, J. A., Roesch, S., Gilmer, T., Bodenheimer, T., Schultz J., Gallo L. C. (2020). Medical Assistant Health Coaching ("MAC") for Type 2 Diabetes in Diverse Primary Care Settings: A Pragmatic, Cluster-Randomized Controlled Trial. *Contemporary Clinical Trials.* doi:10.1016/j.cct.2020.106164. Epub ahead of print.

3. **Bravin, J. I.,*** Carrasco, J.,* Kalichman, M. (2020). Ethical foundations for graduate students in the psychological sciences. *Translational Issues in Psychological Science, 6*(3), 247–256. https://doi.org/10.1037/tps0000269

4. Gallo, L. C., Fortmann, A. L., **Bravin, J. I.,** Clark, T. L., Savin, K. L., Ledesma, D. L., Euyoque, J. A., Sandoval, H., Roesch, S. C., Gilmer, T., Talavera, G. A., & Philis-Tsimikas, A. (2020). My Bridge (Mi Puente) to Better Cardiometabolic Health and Well Being– A Care Transitions Intervention for Hispanics/Latinos with Multiple Chronic Conditions and Behavioral Health Concerns: Protocol for a Randomized Controlled Trial. *Trials*, *21*, 174. doi:10.1186/s13063-019-3722-8

5. McCurley, J. L., Gutierrez, A. P., **Bravin, J. I.,** Schneiderman, N., Reina, S. A., Khambaty, T., Castañeda, S. F., Smoller, S., Daviglus, M., O'Brien, M. J., Carnethon, M. R., Isasi, C. R., Perreira, K., Talavera, G. A., Yang, M., & Gallo, L. C. (2019). Association of Social Adversity with Comorbid Diabetes and Depression Symptoms in the Hispanic Community Health Study/Study of Latinos Sociocultural Ancillary Study: A Syndemic Framework. *Annals of Behavioral Medicine*. doi: 10.1093/abm/kaz009

6. Slopen, N., Strizich, G., Hua, S., Gallo, L. C., Chae, D. H., Priest, N., Gurka, M. J., Bangdiwala, S. I., **Bravin, J. I.**, Chambers, E. C., Daviglus, M. L., Llabre, M. M., Carnethon, M. R., & Isasi, C. R. (2019). Maternal experiences of ethnic discrimination and child cardiometabolic outcomes in the Study of Latino (SOL) Youth. *Annals of Epidemiology*, *34*, 52-57. https://doi.org/10.1016/j.annepidem.2019.03.011

7. Gallo, L. C., Roesch, S. C., **Bravin, J. I.**, Savin, K. L., Perreira, K., Carnethon, M. R., Delamater, A. M., Salazar, C. R., Lopez-Gurrola, M., & Isasi, C. R. (2019). Socioeconomic Adversity, Social Resources, and Allostatic Load Among Hispanic/Latino Youth: The Study of Latino Youth. *Psychosomatic Medicine*, *81*, 305-312. doi: 10.1097/PSY.0000000000000668

8. **Bravin, J. I.**, Gutierrez, A. P., McCurley, J. L., Roesch, S. C., Isasi, C. R., Delamater, A. M., Perreira, K., Van Horn, L., Castañeda, S. F., Pulgaron, E. R., Talavera, G. A., Daviglus, M., Lopez-Class, M., Zeng, D., & Gallo, L. C. (2019). Extra-familial social factors and obesity in the Hispanic Community Health Study/Study of Latinos Youth. *Journal of Behavioral Medicine*, *52*, S583-S696. doi:10.1007/s10865-019-00022-7

9. Potochnick, S. R., Perreira, K., **Bravin, J. I.**, Castañeda, S. F., Daviglus, M., Gallo, L. C., Van Horn, L., Isasi, C. R., & Zeng, D. (2019). Food Insecurity Among Hispanic/Latino Youth: Who Is at Risk and What Are the Health Correlates? *Journal of Adolescent Health*, *64*, 631-639. doi: 10.1016/j.jadohealth.2018.10.302

10. Aguilera, A., Bruehlman-Senecal, E., Liu, N., & **Bravin, J. I.** (2018). Implementing group CBT for depression among Latinos in a primary care clinic. *Cognitive & Behavioral Practice, 25*, 135-144. doi: 10.1016/j.cbpra.2017.03.002.

11. Muñoz, R. F., Bunge, E. L., Chen, K., Schueller, S. M., **Bravin, J. I.**, Shaughnessy, E. A., & Pérez-Stable, E. J. (2015). Massive open online interventions: A novel model for delivering behavioral-health services worldwide. *Clinical Psychological Science*, *4*, 194-205. doi:10.1177/2167702615583840.

12. **Bravin, J. I.,** Bunge, E. L., Evare, B., Wickham, R. E., Pérez-Stable, E. J., & Muñoz, R.

F. (2015). Socioeconomic predictors of smoking cessation in a worldwide online smoking cessation trial. *Internet Interventions*, *2*, 410-418. doi:10.1016/j.invent.2015.10.001.

13. Muñoz, R. F., Chen, K., Bunge, E., **Bravin, J. I.**, Shaughnessy, E. A., & Pérez-Stable, E. J. (2014). Reaching Spanish-speaking smokers online: a ten-year worldwide research program. *Revista Panamericana de Salud Pública*, *35*, 407-414. ISSN:1020-4989.

MANUSCRIPTS IN PREPARATION

1. Gutierrez, A. P., **Bravin, J. I.**, McCurley, J. L., Roesch, S. C., Gallo, L. C., Talavera, G. A., Perreira, K., Carnethon, M. R., Daviglus, M., Isasi, C. R., & Zeng, D. *Prevalence of trauma and associations with psychological distress in US Hispanics/Latinos: Results from the HCHS/SOL Sociocultural Ancillary Study.* [Manuscript in Preparation].

2. Gutierrez, A. P., **Bravin, J. I.**, Roesch, S. C., Talavera, G. A., Gallo, L. C., Isasi, C. R., Daviglus, M., Llabre, M. M., Estrella, M. L., Perreira, K., Zeng, D., Reina, S. A., & Tarraf, W. *Trauma exposure, psychological distress, and pre-clinical markers of cardiometabolic disease among Hispanics/Latinos in the HCHS/SOL Sociocultural Ancillary Study.* [Manuscript in preparation].

3. Pompano, L. M., Gallo, L. C., Talavera, G. A., McClain, A. C., **Bravin, J. I.**, Van Horn, L., Daviglus, M. L., Isasi, R. C., Perreira, K. M., Sotres-Alvarez, D., & Mattei, J. (Analyses in progress). *Associations between parental dietary intake patterns and symptoms of disordered eating and body image dissatisfaction in Hispanic/Latino Youth: Results from the HCHS/SOL Youth Ancillary Study*. [Manuscript in preparation].

4. Vidot, D. C., Reina, S. A., Garcia, M. L., Bandiera, F. C., Van Horn, L., Estrella, M. L., Isasi, C. R., Gallo, L. C., & **Bravin, J. I.** *Unhealthy weight loss practices, alcohol, and tobacco use among Hispanic/Latino Youth: Results from the Hispanic Community Health Study/Study of Latino Youth.* [Manuscript in preparation].

*Note: * = authors equally contributed to manuscript*

CONFERENCE PRESENTATIONS

1. Sandoval, H., **Bravin, J. I.,** Euyoque, J. A., Gallo, L. C., Clark, T., Savin, K., Preciado, J., Luu, K., Vital, D., Philis-Tsimikas, A., Fortmann, A. L. (2020, April 1-4). *A multi-method approach for identifying high-risk patients with unmet behavioral health needs in a safety-net hospital setting: Lessons learned.* [Poster accepted for presentation]. The 41st Annual Meeting of the *Society of Behavioral Medicine*, San Francisco, CA, United States. https://www.sbm.org/UserFiles/file/FinalProgram.pdf (Conference canceled)

2. Clark, T. L., Fortmann, A. L., Savin, K. L., **Bravin, J. I.**, Sandoval, H., Euyoque, J. A., Bagsic, S., Philis-Tsimikas, A., Gallo, L. C. (2020, March 11-14). *Patient perceptions of chronic illness care and HbA1c in diverse T2DM adults: A cross-sectional analysis.* [Poster accepted for presentation]. The American Psychosomatic Society Annual Meeting, Long Beach, CA, United States. https://psychosomatic.org/wp-content/uploads/2020/03/APS_ProgramBOOK_2020_REV.pdf (Conference canceled)

3. **Bravin, J. I.**, Anderson, M., Clark, T. L., Savin, K. L., Euyoque, J. A., Ledesma, D. L., Fortmann, A. L., Philis-Tsimikas, A., & Gallo, L. C. (2019, June 12-19). *Mi Puente: A care transitions intervention for at-risk Hispanics with multiple cardiometabolic conditions.* [Poster presentation]. The American Diabetes Association 79th Scientific Sessions, San Francisco, CA, United States.

4. Clark, T. L., Gallo, L., Euyoque, J. A., Savin, K. L., **Bravin, J. I.,** Sandoval, H., Ledesma, D. L., Philis-Tsimikas, A., Fortmann, A. L. (2019, June 12-19). *Tailoring of a pragmatic MA health coaching intervention for diverse T2D populations.* [Poster presentation]. The American Diabetes Association 79th Scientific Sessions, San Francisco, CA, United States.

5. Savin K. L., Patel, S. R., Clark, T. L., **Bravin, J. I.**, Roesch, S. C., Sotres-Alvarez, D., Mossavar-Rahmani, Y., Evenson, K. R., Daviglus, M., Ramos, A. R., Zee, P. C., Gellman, M. D., Gallo, L. C. (2019, March 6-9). *Relationships of sleep duration and variability with overall physical activity in the Hispanic Community Health Study/Study of Latinos Sueño Ancillary Study*. [Poster presentation]. The 77th Annual Meeting of the American Psychosomatic Society, Vancouver, British Columbia.

6. Savin K. L., Clark, T. L., **Bravin, J. I**., Gallo, L. C. (2019, March 1-2). *Relationships of sleep duration and variability with physical activity in the Hispanic Community Health Study/Study of Latinos Sueño Ancillary Study.* [Oral presentation]. The Student Research Symposium, San Diego State University, San Diego, CA, United States.

7. **Bravin, J. I.**, Gutierrez, A. P., McCurley, J. L., Roesch, S. C., Isasi, C. R., Delamater, A. M., Perreira, K., Van Horn, L., Castañeda, S. F., Pulgaron, E. R., Talavera, G. A., Daviglus, M., Lopez-Class, M., Zeng, D., Gallo, L. C. (2018, April 11-14). *Extra-familial social factors and obesity in the Hispanic Community Health Study/Study of Latinos Youth.* [Poster presentation]. The Society for Behavioral Medicine 39th Annual Meeting, New Orleans, LA, United States.

8. Savin K. L., **Bravin, J. I**., Roesch, S. C., Isasi, C. R., Perreira, K. M., Carnethon, M. R., Delamater, A. M., Salazar, C. R., Lopez-Gurrola, M. D., Gallo, L. C. (2018, April 11-14). *Socioeconomic adversity, social resources, and allostatic load: Results from the Study of Latino Youth*. [Poster presentation]. The Society for Behavioral Medicine 39th Annual Meeting, New Orleans, LA, United States.

9. Savin K. L., **Bravin, J. I**., Gallo, L. C. (2018, March 2-3). *Socioeconomic adversity, social resources, and allostatic load: Results from the Study of Latino Youth.* [Oral presentation]. The Student Research Symposium, San Diego State University, San Diego, CA, United States.

10. McCurley, J. L., Gutierrez, A. P., **Bravin, J. I.**, Schneiderman, N., Reina, S. A., Khambaty, T., Castañeda, S. F., Smoller, S., Daviglus, M., O'Brien, M. J., Carnethon, M. R., Isasi, C. R., Perreira, K., Talavera, G. A., Yang, M., Gallo, L. C. (2018, April 11-14). *Structural and psychosocial risk factors for comorbid depression and diabetes in U.S. Hispanics/Latinos from the HCHS/SOL and Sociocultural Ancillary Study: A syndemic approach.* [Oral symposium abstract presentation]. The Society for Behavioral Medicine 39th Annual Meeting, New Orleans, LA, United States.

11. Soto, A., Holland, M., Savin, K. L., **Bravin, J. I.,** Gallo, L. C., Fortmann, A. (2018, April 4). *Challenges and strategies in recruiting Hispanic/Latino inpatients in a safety-net hospital setting*. [Poster presentation]. UC San Diego Public Health Research Day, San Diego, CA, United States.

12. Muñoz, R. F., Bunge, E. L., Chen, K., Schueller, S. M., **Bravin, J. I.**, Shaughnessy, E. A. & Pérez-Stable, E. J. (2014, October 12). *A massive open online intervention for smoking cessation: Dissemination of free health resources to the world.* [Oral abstract presentation]. The 13th Annual Health Disparities Research Symposium, San Francisco, CA, United States.

13. Muñoz, R. F., Bunge, E. L., Chen, K., Schueller, S. M., **Bravin, J. I.**, Shaughnessy, E. A. & Pérez-Stable, E. J. (2014, April 23-25). *Massive open online interventions: A call for action.* [Oral abstract presentation]. The 7th Scientific Meeting of the International Society for Internet Interventions, Valencia, Spain.

14. Muñoz, R. F., Chen, K., **Bravin, J. I.**, Shaughnessy, E. A. & Pérez-Stable, E. J. (2013, April 16-18). *Reach and effectiveness of a ten-year international Spanish-language Stop-Smoking internet site*. [Oral abstract presentation]. The 6th Scientific Meeting of the International Society for Internet Interventions Symposium, Lima, Peru.

SERVICE

2020 – present	Diversity Committee member, VA Puget Sound Health Care System
2020 – present	Hispanic Employment Planning Committee, VA Puget Sound Health Care System
2019 – 2020	Center for Ethics in Science and Technology, Campus Representative
2017 – 2018	American Psychological Association Division 38 (Society for Health Psychology), Campus Representative
2017 – 2018	American Psychological Association of Graduate Students Advocacy Coordinating Team, Campus Representative

PROFESSIONAL DEVELOPMENT

2020	Ally Skills Workshop *Workshop via UCSD Psychiatry Education & Training Professional Development Series*
2020	Telepsychology Best Practices *Online training via American Psychological Association* Received certificate of completion
2019	Introduction to DBT for Eating Disorders *UCSD Eating Disorders Center for Treatment and Research, San Diego, CA* Received certificate of completion

2019	Improving Cultural Competency for Behavioral Health Professionals *Online training via Ciné-Med Inc.* Received certificate of completion
2019	Cognitively Based Compassion Training (CBCT) *University of California San Diego, San Diego, CA*
2019	Mediation Analysis for the Social Sciences *San Diego State University, San Diego, CA*
2018	Scientific Ethics Course *University of California San Diego, San Diego, CA*
2018	Motivational Interviewing *VA San Diego Healthcare System, San Diego, CA*
2017	Acceptance and Commitment Therapy *VA San Diego Healthcare System, San Diego, CA*
2016	Health Coaching Principles *Scripps Whittier Diabetes Institute*
2016	Motivational Interviewing for Type 2 Diabetes *Scripps Whittier Diabetes Institute, San Diego, CA;*
2016, 2017, 2018	Clinical Management and Behavioral Interventions for Diabetes Care *Scripps Whittier Diabetes Institute, San Diego, CA*

PROFESSIONAL AFFILIATIONS

American Psychological Association (APA) – Student Affiliate
Society for Health Psychology (APA Division 38) – Student Affiliate
National Center for Faculty Development & Diversity –Student Member

LANGUAGES

Bilingual in Spanish/English (UC San Diego Health Qualified Bilingual Provider)

ABSTRACT OF THE DISSERTATION

The Associations of Patient Activation and Self-Management with Diabetes Clinical Control in Diverse Primary Care Patients

by

Julia I. Bravin

Doctoral of Philosophy in Clinical Psychology

University of California San Diego, 2021
San Diego State University, 2021

Professor Linda C. Gallo, Chair

Background. Type 2 diabetes mellitus (T2DM) disproportionately impacts low socioeconomic status and ethnic/racial minority groups. Research suggests patient activation (i.e., the knowledge, confidence, and skills to manage one's health) may be associated with better self-management and diabetes clinical control; however, these associations remain largely understudied among diverse primary care patients. This study aimed to: 1) examine the relationships between patient activation and diabetes clinical control indicators (glycosylated

hemoglobin [A1c], low-density lipoprotein cholesterol, and systolic blood pressure); 2) examine the relationships between patient activation and self-management behaviors; 3) determine if self-management behaviors act as indirect mechanisms in the association between patient activation and clinical control; and assess whether the relationships among these variables differed across healthcare systems.

Design. This cross-sectional study used data collected from 297 participants who completed the baseline assessment of a cluster randomized pragmatic trial testing a medical-assistant health coaching intervention in adults with poorly controlled T2DM from two demographically distinct healthcare systems. Multiple linear regression models tested the associations between 1) patient activation and indicators of diabetes clinical control, and 2) patient activation and self-management. Path analysis tested the indirect effect of self-management in the associations between patient activation and clinical control, and the moderating effect of healthcare system.

Results. Patient activation was not significantly associated with either of the three clinical control indicators (all *p*s > .05). Patient activation was significantly associated with overall self-management (B = 0.16, $p < .05$), healthful diet (B = 0.02, $p < .05$), low-fat, produce-rich diet (B = 0.02, $p < .05$), and physical activity (B = 0.03, $p < .05$). Patient activation was not significantly associated with blood glucose monitoring or medication adherence. In mediation analyses, patient activation was (unexpectedly) positively related to A1c indirectly through overall self-management, B = 0.01 (95% CI: .00, .01). No other significant indirect effects or evidence for moderation were observed.

Conclusion. This study sought to clarify the unique role of patient activation in relation to self-management and clinical control in a diverse primary care sample. The lack of consistent

associations among study variables underscores the complexity of achieving optimal T2DM outcomes.

1. INTRODUCTION

Chronic health conditions, such as cardiovascular disease and diabetes, account for an estimated $2.97 trillion in annual healthcare expenditures in the United States (Buttorff, Ruder, & Bauman, 2017). Independently, diabetes costs the healthcare system and employers $237 billion, and this amount is projected to increase over time, as incidence and prevalence continue to rise (American Diabetes Association, 2018). According to recent estimates, the number of US adults with diagnosed diabetes will nearly triple from 2014 to 2060, and over one in six adults will be diagnosed with diabetes by the year 2060 (Lin et al., 2018).

Diabetes prevalence is not equally distributed across the US and marked disparities in disease burden exist. For example, ethnic and racial minority groups including American Indians/Alaska Natives, non-Hispanic blacks, and people of Hispanic ethnicity are disproportionately affected (National Diabetes Statistics Report, 2017). Higher levels of diabetes morbidity and mortality are also disproportionately experienced among those of lower socioeconomic status (Scott, Chambers, Goyder, & O'Cathain, 2017), a pattern consistent with findings from large-scale epidemiological studies of diverse US Hispanics/Latinos (Hispanic Community Health Study/Study of Latinos [HCHS/SOL]; Schneiderman et al., 2014). Patients with complex comorbidities, those who face financial and social hardships, and those with limited English proficiency face particular challenges in achieving optimal health outcomes (Okrainec, Booth, Hollands, & Bell, 2015; Houle et al., 2016). Addressing contributors to diabetes disparities, as well as understanding factors related to optimal treatment of diabetes in diverse populations, are thus urgent public health goals.

1.1 Characterizing Type 2 Diabetes

Type 2 diabetes mellitus (T2DM) is characterized by the progressive loss of insulin-producing beta cells and cellular insulin resistance, resulting in high levels of blood glucose (hyperglycemia). Through a variety of mechanisms, including hyperglycemia and decreased blood flow to nerves, diabetes leads to damage of the micro- and macro-vasculature of the body. Damage to microvascular systems puts those with un-controlled diabetes at high risk for developing complications such as retinopathy and blindness, limb amputation, and kidney disease (Centers for Disease Control and Prevention [CDC], 2019). T2DM also increases risk for macrovascular complications, including higher risk of atherosclerotic cardiovascular disease, myocardial infarction, stroke, and death (CDC, 2019).

There is evidence from large prospective randomized trials that achieving diabetes control by maintaining blood glucose targets can delay the onset and progression of diabetes complications (Zoungas et al., 2017; Zoungas et al., 2014; Ismail-Beigi et al., 2010; King, Peacock, & Donnelly, 1999). Furthermore, reducing risk factors such as smoking, obesity, hypertension, and hyperlipidemia, is recognized as an effective means of avoiding or delaying micro- and macrovascular complications, particularly when addressed early in the disease continuum (American Diabetes Association [ADA], 2019).

1.2 Indicators of T2DM Clinical Control

Glycated hemoglobin (A1c) percentage, a measure of average glucose regulation over the prior 3 months, is used as a primary gauge of diabetes control (ADA, 2019) Results from several landmark studies demonstrate that achieving A1c below 7.0% produces reductions in incidence of micro- and macrovascular complications, cardiovascular outcomes, and associated mortality (Ismail-Beigi et al., 2010, Zoungas et al., 2017; The ADANCE Collaborative Group, 2008). As

such, the current American aDiabetes Association guidelines recommend that patients work with their care providers towards an A1c target of <7% through a combination of lifestyle and pharmacologic treatment (ADA, 2019). To further improve cardiovascular outcomes, in addition to maintaining A1c targets, clinical guidelines recommend screening for and addressing risk factors including hypertension and dyslipidemia.

Hypertension and abnormal lipid profiles are highly prevalent among those with diabetes (Fox et al., 2015). Hypertension, previously defined as a sustained blood pressure of ≥ 140/90 mmHg and more recently ≥ 130/80 (Whelton et al., 2018), is observed in approximately 80% of patients with T2DM (Fox et al., 2015). Furthermore, increased risk of macro- and microvascular events is observed with increasing levels of systolic blood pressure, starting as low as 115 mmHg (Forouzanfar et al., 2017). An abnormal lipid profile (including elevated total cholesterol, triglycerides, LDL cholesterol [LDL-C], and low HDL cholesterol HDL-C])—another common feature of T2DM (Carter et al, 2013)—independently contributes to increased cardiovascular risk including risk of atherosclerotic cardiovascular disease and coronary events (Schofield, Liu, Rao-Balakrishna, Malik, & Soran, 2016).

Effective treatment of hypertension and dyslipidemia in diabetes includes both lifestyle management (e.g., maintaining a healthy weight, engaging in adequate levels of physical activity, and consuming a healthy diet, for example, by restricting sodium intake, and increasing consumption of fruits and vegetables) and pharmacologic therapy (e.g., angiotensin-converting-enzyme inhibitors, angiotensin receptor blockers, and/or diuretics for hypertension, and statins for hyperlipidemia). Results of meta-analyses consistently demonstrate that treatment of hypertension (Brunström & Carlberg, 2016; Thomopoulos, Parati, & Zanchetti, 2017; Xie, Atkins et al., 2016) and dyslipidemia (Carter et al., 2013; Taylor et al., 2013) to recommended

targets (<130 mmHg and LDL-C <100 mg/dL, respectively) produces significant reductions in vascular risk and mortality among those with diabetes.

1.3 Self-Management in Type 2 Diabetes

Despite the effective evidence-based treatments available for diabetes, according to the 1999-2010 National Health and Nutrition Examination Survey (NHANES), 33-49% of patients with diabetes still do not meet American Diabetes Association (ADA)-recommended targets for glycemic, blood pressure, or cholesterol control, and only 14% meet targets for all three while also abstaining from smoking (Ali et al., 2013). Moreover, disparities exist according to race/ethnicity in the extent to which targets are achieved. In Hispanics/Latinos enrolled in the HCHS/SOL, key barriers to achieving diabetes control goals include nonadherence to self-management regimens (Bharti & Bharti, 2017, Krass, Schieback, & Dhippayom, 2014), poor access to programs designed to support self-management (i.e., diabetes self-management education and support; Strawbridge, Lloyd, Meadow, Riley, & Howell, 2015), and lack of insurance (Casagrande et al., 2018).

Diabetes self-management is a complex set of behaviors that includes self-monitoring blood glucose levels and blood pressure, taking medications as prescribed, managing lifestyle changes, such as physical activity and dietary recommendations, and attending routine preventative care appointments. It is recognized that patients and healthcare providers must work collaboratively to agree upon and carry out a diabetes management plan that integrates both clinical recommendations and patients' individual needs and values. The ADA (2019) recommends strategies to promote adherence to treatment standards and overcome barriers to

optimal care that include both patient-level and care delivery system-level elements, as described by the Chronic Care Model.

1.4 The Chronic Care Model

The Chronic Care Model (CCM) (Wagner, Austin, & Von Korff, 1996; Wagner et al., 2001) is a well-established, effective organizational approach to improving diabetes treatment in primary healthcare settings (Stellefson, Dipnarine, & Stopka, 2013). This framework integrates community and health system components to facilitate productive patient-provider interactions and optimize care, both in and outside of the primary care environment (see Figure 1). Importantly, in this patient-centered approach, patients and their families are viewed as integral parts of the greater healthcare team. Achieving optimal diabetes outcomes through successful implementation of the CCM thus involves empowering patients to actively self-manage and engage in their healthcare (Coleman, Austin, Brach, & Wagner, 2009).

1.5 Patient Activation and Self-Management

An activated patient is a central and critical feature of successful chronic disease care according to the CCM. While several patient-level factors have been associated with healthcare engagement (e.g., self-efficacy and locus of control; Nuccitelli, et al., 2018; Jaarsma, Cameron, Riegel, & Stromberg, 2017), patient-activation is considered a distinct construct comprising the knowledge, motivation, confidence, and skills needed to manage one's health and healthcare (Hibbard, Stockard, Mahoney, & Tusler, 2004; Hibbard, Mahoney, Stockard & Tusler, 2005). Among primary care patients, higher patient activation is associated with better health outcomes including lower body weight and having blood pressure, lipid, and A1c values within

recommended ranges (Sacks, Greene, Hibbard, Overton, & Parrotta, 2017; Bolen et al., 2014). In contrast, lower patient activation is associated with more frequent hospitalizations and emergency room use (Sacks et al., 2017; Kinney, Lemon, Person, Pagoto, & Saczynski, 2015).

The positive associations between patient activation and better health outcomes may be, in part, a result of greater adherence to health-promoting and self-care behaviors. Higher patient activation, for example, is associated with increased vegetable and fruit consumption, physical activity, (Hibbard, Stockard, Mahoney, and Tusler, 2007; Mosen et al., 2007), and better adherence to medication regimens (Graffigna, Berello, & Bonanomi, 2017). Numerous studies have also demonstrated that compared to less activated patients, patients with higher levels of activation are more likely to engage in proactive healthcare utilization such as attending routine care visits and obtaining preventive screenings (Hendriks & Rademakers, 2014; Greene & Hibbard, 2012).

Importantly, the evidence of associations between patient activation and self-management behaviors for patients with chronic diseases, such as diabetes, is less consistent (Turner, Anderson, Wallace, & Bourne, 2015; Hendricks & Rademakers, 2014; Zimbudzi et al., 2017) and does not reliably translate to improved clinical control (Bolen et al., 2014). Furthermore, there is evidence that patient activation may be more strongly related to some diabetes self-management behaviors (e.g., adherence to blood glucose monitoring and general diet recommendations; Zimbudzi et al., 2017), and less strongly to others (e.g., medication adherence, physical activity, and foot checking; Kinney et al., 2015; Zimbudzi et al., 2017)—though, notably, findings vary across studies (Hendricks & Rademakers, 2014). While there is a growing number of studies surrounding patient-level factors' (e.g., patient activation) associations with self-management and diabetes clinical control, inclusion of diverse samples,

particularly those that include large proportions of underserved primary care patients is lacking (Kinney et al., 2015; Bolen et al., 2014). How specific diabetes self-management behaviors may be differentially related to level of activation in diverse primary care populations remains to be clarified.

Despite the theoretical associations among patient activation, engagement in self-management behaviors, and clinical control in chronic diseases, evidence to support these associations is inconsistent among patients with T2DM. To fully understand the nature of these associations, a systematic examination of how patient activation is related to specific diabetes self-management behaviors and indicators of current clinical control among diverse primary care patients is warranted. Furthermore, there is a distinct lack of research surrounding patient activation and diabetes self-management in diverse populations, particularly among those with a large proportion of Hispanics/Latinos, a population facing disproportionate diabetes risk. Investigating these associations in a diverse sample may therefore be a critical step in understanding and reducing diabetes disparities in the US.

1.6 Care Delivery Systems

The last decade has seen a large shift toward the adoption of comprehensive care delivery models such as the CCM (Wagner et al., 1996; Wagner et al., 2001). In this framework, health outcomes and patients' engagement in care are inextricably linked to the healthcare context. As such, in addition to patients' level of adherence to self-management behaviors, diabetes health outcomes may be influenced by healthcare system-level factors, such as the system's ability to address the needs of chronic disease patient populations. Optimal chronic disease management includes several features such as the capacity to provide proactive team-based care, self-

management and decisional support, a quality-oriented culture, and having optimized information systems (Wagner et al., 1996; Wagner et al., 2001). Adherence to such CCM approaches has been associated with several positive outcomes in patients with diabetes including improvements in A1c, blood pressure, and lipid levels, greater engagement in self-management behaviors, and lower healthcare costs (Stellefson, Dipnarine, & Stopka, 2013). Despite these positive outcomes, CCM-congruent care for patients with diabetes remains suboptimal and is highly variable across healthcare systems (Ali et al., 2013).

Healthcare systems differing in structure, resources, and funding mechanism may face different barriers to providing high quality chronic disease care. Compared to private insurance-based health systems, community-based healthcare centers serving largely un- and uninsured populations may face greater challenges to meeting the needs of their chronic disease patients due to inadequacy of reimbursement payments to cover upfront investment for staffing, inadequate infrastructure for health information exchange with other providers, and limited electronic record capabilities for documenting and updating care plans, among others (Schurrer, O'Malley, Wilson, McCall, & Jain, 2017). Although few studies have examined the potential impact of health-care system factors in the association of patient activation and self-management, these are theoretically interlinked. There is preliminary evidence, for example, that patient-level factors, such as patient activation, may be more strongly associated with diabetes self-management behaviors (and, subsequently, with clinical control) in clinical settings with more staff trained to understand the role of patient activation and provide self-management support (Alvarez, Greene, Hibbard, & Overton, 2016).

How differences in system-level factors may be associated with patient-level factors is not well understood. In addition to examining level of patient activation, engagement in self-

management behaviors, and how these relate to current indicators of control, to fully contextualize findings, it is also necessary to examine how these associations might vary across diverse, real-world primary healthcare systems (Stellefson, Dipnarine, & Stopka, 2013).

1.7 Summary, Objectives, and Aims

As outlined in the CCM, optimal health outcomes in diabetes are achieved through an interplay between patient-level factors, including level of activation and patients' level of engagement in self-management behaviors, and healthcare system factors. Despite the theoretical link between patient activation, self-management, and clinical control, evidence to support these associations is inconsistent among patients with T2DM. A closer examination of the relationships between patient activation, specific diabetes self-management behaviors, and indicators of current clinical control among diverse primary care patients is warranted. Understanding how these associations might vary across healthcare systems may further clarify the relationships between system- and patient-level factors in producing optimal health outcomes in the real-world primary care context.

To address this need, the proposed study will examine the cross-sectional associations of patient activation, self-management behaviors, and primary indicators of clinical control among adult patients with poorly controlled T2DM from two distinct healthcare systems in San Diego County (Scripps, a large, nonprofit, private insurance-based health system and Neighborhood Healthcare, a federally qualified health center that serves a low-income, un- and underinsured patients, largely Hispanic/Latino population), who are enrolled in a pragmatic randomized clinical trial testing a health coaching-primary care-team model of diabetes care. The objectives and specific aims of the present study (as depicted in Figure 1) are as follows:

Objective 1: To examine the relationships between patient activation and diabetes clinical control.

Aim 1. To determine whether patient activation is associated with three indicators of diabetes clinical control [primary, glycosylated hemoglobin (A1c) and secondary, low-density lipoprotein cholesterol (LDL-C) and systolic blood pressure (SBP)], adjusting for participant sociodemographic characteristics and study site.

Hypothesis 1. Higher patient activation was hypothesized?? be associated with better clinical control, i.e., lower A1c, LDL-C and SBP values, and these associations will remain significant after adjusting for covariates.

Objective 2: To examine the relationships between patient activation and adherence to diabetes self-management behaviors.

Aim 2a. To determine whether there is an association between patient activation and overall level of adherence to self-management behaviors after controlling for participant sociodemographic characteristic and study site.

Hypothesis 2a. Higher patient activation will be associated with a higher level of overall adherence to self-management behaviors, and these associations will remain significant after controlling for covariates.

Aim 2b. To examine the associations between patient activation and five specific diabetes self-management behaviors (maintaining an overall healthful diet, having a low-fat and produce-rich diet, engaging in physical activity, self-monitoring blood glucose, and adhering to diabetes medications), adjusting for covariates.

Hypothesis 2b. Higher patient activation will be associated with greater adherence to self-management behaviors [i.e., greater adherence to overall healthful diet (general diet), greater

adherence to a low-fat and produce-rich diet (specific diet), greater levels of physical activity, more regular blood glucose self-monitoring, and greater medication adherence], and these associations will remain significant after adjusting for participant sociodemographic characteristics and study site.

Objective 3: To determine if self-management behaviors act as an indirect mechanism in the association between patient activation and diabetes clinical control.

Aim 3. To determine whether there is an indirect effect of engagement in self-management in the association of patient activation with clinical control, while controlling for covariates.

Hypothesis 3. There will be a significant indirect effect of self-management behaviors in the relationship between patient activation and diabetes clinical control indicators, after controlling for patient sociodemographic characteristics and study site. The direct effect from patient activation to clinical control is expected to remain statistically significant in these models.

Exploratory Aim. To assess whether the relationships among patient activation, self-management behaviors, and clinical control differ by healthcare system.

Hypothesis. The association of patient activation with engagement in self-management will vary across healthcare system. Specifically, the association between patient activation and self-management behaviors will be smaller among participants recruited from a lower-resource community healthcare system (NHC), compared to those recruited from a higher-resource private-insurance healthcare system (Scripps).

2. METHODS

To investigate the aforementioned aims, the proposed dissertation consists of a cross-sectional, observational study utilizing baseline data collected from participants enrolled in an ongoing pragmatic randomized-controlled trial, titled "Medical Assistant Health Coaching for Diabetes in Diverse Primary Care settings" (i.e., MAC). Baseline data include clinical indicator and demographic data collected via electronic medical record (EMR) and self-report measures collected via a phone-delivered survey (patient reported outcomes survey).

2.1 Participants

MAC trial overview. Participants are part of a larger, cluster (clinic-level) randomized pragmatic trial comparing MA-Health Coaching (MAC) versus usual care (UC) in improving clinical control and patient-reported behavioral (diabetes self-care) and psychosocial outcomes (quality of life and patient activation) among individuals with poorly controlled T2DM. Participants in the MAC trial are N=600 adult (age ≥ 18 years) patients diagnosed with T2DM, with one or more elevated clinical indicators of diabetes control (i.e., A1c ≥ 8.0%, and/or SBP ≥ 140 mmHg, and/or LDL-c ≥ 100 mg/dL) in the last 90 days, who completed a primary care visit at one of the participating clinics during the enrollment period. Following enrollment, patients were invited by phone to participate in the patient reported outcome sub-study, which consists of completing a brief, telephone-based survey administered at baseline, 6, and 12 months post-enrollment. A total of N=305 participants consented to the baseline survey. Six of these participants, had begun to provide data but discontinued shortly after survey administration had begun due to a variety of reasons including having misunderstood what the survey entailed and having a change of heart about participation. For an additional two, survey administrators

discovered participants had a difficult time following the questions and/or providing answers, and survey was terminated. Data for these 8 participants were excluded from analyses. A total of n = 170 NHC participants and n = 127 Scripps Health participants were included in the final analytic sample.

2.2 Procedures

Study setting. The MAC trial is took place in two primary care clinics housed within demographically distinct healthcare systems: Neighborhood Healthcare (NHC) and Scripps Health. Neighborhood Healthcare is a federally qualified health center and designated Patient-Centered Medical Home serving a predominantly low income, un- or underinsured, racial/ethnic minority patient population. Neighborhood Healthcare employs 650 employees and provides an estimated 271,00 medical, dental and behavioral health visits to 67,000 people annually, regardless of their ability to pay. Neighborhood Healthcare uses a single EMR system (eClinicalWorks) across its 11 community health centers. Scripps Health, a large, non-profit, private insurance-based health system, serves a predominantly non-Hispanic white, middle-to-high income patient population. Scripps Health houses 5 hospitals and 20 primary care clinics organized within two integrated medical groups—Scripps Coastal Medical Center and Scripps Clinic Medical Group. Scripps Health provides ambulatory care to 350,000 patients via 1.5 million clinic visits each year and utilizes a single EMR across its sites (Epic).

Diabetes registries from both healthcare systems were reviewed to aid in the study clinic selection. The size of diabetes panels across Neighborhood Healthcare and Scripps primary care clinics were examined, and the two clinics in each health system with diabetic panels closest to the mean size were selected. Patient clinical and demographic characteristics at the study clinics

were then reviewed to ensure approximate equivalence. An EMR query using study eligibility criteria was then conducted to ensure the pool of eligible patients was sufficient to meet enrollment goals. One clinic within each system was randomly assigned to intervention (MAC), and one to control (UC).

Study enrollment. Intervention clinic EMR data were reviewed daily to identify eligible patients presenting to the clinic on the given day. When multiple eligible patients had clinic appointments at, or close to the same time, patients with the highest clinical risk score (based on A1c, LDL, and SBP), were prioritized to receive MA health coaching. Eligible patients who were approached and completed an initial encounter with the MA Health Coach during their scheduled clinic visit (i.e., index visit) were then deemed "enrolled". For every intervention arm participant enrolled, a patient with a matched risk score who completed an appointment (i.e., index visit) that same business week at the respective UC site was identified and "enrolled" into the UC group. All enrolled participants (from intervention and UC clinics) were qualified for contact regarding the patient-reported outcomes sub-study.

Patient-reported outcomes sub-study. Following study enrollment, all participants were mailed a letter notifying them that they would be contacted by phone within one week and invited to participate in a survey evaluating their healthcare experience with Scripps Health or Neighborhood Healthcare. The letter explained the content of the survey as pertaining to their healthcare, the things they do to manage their health, and their quality of life. Approximately one week after mailing the recruitment letter, participants were called and provided with a brief overview of the patient-reported outcomes survey. If participants provided verbal consent to participate in the sub-study and were available to compete the survey during that call, the first survey (i.e., baseline) was administered in the participant's preferred language (English or

Spanish), or scheduled and completed at a later date (if participant unavailable at that time). Surveys were administered by trained bilingual, bicultural research assistants using a standardized protocol designed to accommodate participants with a range of health statuses and literacy levels.

Informed consent. MAC is a pragmatic, cluster-randomized trial in which the intervention is conducted at a clinic level and is delivered as part of routine care. Additionally, the physical and psychological risk associated with health coaching interventions is considered low. Taking these features into consideration, combined with the precedent provided by similar prior pragmatic, cluster-randomized trials (Ramsberg, & Platt, 2018), the Scripps Institutional Review Board (IRB) waived the requirement to collect individual informed consent from participants in the primary MAC trial. Verbal consent was obtained from all participants who completed the patient-reported outcomes assessment portion of the trial.

All procedures and materials for the current study were approved by the Scripps IRB, which served as the reviewing IRB, and the San Diego State University IRB, which served as the relying IRB.

2.3 Data management and quality control

Indicators of clinical control (A1c, LDL-C, and SBP) were collected via standardized clinic assessment and laboratory protocols, and obtained from clinic EMR systems. EMR data collected at baseline was abstracted by trained research staff and include demographic (e.g., age, sex, race and ethnicity), insurance status, comorbidities, risk factors and clinical control lab values.

For the primary MAC trial, EMR data for each enrolled participant will be abstracted for 12 months following their enrollment date. With the exception of LDL-C (due to its clinically-indicated annual evaluation), up to 5 data points may be available (months 0, 3, 6, 9, 12) for each clinical control indicator. In the present study, participants' clinical values closest to baseline—collected either during the index visit or from the most recent lab draw prior to the baseline date (i.e., date on which the patient reported outcome survey was completed) –were used in analyses. Data collected following the baseline date or after exposure to the intervention was not examined. The time (in days) between completion of the baseline survey and the date on which clinical indicators labs were drawn was calculated and included as a covariate in analyses. Following extraction, study investigators and hospital analysts checked EMR data for completeness and compared data to live EMR records for accuracy.

Phone-assessment data were entered into study databases and periodically reviewed for accuracy and completeness by trained, bilingual research staff. Both EMR and phone-assessment data are stored in secure web-based Research Electronic Data Capture (REDCap) databases. All data are stored on servers with environments that adhere to data security regulations according to HIPAA, CITI, and NIH, and are backed up to secure offsite servers on a weekly basis.

Staff training. Study staff are registered as contractors with Scripps (i.e., complete general volunteer and HIPAA training, and gain medical clearance) and are trained and certified in standardized study procedures (i.e., questionnaire administration recruitment procedures, consenting, database use, and CITI protection of Human Subjects certification).

2.4 Measures

Clinical indicators of diabetes control.

Glycated Hemoglobin A1c (A1c). Glycemic control will be assessed via A1c percentage, a measure of average glucose regulation over the prior 3 months. A1c is considered the primary indicator of diabetes control, with higher levels indicating worse control. A1c values greater than or equal to 7% are associated with elevated risk of complications, and A1c greater than or equal to 8.0%, are considered indicative or poorly controlled diabetes (ADA, 2019). It is recommended that individuals with T2DM have their A1c checked every three months as part of their chronic disease care plan. In the present study, A1c values were collected and processed via routine blood draw procedures at each health care system, using standardized protocols. If A1c was not measured on the index visit date, the most recent value (collected prior to the baseline date) was used in analyses.

Systolic Blood Pressure (SBP). Blood pressure control was assessed via systolic blood pressure (SBP) values. Hypertension is clinically defined as a sustained blood pressure of ≥ 140/90 mmHg; to reduce associated risk, standards of care recommend most patients with diabetes be treated to an SBP target of <140 mmHg and a DBP goal of < 90 mmHg (ADA, 2019). While both diastolic and systolic blood pressure have been linked to cardiovascular complications, SBP has historically been selected as a treatment target due to its robust response to intervention and unequivocal association with risk reduction (Forouzanfar et al., 2017). In the present study, SBP is regularly assessed using standardized assessment methods as part of the routine clinical encounter; values from the index visit date were utilized in the present study.

Low-Density Lipoprotein Cholesterol (LDL-C). Indication of lipid control were assessed via low-density lipoprotein cholesterol (LDL-C) lab values. While improvements across lipids [including total cholesterol, LDL cholesterol, triglycerides, and high-density (HDL) cholesterol] have produced reductions in negative outcomes among patients with T2DM (Haffner, 1998),

treatment of LDL cholesterol is considered the first priority for intervention among patients with T2DM and cooccurring dyslipidemia due to its robust and positive response to pharmacotherapy (with minimal adverse effects; ADA, 2019). For patients with T2DM, LDL cholesterol of ≥130 mg/dl (3.35 mmol/l) is considered above the recommended level and should be treated to achieve a goal of <100 mg/dl (2.60 mmol/l) (ADA, 2019). Standards of care recommend individuals with T2DM have their lipid levels checked annually (ADA, 2019). In the proposed study, participant's most recent LDL-C value collected during routine clinic blood draws, utilizing standardized protocols, prior to the baseline will be used in analyses.

Patient Activation.

Patient Activation Measure (PAM) (13-items). Patient activation was assessed via the PAM (Hibbard et al., 2005). This 13-item measure assesses a respondent's knowledge, skills, and beliefs to self-manage his/her own care, collaborate with his/her healthcare providers, and sustain health behaviors. Sample items include, "I know what each of my prescribed medications do" and "I am confident that I can maintain lifestyle changes, like eating right and exercising, even during times of stress." Participants indicated their level of agreement with each of the included statements on a four-point Guttman-like scale (ranging from "disagree" to "agree strongly"). A summary score is calculated as the mean of the valid items. PAM-13 items have a calibrated scale range from 38.6 to 53.0. PAM scores are transformed (through Insignia's proprietary natural logarithm) into a theoretical activation score ranging from 0-100 (interval scale). Raw PAM scores are converted to activation scores using a scoring sheet provided by developers (Hibbard et al., 2004). Higher scores indicate a higher level of patient activation (Hibbard et al., 2005). If a respondent answers "not applicable", "don't know", or refused to answer more than three items, no summary score is calculated. The PAM-13 has been validated

in multiple chronic disease populations (Skolasky et al., 2011; Stepleman et al, 2010; Prey et al., 2016) and has demonstrated strong psychometric properties, including high internal consistency ($\alpha = 0.81$) and construct validity (Skolasky et al., 2011; Stepleman et al, 2010; Prey et al., 2016). Prior studies have shown the PAM-13 is associated with several self-reported self-management and health behaviors including greater fruit and vegetable consumption, following a regular exercise schedule (Hibbard et al., 2005) and reporting greater medication adherence (Kinney et al., 2015). The Spanish version of the PAM has also exhibited good internal consistency ($\alpha = .88$), validity, test-retest reliability and has been deemed appropriate for use among diverse Spanish-speaking populations with varied education levels (Alegria, Sribney, Perez, Laderman, & Keefe, 2009).

Adherence to Diabetes Self-Management Behaviors.

Diabetes Self-Care Activities. Adherence to diabetes-specific self-management behaviors was assessed via 7 items from the Summary of Diabetes Self-Care Activities Measure (SDSCA; Toobert & Glasgow, 1994). This self-report measure asked respondents to indicate the number of days in the past week (0-7) they were able to perform diabetes self-management behaviors (e.g., "On how many of the last seven days did you test your blood sugar?"). Self-management behaviors cover five domains: 1) adherence to overall healthful diet (general diet; 1 item); 2) adherence to a low-fat, and produce-rich diet (specific diet; 2 items); 3) meeting physical activity recommendations (at least 30 minutes of continuous activity, including walking) (1 item); 4) blood glucose self-monitoring (1 item); and 5) following prescribed medication regimen (oral medication and/or insulin) (2 items). In prior research, the SDSCA has demonstrated associations with other measures of diabetes self-management (e.g., measures of diet and exercise and medication adherence), adequate test-retest reliability (Toobert, Hampson, & Glasgow, 2000),

sensitivity to change in response to intervention (Philis-Tsimikas, Fortmann, Lleva-Ocana, Walker, & Gallo, 2011), and correlation with clinical control (Schmitt, et al., 2013). The Spanish translation of the SDSCA has also shown adequate psychometric properties, including strong test-retest reliability and adequate internal consistency (α = .68) (Borges & Ostwald, 2008). Due to the disparate nature of the self-management behaviors contained in the measure, the SDSCA subscales were designed to be examined individually (Toobert & Glasgow, 1994). However, prior literature suggests that SDSCA subscales may also be combined (averaged) to create an overall self-management score for each participant (e.g., Fortmann, Gallo, & Philis-Tsimikas, 2011). Due to the theoretical positive association between patient activation and adherence to all self-management behaviors, for the purposes of this study, SDSCA total and subscale scores will be examined.

Covariates. The following sociodemographic data collected through the patient-reported outcome survey were considered covariates: Participant age (modeled continuously), sex (male vs. female, with female as the referent group), ethnicity (Hispanic/Latino vs. non-Hispanic), race (White, Black or African American, American Indian or Alaskan Native, Asian, Native Hawaiian or Pacific Islander, Multiracial), annual household income (<$30,000 vs. >/= $30,000), number of years since diagnosis (modeled continuously), language of interview (English vs. Spanish), days between baseline survey and clinical value draw, and study site (Scripps vs. NHC). Racial categories were collapsed into one "non-White" category; for analyses, race and ethnicity categories were combined into four dummy coded variables with Non-Hispanic White as the referent group). Covariates found to have associations with study variables at *p*-values < .10 were included in the final models; thus, participant education (< high school diploma/general education degree [GED], high school diploma/GED only, or ≥ high school diploma/GED),

employment status (employed, self-employed, not currently employed), insurance coverage (insured vs. uninsured), place of birth (U.S., Mexico, or other country) were not included as covariates in final models.

2.5 Statistical Approach

SPSS (IBM Corporation 1989, 2016) was used to calculate sample characteristics. Descriptive statistics (means, standard deviations, counts, and percentages) for demographics and key study variables (i.e., patient activation, self-management behaviors, indicators of clinical control) were performed in the total sample and by healthcare system. Two-tailed t-tests (for continuous variables) and chi-squared tests (for categorical variables) were used to compare sample characteristics across healthcare system (Scripps vs. NHC). A Pearson's correlation coefficient matrix was produced and used to examine bivariate associations among key study variables. To examine whether patients who chose to participate in the patient reported outcomes sub-study differed from those who did not elect to participate, the groups were compared on demographic characteristics and baseline clinical control values, via two-tailed t-tests. Intervention and control-arm participants were also compared across basic demographic characteristics and baseline clinical control values using two-tailed t-tests (for continuous variables) and chi-squared tests (for categorical variables).

All other analyses were conducted using maximum likelihood robust (MLR) estimation in MPlus Version 7.4 (Muthén & Muthén, 2012-2015). The MLR procedure utilizes the full-information maximum likelihood (FIML) procedure, which generates unbiased model parameter estimates and standard errors for missing outcome data (Enders, 2010). As such, cases with missing outcome data can be included in the analyses. Although MLR is robust to violations of

model assumptions (e.g., non-normality and heteroscedasticity), data was inspected for violations of assumption of normality, homogeneity of variance, and linearity before any statistical analyses were conducted; no data transformations were necessary. To determine statistical significance for beta estimates of direct associations, an alpha level of $p < .05$ (two-tailed) was used. Statistical significance of the indirect effect was determined using bootstrapping procedures. Unstandardized indirect effects were computed for each of 10,000 bootstrapped samples, and the 95% confidence interval was computed by determining the indirect effects at the 2.5th and 97.5th percentiles.

Objective 1: To examine the relationships between patient activation and diabetes clinical control.

Analyses for Aim 1. Multiple linear regression was used to determine whether patient activation (as indicated by total PAM score) is associated with indicators of diabetes clinical control (A1c, LDL-C, SBP) (path *c′* in Figure 2). Separate multiple linear regression models were used to test patient activation (as a continuous exposure variable) with each indicator of control as an outcome, controlling for participant demographics (age, sex, race-ethnicity), income, number of years since diagnosis, language of interview, study site, and number of days between lab value drawing and baseline survey.

Objective 2: To examine the relationships between patient activation and adherence to diabetes self-management behaviors.

Analyses for Aim 2a. Multiple linear regression was used to examine the relationship between patient activation and overall adherence to self-management behaviors (as indicated by SDSCA total score) (path *a* in Figure 2). The model included patient activation as the exposure

variable and SDSCA total score (modeled continuously) as the outcome, while controlling for covariates.

Analyses for Aim 2b. Separate linear regression models were used to explore associations between patient activation and individual self-management behaviors captured in each of the five SDSCA subscales (i.e., overall healthful diet, low-fat and produce-rich diet, physical activity, blood glucose self-monitoring, and medication adherence), controlling for covariates.

Objective 3: To determine if self-management behaviors act as an indirect mechanism in the association between patient activation and diabetes clinical control.

Analyses for Aims 3. Path analysis was used to test the indirect (mediating) effect of self-management behaviors in the relationship between patient activation and indicators of clinical control (indirect path *ab* in Figure 2). Models tested patient activation as the exposure variable, each indicator of clinical control as the outcome, and diabetes self-management behaviors as the mediators. Self-management variables (i.e., summary SDSCA score and individual self-management behaviors) were examined in separate models. Because significant *a* and *b* paths are no longer considered prerequisites for testing of mediation (Hayes, 2018), models were repeated for each indicator of control outcome. The statistical significance of the indirect effect was determined by using bias-corrected bootstrapped 95% confidence intervals.

Exploratory Aim: To assess whether the relationships among patient activation, self-management behaviors, and clinical control differ by healthcare system.

Analyses for Exploratory Aim. The potential moderating effect of healthcare system on the relationship between patient activation and self-management was tested in a multi-step approach. First, multiple linear regression was used to examine the potential effect of healthcare system in

the association between patient activation and self-management. A multiplicative interaction term of healthcare system X patient activation score was constructed. Models included patient activation, healthcare system, and healthcare system X patient activation as predictor variables and SDSCA score as the outcome, while controlling for covariates. Models were repeated for each self-management behavior. Path analysis was used to examine the potential moderating effect of healthcare system in the context of the mediation model (i.e., testing moderated mediation; see Figure 3). Models tested the moderating effect of healthcare system by including healthcare system X patient activation in the path from patient activation to self-management, while controlling for covariates. Models were repeated for each indicator of control outcome and self-management behavior. The statistical significance of the moderating effect was determined by using bias-corrected bootstrapped 95% confidence intervals.

2.6 Power analysis

Reaching statistical significance in models testing indirect effects (mediation path models) requires more power than models testing direct effects. Thus, the focus of the following power analysis is on the proposed mediation effects models. Thoemmes, Mackinnon, and Reiser (2010) suggest that in order to detect an indirect (mediated) effect with power of .80 in a single mediator model in which path *a* is expected to have a medium effect and path *b* is expected to have a small, medium, and large effect, sample size requirements are *N*=450, *N*=92, and *N*=66, respectively. If path *a* is expected to have a large effect size, sample size requirements are *N*=512, *N*=76, and *N*=42 (see Table 1).

Studies examining the association between patient activation and SDSCA self-management composite scores have observed effects of medium to large magnitude (Mosen et

al., 2007; Zimbudzi et al., 2017). While few studies have examined the associations between patient activation and specific SDSCA self-management behaviors, associations between patient activation and similar assessments of diabetes self-care behaviors have demonstrated a wide range of effect sizes from small to large (Zimbudzi et al., 2017; Hibbard 2005; Skolasky et al., 2011). Associations between self-management behaviors and clinical control have also demonstrated a wide range of effects ranging from small to medium for A1c (Toobert, Hampson, & Glasgow, 2000; Schmitt et al., 2013), small to medium for SBP (Zimbudzi et al., 2018), and medium to large for cholesterol (Zimbudzi et al., 2018).

Based on path *a* and *b* effects observed in prior research and Thommes et al.'s estimates, the present sample of *N*=305 was assumed to provide sufficient power to detect associations in the indirect effects models examining SDSCA summary scores as the mediator variable; the present sample size may have been insufficiently powered to detect indirect effects in the associations between individual self-management behaviors including healthy dietary behaviors, glucose monitoring, and medication adherence. Moderation effects are also estimated to be small to medium and may be underpowered (Thoemmes et al., 2010). However, considering the inconsistent nature of prior findings, it is difficult to make definitive judgements of adequacy of power for the present analyses.

3. RESULTS

3.1 Descriptive Statistics

A total of 305 individuals consented to and completed the patient-reported outcomes sub-study of the MAC trial. A total of 8 participants who consented to the sub-study were documented as having unreliable self-report data by survey administrators and/or having little or no self-reported data available. These survey "non-completers" were excluded from analyses for a final analytic sample of 297. When comparing participants in the MAC trial who elected to participate in the patient-reported outcomes sub-study and those who did not elect to participate, there were no significant differences in age or on baseline clinical control (A1c, LDL-C, or SBP) (see Table 2). Neither study site nor whether a patient was in the control or the intervention arm of the study was predictive of whether or not a participant completed the survey. Furthermore, intervention and control arm participants did not differ across age, years living with diabetes, clinical control values, patient activation, or self-management behaviors (see Table 3).

A total of n = 170 NHC participants and n = 127 Scripps Health participants were included in the final analytic sample. Demographics and descriptive characteristics for the study sample and comparisons across the two study sites are reported in Table 4. Participant age ranged from 19 to 95 years (M = 63.0, SD = 13.9) and 58.9% of the sample were men. The majority of participants identified as White (n = 177, 61.2%) and over half were born in the U.S. (n = 160, 53.9%), with 33.0% (n = 98) born in Mexico, and 13.1% (n = 39) born in other countries. Approximately half of the sample (n = 146, 55.1%) reported an annual household income of less than $30,000 and 74.9% (n = 221) reported being unemployed. For education attainment 14% (n = 42) of the sample reported completing elementary school, 9.1% (n = 27) reported completing middle school, 30% reported completing high school/GED or equivalent,

5.7% (n = 17) reported attending a trade or vocational school, and 26.9% (n = 80) reported achieving an associates, college, or advanced professional degree. The majority of the participants reported health insurance coverage (n = 276, 93.2%). Participants reported an average of 12.6 years (SD = 10.3, range = 1 - 62) living with a diabetes diagnosis. The mean patient activation score for the sample was 68.1 (SD = 13.6; range 35.5-100) and the mean overall self-management score was 5.0 (SD = 1.2; range 0-7).

Comparing participants across study site, groups did not significantly differ in the proportion of males included ($\chi^2(1)= 1.3$, $p = 0.25$) or employment status ($\chi^2(1) = 0.05$, $p = 0.82$). Compared to NHC, the Scripps subsample was significantly older ($t(277) = 11.43$, $p <.001$) and was overall less diverse—including a greater proportion of participants who identified as White compared to other races ($\chi^2(1) = 39.6$, $p <.001$), including fewer Hispanic participants ($\chi^2(1) = 93.3$, $p <.001$), and including fewer non-U.S. born participants ($\chi^2(1) = 66.2$, $p <.001$). Fewer Scripps participants chose to complete the survey in Spanish ($\chi^2(1) = 74.6$, $p <.001$). The Scripps subsample also tended to be of higher socioeconomic status, including a greater proportion of participants who endorsed an annual household income of more than $30,000 ($\chi^2(1) = 106$, $p <.001$), an education level of high school equivalent or greater ($\chi^2(1) = 43.6$, $p <.001$), and health insurance coverage ($\chi^2(1) = 16.1$, $p <.001$).

Scripps participants tended to have had a diabetes diagnosis for longer compared to NHC participants ($t(186) = 2.1$, $p = 0.03$). In terms of clinical control (see Table 5 and 6), Scripps participants tended to have overall higher baseline SBP values compared to NHC participants ($t(295) = 2.4$, $p = 0.02$); however, the two groups did not differ on the proportion of participants who had SBP values within the recommended range. Compared to Scripps, the NHC subsample had a greater proportion of participants who had A1c and LDL-c out of recommended ranges

($\chi^2(1) = 27.8$, $p < .001$ and $\chi^2(1) = 5.1$, $p < .001$), respectively. Lastly, when compared across diabetes self-management behaviors, Scripps participants endorsed better adherence to blood glucose monitoring ($t(200) = 5.6$, $p < .001$), while NHC participants endorsed greater adherence to overall healthful diet ($t(271) = 2.9$, $p < .001$), and to a low-fat and produce-rich diet ($t(275) = 1.14$, $p < .05$). The two samples did not differ in physical activity, medication adherence, or in level of patient activation.

Bivariate correlations of patient activation, indicators of diabetes clinical control, and self-management variables are presented in Table 7. Patient activation was positively correlated with all self-management behaviors with the exception of blood glucose monitoring and medication adherence, although correlations were small to moderate in magnitude (r ranged from 0.15 to 0.21). No significant correlations were observed between patient activation and any of the clinical indicators. Overall adherence to self-management (SDSCA total score) was significantly positively correlated with A1c ($r = 0.13$), though the association was small, and not correlated with LDL-c or SBP. Blood glucose monitoring was also found to be moderately positively correlated with A1c ($r = 0.28$), and adherence to a low-fat, produce-rich diet (specific diet) was positively correlated with SBP ($r = 0.14$), though this association was small. Health care system was correlated with all study variables (r ranged from -0.38 to 0.17) with the exception of patient activation, physical activity, specific diet, and medication adherence.

3.2 Patient Activation and Clinical Control

Aim 1 of the study was to determine whether patient activation was associated with the three indicators of diabetes clinical control, adjusting for covariates. Results of the multiple linear regression models testing the association between patient activation as the exposure

variable and A1c, LDL-C, and SBP as outcome variables are presented in Table 8, 9, and 10, respectively. Patient activation was not significantly associated with any of the three clinical indicators of control, a finding which remained consistent with and without inclusion of covariates (all *p*s > .05).

3.3 Patient Activation and Diabetes Self-Management Behaviors

Aim 2 of the study was to examine the relationship between patient activation and adherence to self-management behaviors. Results of the Aim 2a multiple linear regression models that included patient activation as the exposure variable and overall adherence to self-management behaviors (SDSCA total score) as the outcome are presented in Table 11. Tables 12-16 present the Aim 2b results of linear regression models examining patient activation as the exposure and each of the individual self-management behaviors captured in each of the five SDSCA subscales (i.e., overall healthful diet, low-fat and produce-rich diet, physical activity, blood glucose self-monitoring, and medication adherence) as outcome variables. Patient activation was significantly associated with overall adherence to self-management behaviors (B = 0.16, $p < .05$). Patient activation was also found to be significantly associated with adherence to an overall healthful diet (B = 0.02, $p < .05$), adherence to a low-fat, produce-rich diet (B = 0.02, $p < .05$), and physical activity (B = 0.03, $p < .05$). Patient activation was not significantly associated with adherence to blood glucose self-monitoring or medication adherence. Results remained consistent with and without inclusion of covariates.

3.4 Self-Management Behaviors as an Indirect Mechanism

Aim 3 of this study involved testing the indirect (mediating) effect of self-management behaviors in the relationship between patient activation and indicators of clinical control through a series of regression models. Figure 4 summarizes model results examining overall adherence to self-management behaviors as the indirect effects variable and Figures 5-7 present model results testing individual self-management behaviors as the indirect effects variable in relation to A1c. The results demonstrated a non-significant total negative effect of patient activation on A1c, B = -0.08, p = .18. However, significant positive direct associations between patient activation and overall adherence to self-management (*a* path), B = 0.02, $p < 0.01$ and between overall self-management with A1c were observed (*b* path), B = 0.33, $p <.01$. There was a negative direct effect of patient activation on A1c (*c'* path), B = -0.02 (95% CI: -.04, .00), though this did not reach statistical significance. Overall adherence to self-management behaviors was found to be a significant mediator between patient activation and A1c, B = 0.01 (95% CI: .00, .01). In other words, the association between patient activation and higher A1c (though not statistically significant) was explained in part by higher adherence to self-management.

Overall adherence to self-management did not demonstrate a significant indirect effect in models that included LDL-C or SBP as outcomes variables. None of the individual self-management behaviors demonstrated significant indirect effects, a finding that was consistent across all clinical indicators and in models with and without inclusion of covariates (all *p*s > .05).

3.5 Exploratory Moderation Analyses

Exploratory analyses were conducted to examine the potential moderating effect of healthcare system (study site) on the relationship between patient activation and self-

management. There was no evidence for moderation in models examining associations between patient activation, self-management behaviors, and the clinical indicators A1c, LDL-C or SBP (see Table 17 -19). Model results did not vary with and without inclusion of covariates.

4. DISCUSSION

This cross-sectional study sought to evaluate the role of patient activation, diabetes self-management behaviors, and diabetes clinical indicators among primary care patients with poorly controlled diabetes enrolled in a pragmatic randomized clinical trial testing a health coaching-primary care-team model of diabetes care. Diabetes control is understood to result from a complex interplay of patient- and system-level factors (Wagner et al., 1996; Wagner et al., 2001). Additionally, despite the theoretical link between patient activation, self-management, and clinical control, evidence to support these associations is inconsistent among patients with T2DM. This is the first study, to our knowledge, to systematically examine how patient activation is related to specific diabetes self-management behaviors and indicators of current clinical control among diverse primary care patients with a large proportion of Hispanics/Latinos and explore how these associations may vary across distinct healthcare environments. Given the marked disparities in T2DM experienced in low socioeconomic status and ethnic/racial minority groups, exploration of these associations in a diverse study sample provides an important contribution to the literature.

4.1 Examining the Relationship Between Patient Activation and Diabetes Clinical Control

It was hypothesized for Aim 1 of this study that higher patient activation would be associated with lower A1c, LDL-C, and SBP values. Patient activation scores were relatively high in the present sample with an average score of 68.1 (SD = 13.6) in a possible range of 0-100. This level of activation corresponds to the second highest level of activation possible and is characterized as, “Taking action but requires support in maintaining positive behavior change” (scores ranging 55.2–72.4) (Hibbard et al., 2005). Though somewhat higher, the observed mean

PAM score corresponds to the same activation level observed in other primary care populations (M = 59.4, SD =13.8, McCusker, Lambert, Haggerty, Yaffe, Belzile, & Ciampi, 2019; M = 57.5, SD = 13.1, John, Tannous, & Jones, 2020). Patient activation also did not significantly vary across the two healthcare settings. Patient activation was negatively correlated with A1c and LDL-c and positively correlated with SBP, but all of these effects were of small magnitude and none reached statistical significance. In regression models, counter to hypotheses, patient activation was not significantly associated with any of the three clinical indicators of control. While patient activation has been associated with several health outcomes, these findings are notedly inconsistent among primary care patients with T2DM (Sacks, Greene, Hibbard, Overton, & Parrotta, 2017; Bolen et al., 2014). The observed lack of association between patient activation and clinical control, therefore, does not appear to be anomalous. One explanation for these findings might be that system-level factors, such as the availability of CCM-congruent care and patient-provider dynamics, are important and potentially necessary for patient activation to successfully translate to improved health outcomes. For example, in a longitudinal study of primary care patients with T2DM, improvements in patient-provider collaborative decision making (participatory decision making) needed to be present for improvements in patient activation to lead to improvements in medication adherence and subsequent improvement in A1c and LDL-C (Parchman, Zeber, & Palmer, 2010). Other studies have found that providers who are aware of and encourage patient activation are more likely to successfully promote self-management and patient activation in their patients (McCusker et al., 2019). It may therefore only be possible to draw meaningful conclusions about the relationship between patient activation and diabetes outcomes when provider-level factors are taken into consideration. Future

research examining the possibly synergistic effect of provider- and patient-level factors is needed.

4.2 Examining the Relationships Between Patient Activation and Diabetes Self-Management Behaviors

Aim 2 of this study addressed how patient activation related to self-management behaviors. Consistent with hypotheses, there was a significant positive association between patient activation and overall adherence to self-management, represented by SDSCA total scores. Interestingly, associations of patient activation and self-management were not consistently observed across individual self-management behaviors. Patient activation was positively associated with adherence to both healthful eating domains and physical activity, but it was not associated with blood glucose self-monitoring or medication adherence. Prior findings are similarly mixed, with some studies reporting no association between patient activation and self-management behaviors (Hendricks & Rademakers, 2014), some reporting positive associations (Turner, Anderson, Wallace, & Bourne, 2015), others reporting associations with some but not all self-management domains. Zimbudzi et al. (2017), for example, found patient activation was associated with overall self-management of diabetes, as well as the domains of general healthful diet and blood glucose monitoring, but not specific diet, physical activity, or foot checking. The mechanisms that result in optimal behavioral outcomes in each domain likely vary and may explain the inconsistent associations of patient activation across self-management behaviors. For example, factors that influence whether a person exercises might include environmental factors like neighborhood safety and walkability (Ding & Gebel, 2012), while medication adherence may be influenced by the efficiency of a pharmacy to fill prescriptions or a patient's ability to

consistently pay for medication, which are likely not linked to their activation. This study's findings may also be indicative of the importance of contextual factors outlined in the CCM (e.g., healthcare system adherence to CCM best practices or the availability of self-management support), and the previously mentioned provider-level factors not explored in the present study. Future exploration of contextual and additional system-level factors may further clarify the relationship between patient activation and self-management behaviors.

4.3 Exploration of Self-Management Behaviors as Indirect Mechanisms in the Association Between Patient Activation and Diabetes Clinical Control

The final study aim was to assess possible mediating effects of self-management in the association of patient activation and clinical control. While initial associations of patient activation and clinical control were not observed to be statistically significant, patient activation was found to be associated with self-management behaviors. Furthermore, significant *a* and *b* paths are no longer considered necessary prerequisites to testing of a mediation effect, as there is still a possibility that a mediator explains shared variance between exposure and outcome variables without the presence of these strong direct effects (Hayes, 2018). The indirect effect of overall adherence to self-management behaviors was found to be significant in the (not statistically significant) association between patient activation and A1c. This finding is consistent with the overarching hypothesis that self-management behaviors would mediate the association between patient activation and clinical control; however, rather than being associated with lower A1c, better self-management was associated with higher A1c. This finding is surprising but not inconsistent with the mixed results of prior studies (Turner, Anderson, Wallace, & Bourne, 2015; Hendricks & Rademakers, 2014; Zimbudzi et al., 2017) and the lack of association found

between self-management and A1c (Bolen et al., 2014). Optimal glycemic control is understood to result from an interplay of several patient-level, environmental-level, and health-care-level factors (Coleman, Austin, Brach, & Wagner, 2009) and poor glycemic control is not necessarily indicative of low engagement in self-management behaviors. It is possible for those who are actively engaging in self-management to have A1c values that are out of range. Other patient-level factors found to independently impact self-management and glycemic control, such as psychological and individual difference variables (Rechenberg, Szalacha, Salloum, & Grey, 2019) and healthcare system-level factors such prior engagement in programs designed to support self-management (Strawbridge, Lloyd, Meadow, Riley, & Howell, 2015), were not explored in the present study and are important areas for future research. Lastly, bivariate associations show that the association between self-management and A1c was largely driven by a moderate positive correlation between blood glucose monitoring and A1c and positive (though insignificant) correlation between medication adherence and A1c. Patients with poorer glycemic control, i.e., higher A1c values, are asked to monitor blood glucose more often than those with better A1c as part of routine care (ADA, 2019). More generally, it is possible that patients with recent lab draws indicating they need improvement in their clinical values may be asked to and/or are motivated to engage in an increase in self-management behaviors. Self-report measures were collected up to three months after lab-draws and may therefore be reflective of this greater engagement in self-management. Together, this may explain the positive association between self-management and higher clinical indicator values observed in the present sample. Longitudinal studies examining these associations are needed to elucidate causal pathways from individual self-management behaviors and improved diabetes outcomes.

4.4 Assessing the Relationships Among Patient Activation, Self-Management Behaviors, and Clinical Control Across Healthcare Systems

Finally, the exploratory Aim of this study was to assess whether the relationships among patient activation, self-management behaviors, and clinical control differed by healthcare system. While moderation models did not reveal any significant effects, these analyses may have been underpowered. Additionally, there were notable differences across the two study sites: NHC patients were more diverse, tended to be uninsured, and of lower socioeconomic status. NHC patients also tended to be younger, have had a diabetes diagnosis for fewer years, and have higher A1c values. Scripps patients endorsed higher overall adherence to self-management and blood glucose monitoring, while NHC patients endorsed greater adherence to dietary recommendations. Considering these marked group differences, it is interesting that the two subsamples did not differ in level of patient activation, with both groups reporting relatively high mean activation scores. It is clear that more research is needed to elucidate the associations between system-level and patient-level factors that might influence diabetes control in diverse primary care samples.

4.5 Clinical implications

The results of this study suggest that patient activation may be important to understanding the connection between self-management behaviors and clinical outcomes only under specific circumstances. Due to the heterogeneity of self-management behavior recommendations, and the need to individualize self-management plans to each patient and their dynamic clinical presentation, it may be useful to assess self-management behaviors individually. Measures of overall adherence to general self-management recommendations such

as the SDSCA may not meaningfully capture behavior in the clinical context. Moreover, it appears that understanding and achieving optimal diabetes outcomes requires consideration of the larger healthcare and community-level context. Rather than a one-size-fits all approach, interventions aimed at promoting patient activation and self-management among patients with T2DM may need to tailor interventions to individual patients' needs while also considering the obstacles patients face in completing recommended activities.

4.6 Strengths and Limitations

The present dissertation study has several strengths including utilizing objective measures of clinical control (e.g., A1c) directly extracted from EMR and using validated self-report measures of diabetes self-management and patient activation. Additionally, this study investigated associations among key variables in data collected from a diverse patient population recruited from two distinct primary care settings. The inclusion of patients with a range of sociodemographic characteristics is a notable improvement upon prior studies that exclusively examined predominantly White and/or insured patients. Furthermore, by using data from a pragmatic clinical trial, this study sought to shed light on the role of patient activation, self-management, and clinical control in a real-world healthcare context.

Despite these strengths, this study also has several limitations of note. A key limitation is the timing of the self-reported assessment in relation to trial enrollment. All participants completed baseline surveys one week following their last clinic appointment. For patients in the intervention arm of the study, this means baseline surveys were completed after receiving their first health coaching session (i.e., first intervention dose). Baseline survey responses could therefore have been influenced by the patient's last clinical encounter—an effect that was likely

more dramatic for intervention arm participants. This could have inflated self-reporting of activation and self-management behaviors. Overall, not having a true "baseline" measure of self-report data may have diluted effects of activation and self-management in analyses. While indicators of diabetes control were assessed via objective measures, there may have been significant differences across clinics (and potentially within clinics) in how systolic blood pressure was assessed, as there were no standardized assessment protocols. Variability in how clinical indicators data were collected was not assessed or controlled for and may have impacted the reliability of the SBP values used in the present study. Additionally, there are several medical conditions that may significantly impact the validity of A1c assays. For example, conditions such as anemia and uremia can result in falsely elevated A1c, while others such as acute and chronic blood loss and splenomegaly can result in falsely lowered A1c (Radin, 2014). The current study did not account for such conditions. Another notable limitation of this study is the use of a convenience sample. The present sample is restricted to those recruited from two healthcare systems in San Diego County. The results of this study may therefore not be generalizable to other primary care or T2DM populations. The study sample is further limited in that it only includes those who elected to complete the patient-reported outcome survey. While there were no notable differences between those who elected to complete the survey and those who did not in terms of basic demographic characteristics and baseline clinical control, it is still possible that these patients are distinct from the wider diabetes patient population, e.g., they may be particularly motivated to take action in managing their diabetes or may demonstrate different health behaviors compared those who did not choose to participate in the sub-study. While baseline clinical control values between sub-study participants and non-participants were not found to be significantly different, there may be other differences not accounted for which may

differentially impact patients' engagement in self-management and/or clinical control. Taken together, while the present study included a wide range of primary care patients from diverse socioeconomic and racial/ethnic backgrounds, this study's findings may not be generalizable to the patient populations outside of southern California, or populations that include large proportions of other underserved patient groups (e.g., those living in rural areas).

Another important limitation of the current study is that it consists of only the baseline measures taken from a longitudinal study, which precludes any conclusions regarding causality or directionality of the associations among study variables. The present study uses self-report measures to assess adherence to diabetes self-management behaviors which may introduce recall bias, socially desirable responding, as well as a problem of shared variance among variables. It has been observed that self-reporting of health behaviors does not consistently relate to objective measures of such behaviors (e.g., Nieuwlaat Mistry, & Haynes, 2016). Us,e of self-report measures of self-management may explain the positive association of reported adherence to self-management and A1c values observed in this and in prior studies. Additionally, the SDSCA items are intended to capture heterogeneous self-management behaviors, some of which lack specificity (e.g., adherence to an "overall healthful diet" is ambiguous) and others which may significantly vary based on individual clinical features (e.g., frequency of glucose monitoring). It is also remains unclear if such heterogeneous behaviors may be combined to produce a meaningful summary scores (Toobert & Glasgow, 1994). Together, the SDSCA can only provide a gross assessment of appropriately frequent engagement in self-management activities, which may account for the relatively weak associations of SDCA scores with glycemic control (A1c levels) in this and prior studies (e.g., Schmitt, Reimer, Hermanns, Huber, Ehrmann, Schall, & Kulzer, 2016).

With the ever-increasing availability of technology used to collect self-management data such as, actigraphy for physical activity assessment and digital glucose monitoring technologies (Reddy, Verma, & Dungan, 2020), it is now easier to have more objective and valid measures of diabetes care. Use of direct, objective measures of self-management behaviors in future studies may serve to clarify the associations between self-management, patient activation, and diabetes clinical control.

4.7 Conclusion

In summary, this study utilized cross-sectional data from a primary care sample to examine the possible associations between patient activation, self-management behaviors, and diabetes clinical control. This study represents a unique contribution to the literature in its use of objective measures of clinical control, validated measures of self-management, and the inclusion of a demographically diverse sample. Patient activation was observed to be high across the sample. Patient activation was not found to be associated with indicators of clinical control and was found to be positively associated with overall, diet-related, and physical activity self-management behaviors. Potential indirect effects of self-management in the association of patient activation and clinical control were examined. Patient activation was related to A1c indirectly through overall self-management, but in an unexpected direction. No other indirect effects of specific self-management behaviors were detected. Although mediation and moderation analyses were likely underpowered, the lack of strong and consistent associations between study variables may be emblematic of the complexity of achieving optimal diabetes outcomes and that neither high levels of activation nor high levels of self-management are sufficient in producing optimal health outcomes in T2DM. Taking into consideration the larger CCM framework, it is likely that

patient-level factors, such as patient activation and self-management, must work in concert with additional contextual factors to produce optimal health outcomes. These systemic factors were not explored in the present analyses; future research is therefore needed to clarify the relationships between patient activation, individual self-management behaviors, and diabetes clinical control. Lastly, interventions aimed at promoting optimal behavioral and clinical outcomes among patients with T2DM may be most effective when tailored to fit patients' individual needs and consider the barriers they may face in meeting behavioral goals.

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Table 1. Required sample size to detect a mediated effect with power of .80 in a single mediator model with dichotomous treatment assignment

	b Path		
a path	small (.14)	medium (.39)	large (.59)
small (.2)	640	404	394
medium (.5)	450	92	66
large (.8)	512	76	42

Note. From Thoemmes, F., MacKinnon, D. P., & Reiser, M. R. (2010). Power analysis for complex mediational designs using Monte Carlo methods. *Structural Equation Modeling*, *17*(3), 510-534). Path *c'* is held constant at .28, because it does not influence the power of the mediated effect (*ab*).

Table 2. Patients who completed the patient reported outcome survey and those who did not complete the survey compared by baseline clinical control values and age

	Completers	Non-completers		
	M (SD)	M (SD)	*t*	*p*-value
Age	63.0 (13.9)	68.0 (10.4)	1.3	0.30
A1c	8.8 (2.3)	9.7 (3.5)	0.6	0.40
SBP	132.1 (17.8)	122.6 (20.4)	-1.3	0.93
LDL-C	99.5(46.1)	85.0 (45.0)	-0.6	0.76

Note. A1c = glycosylated hemoglobin; LDL-C = low-density lipoprotein cholesterol; SBP = systolic blood pressure

Table 3. Patients who were in the intervention arm compared to those in the control arm of the Medical Assistant Coaching Trial compared by age, years since receiving a diabetes diagnosis, baseline clinical control values, patient activation (PAM score), and self-management behaviors (SDSCA total and subscale scores)

	Intervention (n=153)	Control (n= 126)	Group
	M (SD)	M (SD)	*t*
Age	63.1 (13.6)	62.7 (14.2)	0.3
Years with diabetes diagnosis	11.6 (9.5)	13.6 (11.4)	-1.6
A1c	9.0 (2.3)	8.7 (2.4)	1.0
LDL-C	97.3 (45.1)	101.6 (47.3)	-0.6
SBP	132.2 (17.6)	131.4 (18.2)	0.4
PAM	69.1 (14.0)	66.6 (13.3)	1.5
SDSCA total score	5.1 (1.1)	4.9 (1.3)	1.8
SDSCA general diet	5.4 (2.1)	5.3 (2.2.)	0.4
SDSCA specific diet	4.6 (1.6)	4.5 (1.8)	0.4
SDSCA physical activity	4.2 (2.6)	3.9 (2.7)	1.0
SDSCA blood glucose monitoring	5.0 (2.8)	4.5 (3.0)	1.4
SDSCA medication adherence	6.5 (1.5)	6.2 (2.0)	1.1

Note. A1c = glycosylated hemoglobin; LDL-C = low-density lipoprotein cholesterol; SBP = systolic blood pressure; PAM = Patient Activation Measure; SDSCA = Summary of Diabetes Self-Care Activities Measure

Table 4. Baseline sample characteristics overall and by study site of participants in the self-reported outcomes sub-study of the Medical Assistant Coaching Trial

	Total sample (N=297)	NHC (n=170)	Scripps Health (n=127)	Site comparisons [a]	
	M (SD)	M (SD)	M (SD)	*t*	*p*-value
Age (years) (n=297)	62.98 (13.9)	56.4 (11.8)	71.8 (11.3)	11.4	<.001
Number of years with diabetes diagnosis (n=277)	12.64 (10.3)	11.5 (8.6)	14.3 (12.1)	2.1	<.05
	N (%)	N (%)	N (%)	χ^2	*p*-value
Sex (n=297)					
Male	122 (58.9)	65 (38.2)	57 (44.9)	1.3	.249
Female	175 (41.1)	105 (61.8)	70 (55.1)		
Race (n=289)					
White	177 (61.2)	74 (45.4)	103 (81.7)	43.6	<.001
Black/African American	9 (3.1)	6 (3.7)	3 (2.4)		
American Indian	2 (0.7)	2 (1.2)	0 (0.0)		
Asian	10 (3.5)	7 (4.3)	3 (2.4)		
Native Hawaiian or Pacific Islander	7 (2.4)	5 (3.1)	2 (1.6)		
Other	74 (25.6)	63 (38.7)	11 (8.7)		
More than one race	10 (3.5)	6 (3.7)	4 (3.2)		
Hispanic/Latino Ethnicity (n=296)					
Yes	140 (47.3)	121 (71.6)	19 (15.0)	93.3	<.001
No	156 (52.7)	48 (28.4)	108 (85.0)		
Place of Birth (n=297)					
Born in the US	160 (53.9)	57 (33.5)	103 (81.1)	81.3	<.001
Born in Mexico	98 (33.0)	91 (53.5)	7 (5.5)		
Born in a country other than US or Mexico	39 (13.1)	22 (12.9)	17 (13.4)		

Table 4. (Continued) Baseline sample characteristics overall and by study site of participants in the self-reported outcomes sub-study of the Medical Assistant Coaching Trial

	Total sample (N=297)	NHC (n=170)	Scripps Health (n=127)	Site comparisons [a]	
	N (%)	N (%)	N (%)	χ^2	*p*-value
Household yearly income (n=265)					
<$30,000	146 (55.1)	123 (83.1)	23 (19.7)	106	<.001
≥$30,000	119 (44.9)	25 (16.9)	94 (80.3)		
Education level (n=297)					
< HS diploma or GED	69 (24.1)	62 (38.5)	7 (5.6)	43.6	<.001
≥ HS diploma or GED	217 (75.9)	99 (61.5)	118 (94.4)		
Employment status (n=295)					
Employed	74 (25.1)	43 (25.6)	31 (24.4)	0.05	.820
Unemployed	221 (74.9)	125 (74.4)	96 (75.6)		
Insurance coverage (n=296)					
Not covered by health insurance	20 (6.8)	20 (11.8)	0 (0.0)	16.1	<.001
Covered by health insurance	276 (93.2)	149 (88.2)	127 (100.0)		
Language of interview (n=297)					
English	209 (70.4)	86 (50.6)	123 (96.9)	74.6	<.001
Spanish	88 (29.6)	84 (49.9)	4 (3.1)		

Note. NHC = Neighborhood Health Care; SD = Standard Deviation

[a] NHC and Scripps subsamples compared across demographic variables. T-tests for continuous variables; Chi^2 for dichotomous variable

Table 5. Baseline sample characteristics overall and by study site of participants in the self-reported outcomes sub-study of the Medical Assistant Coaching Trial

	Total sample (N=297)	NHC (n=170)	Scripps Health (n=127)	Site comparisons	
	M (SD)	M (SD)	N (SD)	*t*	*p*-value
A1c	8.8 (2.3)	9.6 (2.3)	7.8 (1.9)	-6.90	<.001**
LDL-C	99.5 (46.1)	108.9 (48.5)	87.8 (40.3)	1.70	0.09
SBP	132.1 (17.8)	130 (18.1)	134.1 (17.2)	2.40	0.02*
PAM	68.1 (13.6)	76.4 (13.4)	68.9 (14.0)	0.93	0.35
SDSCA total score	5.0 (1.2)	4.8 (1.2)	5.1 (1.2)	-2.05	0.04*
SDSCA general diet	5.3 (2.1)	5.8 (1.8)	5.1 (2.3)	2.89	<.001**
SDSCA specific diet	4.6 (1.7)	4.7 (1.6)	4.2 (2.6)	1.14	0.01*
SDSCA physical activity	4.0 (2.6)	3.8 (2.6)	4.2 (2.6)	-1.26	0.21
SDSCA blood glucose monitoring	4.8 (2.9)	3.6 (3.2)	5.6 (2.3)	-5.55	<.001**
SDSCA medication adherence	6.4 (1.7)	6.3 (1.9)	6.3 (1.6)	-0.58	0.56

Note. NHC = Neighborhood Health Care; SD = Standard Deviation; A1c = glycosylated hemoglobin; LDL-C = low-density lipoprotein cholesterol; SBP = systolic blood pressure; PAM = Patient Activation Measure; SDSCA = Summary of Diabetes Self-Care Activities Measure; * $p < .05$; ** $p < .001$

Table 6. Proportion of participants with diabetes clinical indicators of control out of recommended ranges in the total sample and compared across study site

	Total sample (N=297)	NHC (n=170)	Scripps Health (n=127)	Site comparisons	
	N (%)	N (%)	N (%)	χ^2	*p*-value
A1c out of range	162 (60.4)	118 (69.4)	44 (34.6)	27.8	<.001
LDL-C out of range	46 (26.0)	32 (18.8)	14 (11.0)	5.1	<.05
SBP out of range	83 (27.9)	43 (25.3)	40 (31.5)	1.4	0.20

Note. NHC = Neighborhood Health Care. Control indicator cutoffs were based on the American Diabetes Association (2019) recommendations and were as follows: A1c ≥ 8.0%, SBP ≥ 140 mmHg, LDL-c ≥ 100 mg/dL.

Table 7. Bivariate correlations among patient activation (PAM), self-management behaviors (SDSCA), diabetes control (A1c, LDL-c, SBP), and healthcare system (Scripps, NHC)

Variable	1	2	3	4	5	6	7	8	9	10	11
1. PAM	-										
2. SDSCA total score[1]	0.21**	-									
3. SDSCA general diet subscale	0.16**	0.59**	-								
4. SDSCA specific diet subscale	0.16**	0.63**	0.41**	-							
5. SDSCA physical activity subscale	0.15*	0.48**	0.17**	0.11	-						
6. SDSCA Blood glucose monitoring subscale	0.07	0.58**	0.07	0.09	0.04	-					
7. SDSCA medication adherence subscale	0.01	0.44**	0.12	0.03	0.01	0.21**	-				
8. A1c	-0.07	0.13*	-0.08	-0.07	-0.02	0.28**	0.12	-			
9. LDL-C	-0.04	-0.08	0.01	-0.05	0.01	-0.04	-0.10	0.08	-		
10. SBP	0.01	0.01	0.05	0.14*	-0.04	-0.08	0.01	-0.19**	-0.02	-	
11. Healthcare system[2]	0.05	-0.12*	0.17**	0.07	-0.07	-0.33**	-0.04	-0.38**	-0.23**	0.14*	-

Note. [1]Total scores computed as the mean of all scale items and subscale scores computed as the mean of respective subscale items; [2]0 = Neighborhood Healthcare, 1 = Scripps Health; PAM = Patient Activation Measure; SDSCA = Summary of Diabetes Self-Care Activities Measure; A1c = glycosylated hemoglobin; LDL-C = low-density lipoprotein cholesterol; SBP = systolic blood pressure; * $p < .05$; ** $p < .01$

Table 8. Summary of objective 1 stepwise multiple linear regression analysis examining glycosylated hemoglobin A1c regressed on patient activation (PAM score) and covariates (N=297)

	Model	Unstandardized Coefficients			Standardized Coefficients			
		B	*SE*	95% CI	*β*	*t*	*p*-value	R^2
1	(Constant)	9.63	0.69	(8.29, 10.97)		14.07	<.001	0.01
	Patient Activation	-0.01	0.01	(-0.03, 0.01)	-0.07	-1.19	0.23	
2	(Constant)	12.85	0.97	(10.94, 14.76)		13.19	<.001	0.19
	Patient Activation	-0.01	0.01	(-0.03, 0.01)	-0.06	-1.10	0.27	
	Age (years)	-0.05	0.01	(-0.07, -0.02)	-0.27	-3.66	<.001	
	Male Sex	-0.32	0.26	(-0.83, 0.19)	-0.07	-1.24	0.22	
	Scripps Health	-1.07	0.33	(-1.71, -0.42)	-0.23	-3.25	<.05	
3	(Constant)	12.52	1.24	(10.09, 14.95)		10.09	<.001	0.22
	Patient Activation	-0.01	0.01	(-0.03, 0.01)	-0.08	-1.37	0.17	
	Age	-0.04	0.01	(-0.07, -0.01)	-0.23	-2.78	0.01	
	Male Sex	-0.34	0.30	(-0.93, 0.25)	-0.07	-1.13	0.26	
	Race-ethnicity (dummy coded)[a]							
	Hispanic White	0.44	0.43	(-0.41, 1.29)	0.08	1.02	0.31	
	Hispanic non-White	0.38	0.46	(-0.52, 1.28)	0.07	0.82	0.41	
	Non-Hispanic non-White	-0.27	0.60	(-1.44, 0.90)	-0.03	-0.45	0.65	
	Income ≥ $30,000	0.50	0.38	(-0.25, 1.25)	0.11	1.31	0.19	
	Years since diagnosis	0.01	0.01	(-0.00, 0.04)	0.06	0.94	0.35	
	English Language	-0.61	0.47	(-1.52, 0.30)	-0.12	-1.31	0.19	
	Scripps Health	-1.01	0.47	(-1.93, -0.10)	-0.21	-2.17	0.03	
	Days since A1c lab draw[b]	0.01	0.01	(-0.00, 0.02)	0.08	1.36	0.18	

Note. SE = Standard Error; CI = Confidence Interval; PAM = Patient Activation Measure

[a] Referent group = Non-Hispanic White. [b] Refers to number days between baseline survey and A1c lab draw.

Table 9. Summary of objective 1 stepwise multiple linear regression analysis examining low-density lipoprotein cholesterol (LDL-C) regressed on patient activation (PAM score) and covariates (N=297)

Model		Unstandardized Coefficients			Standardized Coefficients			
		B	*SE*	95% CI	*β*	*t*	*p*-value	R^2
1	(Constant)	110.07	17.26	(76.23, 143.91)		6.38	<.001*	0.00
	Patient Activation	-0.15	0.24	(-0.17, 0.08)	-0.04	-0.64	0.52	
2	(Constant)	136.4						
		3	21.13	(95.02, 177.85)		6.46	<.001*	0.06
	Patient Activation	-0.10	0.23	(-0.56, 0.35)	-0.03	-0.45	0.65	
	Age (years)	-0.35	0.25	(-0.83, 0.14)	-0.10	-1.41	0.16	
	Male Sex	-3.61	7.46	(-18.22, 11.00)	-0.04	-0.49	0.63	
	Scripps Health	-15.49	7.81	(-30.80, -0.18)	-0.17	-1.98	0.047*	
3	(Constant)	136.85	27.27	(83.40, 190.29)		5.02	<.001*	0.19
	Patient Activation	-0.26	0.23	(-0.71, 0.19)	-0.07	-1.13	0.26	
	Age	-0.26	0.33	(-0.92, 0.40)	-0.08	-0.78	0.44	
	Male Sex	-5.46	7.88	(-20.91, 9.99)	-0.06	-0.69	0.49	
	Race-ethnicity (dummy coded) [a]							
	Hispanic White	22.15	16.31	(-9.83, 54.12)	0.17	1.36	0.18	
	Hispanic non-White	21.46	10.36	(1.16, 41.76)	0.21	2.07	0.04*	
	Non-Hispanic non-White	-5.77	13.28	(-31.80, 20.25)	-0.04	-0.44	0.66	
	Income ≥ $30,000	-4.68	10.04	(-24.37, 15.01)	-0.05	-0.47	0.64	
	Years since diagnosis	-1.13	0.36	(-1.83, -0.44)	-0.24	-3.19	0.001*	
	English Language	24.62	13.12	(-1.11, 50.35)	0.24	1.88	0.06	
	Scripps Health	-17.52	10.73	(-38.55, 3.51)	-0.19	-1.63	0.10	
	Days since LDL-C lab draw [b]	-0.11	0.15	(-0.41, 0.18)	-0.06	-0.77	0.44	

Note. SE = Standard Error; CI = Confidence Interval; PAM = Patient Activation Measure. * $p < 0.05$

[a] Referent group = Non-Hispanic White. [b] Refers to number days between baseline survey and LDL-C lab draw.

Table 10. Summary of objective 1 stepwise multiple linear regression analysis examining systolic blood pressure (SBP) regressed on patient activation (PAM score) and covariates (N=297)

Model		Unstandardized Coefficients			Standardized Coefficients			
		B	*SE*	95% CI	*β*	*t*	*p*-value	R^2
1	(Constant)	133.10	4.12	(125.03, 141.17)	8.68	32.32	<.001*	0.00
	Patient Activation	0.01	0.06	(-0.10, 0.12)	0.01	0.18	0.86	
2	(Constant)	108.25	6.40	(95.71, 120.79)	7.06	16.92	<.001*	0.10
	Patient Activation	0.03	0.06	(-0.09, 0.14)	0.02	0.45	0.66	
	Age (years)	0.38	0.08	(0.22, 0.53)	0.34	4.78	<.001*	
	Male Sex	2.06	1.70	(-1.27, 5.40)	0.07	1.21	0.23	
	Scripps Health	-1.74	2.10	(-5.86, 2.38)	-0.06	-0.83	0.41	
3	(Constant)	102.95	7.75	(87.76, 118.15)	6.92	13.28	<.001*	0.11
	Patient Activation	0.08	0.06	(-0.04, 0.20)	0.07	1.29	0.20	
	Age	0.34	0.08	(0.18, 0.50)	0.31	4.19	<.001*	
	Male Sex	3.71	1.84	(0.09, 7.32)	0.12	2.01	0.04*	
	Race-ethnicity (dummy coded)[a]							
	Hispanic White	0.85	2.93	(-4.90, 6.60)	0.02	0.29	0.77	
	Hispanic non-White	0.98	3.18	(-5.24, 7.20)	0.03	0.31	0.76	
	Non-Hispanic non-White	2.20	3.43	(-4.53, 8.94)	0.04	0.64	0.52	
	Income ≥ $30,000	-2.48	2.40	(-7.19, 2.23)	-0.08	-1.03	0.30	
	Years since diagnosis	0.03	0.09	(-0.14, 0.20)	0.02	0.30	0.76	
	English Language	4.44	2.60	(-0.67, 9.54)	0.14	1.70	0.09	
	Scripps Health	-1.56	3.17	(-7.78, 4.66)	-0.05	-0.49	0.62	
	Days since SBP reading[b]	-0.43	0.13	(-0.41, 0.18)	-0.04	-0.35	0.70	

Note. SE = Standard Error; CI = Confidence Interval; PAM = Patient Activation Measure. * $p < 0.05$

[a] Referent group = Non-Hispanic White. [b] Refers to number days between baseline survey and SBP measure.

Table 11. Summary of objective 2 stepwise multiple linear regression analysis examining diabetes self-management (SDSCA total score) regressed on patient activation (PAM score) and covariates (N=297)

	Model	Unstandardized Coefficients			Standardized Coefficients			
		B	*SE*	95% CI	*β*	*t*	*p*-value	R^2
1	(Constant)	3.76	0.35	(3.08, 4.44)		10.79	<.001*	0.04
	Patient Activation	0.02	0.01	(0.01, 0.03)	0.21	3.84	<.001*	
2	(Constant)	3.33	0.46	(2.43, 4.23)		7.26	<.001*	0.07
	Patient Activation	0.02	0.01	(0.01, 0.03)	0.23	4.10	<.001*	
	Age (years)	0.01	0.01	(-0.00, 0.02)	0.10	1.66	0.10	
	Male sex	-0.07	0.14	(-0.34, 0.20)	-0.03	-0.49	0.63	
	Scripps Health	-0.44	0.16	(-0.75, -0.13)	-0.19	-2.79	0.01*	
3	(Constant)	3.53	0.60	(2.36, 4.71)		5.88	<.001*	0.10
	Patient Activation	0.02	0.01	(0.01, 0.03)	0.19	2.83	0.01*	
	Age	0.00	0.01	(-0.01, 0.02)	0.05	0.64	0.52	
	Male sex	-0.01	0.15	(-0.30, 0.29)	-0.00	-0.04	0.97	
	Race-ethnicity (dummy coded)[a]							
	Hispanic White	0.47	0.23	(0.03, 0.92)	0.18	2.08	0.04*	
	Hispanic non-White	0.24	0.24	(-0.22, 0.71)	0.10	1.02	0.31	
	Non-Hispanic non-White	0.35	0.26	(-0.16, 0.86)	0.09	1.35	0.18	
	Income ≥ $30,000	-0.19	0.20	(-0.58, 0.19)	-0.09	-0.98	0.33	
	Years since diagnosis	0.01	0.01	(-0.01, 0.02)	0.07	0.94	0.35	
	English Language	-0.16	0.21	(-0.57, 0.25)	-0.07	-0.77	0.44	
	Scripps Health	0.08	0.22	(-0.35, 0.50)	0.03	0.36	0.72	

Note. SE = Standard Error; CI = Confidence Interval; SDSCA = Summary of Diabetes Self-Care Activities Measure; PAM = Patient Activation Measure. * $p < 0.05$

[a] Referent group = Non-Hispanic White.

Table 12. Summary of objective 2 stepwise multiple linear regression analysis examining healthful diet (SDSCA general diet subscale score) regressed on patient activation (PAM score) and covariates (N=297)

Model		Unstandardized Coefficients			Standardized Coefficients			
		B	*SE*	95% CI	*β*	*t*	*p*-value	R^2
1	(Constant)	3.69	0.69	(2.34, 5.05)		5.35	<.001	0.02
	Patient Activation	0.02	0.01	(0.01, 0.04)	0.16	2.52	0.01*	
2	(Constant)	2.30	0.92	(0.51, 4.10)		2.512	0.01	0.06
	Patient Activation	0.02	0.01	(0.01, 0.04)	0.16	2.51	0.01*	
	Age (years)	0.02	0.01	(-0.00, 0.04)	0.12	1.67	0.09	
	Male sex	0.27	0.25	(-0.21, 0.76)	0.06	1.11	0.27	
	Scripps Health	0.42	0.28	(-0.14, 0.97)	0.10	1.46	0.14	
3	(Constant)	2.25	1.10	(0.10, 4.41)		2.05	0.04*	0.11
	Patient Activation	0.02	0.01	(0.00, 0.05)	0.15	1.99	0.047*	
	Age	0.02	0.01	(-0.01, 0.04)	0.10	1.24	0.21	
	Male sex	0.34	0.26	(-0.18, 0.85)	0.08	1.29	0.20	
	Race-ethnicity (dummy coded)[a]							
	Hispanic White	1.09	0.43	(0.26, 1.93)	0.21	2.56	0.01*	
	Hispanic non-White	0.42	0.43	(-0.43, 1.27)	0.09	0.97	0.33	
	Non-Hispanic non-White	0.59	0.48	(-0.35, 1.54)	0.09	1.23	0.22	
	Income ≥ $30,000	-0.64	0.30	(-1.23, -0.05)	-0.15	-2.11	0.04*	
	Years since diagnosis	-0.02	0.01	(-0.04, 0.01)	-0.08	-1.18	0.24	
	English Language	0.08	0.37	(-0.64, 0.81)	0.02	0.24	0.81	
	Scripps Health	1.25	0.42	(0.42, 2.07)	0.30	2.96	0.003*	

Note. SE = Standard Error; CI = Confidence Interval unstandardized coefficients are presented; SDSCA = Summary of Diabetes Self-Care Activities Measure; General diet subscale assesses adherence to an overall healthful diet; PAM = Patient Activation Measure.* $p < 0.05$

[a] Referent group = Non-Hispanic White.

Table 13. Summary of objective 2 stepwise multiple linear regression analysis examining healthful diet (SDSCA specific diet subscale score) regressed on patient activation (PAM score) and covariates (N=297)

	Model	Unstandardized Coefficients			Standardized Coefficients			
		B	*SE*	95% CI	*β*	*t*	*p*-value	R^2
1	(Constant)	3.25	0.49	(2.28, 4.21)		6.58	<.001*	0.02
	Patient Activation	0.02	0.01	(0.01, 0.03)	0.16	2.81	0.01*	
2	(Constant)	1.58	0.67	(0.27, 2.89)		2.37	0.02*	0.09
	Patient Activation	0.02	0.01	(0.01, 0.03)	0.17	3.17	0.002*	
	Age (years)	0.03	0.01	(0.01, 0.04)	0.23	3.72	<.001*	
	Male sex	-0.39	0.20	(-0.78, -0.00)	-0.12	-1.98	0.048*	
	Scripps Health	-0.20	0.23	(-0.66, 0.26)	-0.06	-0.86	0.39	
3	(Constant)	1.61	0.74	(0.15, 3.07)		2.16	0.03*	0.16
	Patient Activation	0.03	0.01	(0.00, 0.03)	0.15	2.49	0.01*	
	Age	0.02	0.01	(0.01, 0.04)	0.18	2.83	0.01*	
	Male sex	-0.43	0.21	(-0.83, -0.01)	-0.12	-2.01	0.045*	
	Race-ethnicity (dummy coded) [a]							
	Hispanic White	0.95	0.37	(0.22, 1.69)	0.23	2.55	0.01*	
	Hispanic non-White	0.88	0.34	(0.21, 1.54)	0.24	2.59	0.01*	
	Non-Hispanic non-White	1.05	0.34	(0.39, 1.72)	0.19	3.12	0.04*	
	Income ≥ $30,000	-0.06	0.25	(-0.55, 0.43)	-0.02	-0.22	0.82	
	Years since diagnosis	-0.02	0.01	(-0.02, 0.01)	-0.03	-0.60	0.55	
	English Language	-0.32	0.28	(-0.88, 0.24)	-0.09	-1.12	0.26	
	Scripps Health	0.69	0.34	(0.04, 1.35)	0.21	2.06	0.04*	

Note. SE = Standard Error; CI = Confidence Interval; SDSCA = Summary of Diabetes Self-Care Activities Measure; Specific diet subscale assesses adherence to a low-fat and produce-rich diet; PAM = Patient Activation Measure. * $p < 0.05$

[a] Referent group = Non-Hispanic White.

Table 14. Summary of objective 2 stepwise multiple linear regression analysis examining physical activity (SDSCA physical activity subscale score) regressed on patient activation (PAM score) and covariates (N=297)

Model		Unstandardized Coefficients			Standardized Coefficients			
		B	*SE*	95% CI	*β*	*t*	*p*-value	R^2
1	(Constant)	2.11	0.80	(0.54, 3.67)		2.64	0.01*	0.02
	Patient Activation	0.03	0.01	(0.01, 0.05)	0.15	2.53	0.01*	
2	(Constant)	1.44	1.11	(-0.73, 3.61)		1.30	0.19	0.05
	Patient Activation	0.03	0.01	(0.01, 0.05)	0.15	2.64	0.01*	
	Age (years)	0.01	0.01	(-0.02, 0.04)	0.05	0.73	0.46	
	Male sex	0.67	0.31	(0.07, 1.27)	0.13	2.17	0.03*	
	Scripps healthcare system	-0.60	0.37	(-1.32, 0.12)	-0.11	-1.65	0.10*	
3	(Constant)	2.46	1.34	(-0.17, 5.09)		1.83	0.07*	0.07
	Patient Activation	0.03	0.01	(0.01, 0.05)	0.15	1.83	0.02*	
	Age	0.01	0.01	(-0.03, 0.03)	0.00	-0.01	0.99	
	Male sex	0.65	0.34	(-0.01, 1.31)	0.13	1.94	0.05	
	Race-ethnicity (dummy coded)[a]							
	Hispanic White	0.05	0.54	(-1.01, 1.12)	0.01	0.10	0.92	
	Hispanic non-White	0.00	0.51	(-1.00, 1.01)	0.00	0.00	0.10	
	Non-Hispanic non-White	-0.03	0.59	(-1.18, 1.11)	0.00	-0.06	0.96	
	Income ≥ $30,000[d]	0.15	0.42	(-0.68, 0.98)	0.03	0.35	0.73	
	Years since diagnosis	-0.02	0.02	(-0.05, 0.01)	-0.09	-1.36	0.17	
	English Language	-0.65	0.52	(-1.58, 0.28)	-0.11	-1.38	0.17	
	Scripps Health	-0.12	0.52	(-1.14, 0.89)	-0.02	-0.24	0.81	

Note. SE = Standard Error; CI = Confidence Interval; SDSCA = Summary of Diabetes Self-Care Activities Measure; Physical activity subscale assesses meeting physical activity recommendations (at least 30 minutes of continuous activity, including walking); PAM = Patient Activation Measure. * $p < 0.05$

[a] Referent group = Non-Hispanic White.

Table 15. Summary of objective 2 stepwise multiple linear regression analysis examining blood glucose self-monitoring (SDSCA blood glucose subscale score) regressed on patient activation (PAM score) and covariates (N=297)

Model		Unstandardized Coefficients			Standardized Coefficients			
		B	*SE*	95% CI	*β*	*t*	*p*-value	R^2
1	(Constant)	3.72	0.88	(1.99, 5.45)		4.22	<.001*	0.01
	Patient Activation	0.02	0.01	(-0.01, 0.04)	0.01	1.20	0.23	
2	(Constant)	5.09	1.22	(2.69, 7.48)		4.16	<.001*	0.12
	Patient Activation	0.02	0.01	(-0.01, 0.04)	0.08	1.50	0.13	
	Age (years)	-0.01	0.02	(-0.04, 0.02)	-0.05	-0.70	0.48	
	Male sex	-0.32	0.33	(-0.96, 0.32)	-0.06	-0.99	0.321	
	Scripps Health	-1.77	0.41	(-2.57, -0.97)	-0.31	-4.32	<.001 *	
3	(Constant)	4.30	1.48	(1.39, 7.21)		2.90	0.004*	0.15
	Patient Activation	0.02	0.01	(-0.00, 0.05)	0.12	1.87	0.06	
	Age	-0.01	0.02	(-0.04, 0.02)	-0.06	-0.79	0.43	
	Male sex	-0.12	0.34	(-0.80, 0.55)	-0.02	-0.36	0.72	
	Race-ethnicity (dummy coded) [a]							
	Hispanic White	0.36	0.54	(-0.70, 1.41)	0.05	0.66	0.51	
	Hispanic non-White	-0.39	0.57	(-1.50, 0.71)	-0.06	-0.70	0.49	
	Non-Hispanic non-White	-0.05	0.67	(-1.37, 1.27)	-0.01	-0.07	0.94	
	Income ≥ $30,000	-0.52	0.46	(-1.42, 0.39)	-0.09	-1.12	0.26	
	Years since diagnosis	0.05	0.02	(0.01, 0.08)	0.18	2.61	0.01*	
	English Language	-0.12	0.49	(-1.08, 0.85)	-0.02	-0.24	0.81	
	Scripps Health	-1.44	0.57	(-2.56, -0.32)	-0.25	-2.51	0.01	

Note. SE = Standard Error; CI = Confidence Interval; SDSCA = Summary of Diabetes Self-Care Activities Measure; PAM = Patient Activation Measure. * $p < 0.05$

[a] Referent group = Non-Hispanic White.

Table 16. Summary of objective 2 stepwise multiple linear regression analysis examining medication adherence (SDSCA medication subscale score) regressed on patient activation (PAM score) and covariates (N=297)

Model		Unstandardized Coefficients			Standardized Coefficients			
		B	*SE*	95% CI	*β*	*t*	*p*-value	R^2
1	(Constant)	6.25	0.49	(5.29, 7.21)		12.76	<.001*	0.02
	Patient Activation	0.00	0.01	(-0.01, 0.02)	0.01	0.22	0.83	
2	(Constant)	6.45	0.76	(4.97, 7.94)		8.51	<.001*	0.00
	Patient Activation	0.00	0.01	(-0.01, 0.02)	0.02	0.27	0.79	
	Age (years)	0.00	0.01	(-0.02, 0.01)	-0.02	-0.25	0.80	
	Male sex	-0.15	0.23	(-0.59, 0.30)	-0.04	-0.65	0.52	
	Scripps healthcare system	-0.10	0.24	(-0.57, 0.38)	-0.03	-0.40	0.69	
3	(Constant)	7.01	1.13	(4.79, 9.23)		6.19	<.001*	0.03
	Patient Activation	0.00	0.01	(-0.02, 0.02)	-0.01	-0.18	0.86	
	Age	0.00	0.01	(-0.02, 0.02)	-0.01	-0.12	0.91	
	Male sex	-0.30	0.24	(-0.77, 0.17)	-0.09	-1.27	0.20	
	Race-ethnicity (dummy coded)[a]							
	Hispanic White	-0.08	0.44	(-0.94, 0.78)	-0.02	-0.18	0.85	
	Hispanic non-White	-0.32	0.48	(-1.26, 0.62)	-0.08	-0.67	0.51	
	Non-Hispanic non-White	-0.16	0.49	(-1.13, 0.80)	-0.03	-0.33	0.74	
	Income ≥ $30,000[d]	0.56	0.31	(-0.05, 1.18)	0.16	1.80	0.07	
	Years since diagnosis	0.00	0.01	(-0.03, 0.02)	-0.03	-0.33	0.74	
	English Language	-0.34	0.39	(-1.10, 0.42)	-0.09	-0.88	0.38	
	Scripps Health	0.40	0.38	(-1.14, 0.34)	-0.12	-1.07	0.29	

Note. SE = Standard Error; CI = Confidence Interval; SDSCA = Summary of Diabetes Self-Care Activities Measure; PAM = Patient Activation Measure. * $p < 0.05$

[a] Referent group = Non-Hispanic White

Table 17. Exploratory path models with glycosylated hemoglobin A1c as the dependent variable, Patient Activation Measure as the independent variable, and Summary of Diabetes Self-Care Activities Measure (SDSCA) total score and SDSCA subscales tested as the indirect effect (mediator) variable.

Model	Moderation effect		*ab* path Indirect effect		*a* path SDSDCA on PAM		*b* path A1c on SDSCA	
	B (SE)	(95%CI)	*B* (SE)	(95%CI)	*B* (SE)	*β*	B (SE)	*β*
Moderator: Site Mediator: SDSCA total score	0.00 (0.00)	(-0.00, 0.01)	0.00 (0.00)	(0.00, 0.01)	0.27 (0.12)	0.13*	0.01 (0.01)	0.13
Moderator: Site Mediator: SDSCA General Diet	0.00 (0.00)	(-.000, 0.01)	0.00 (0.00)	(0.00, 0.00)	0.02(0.08)	0.02	0.00 (0.02)	0.01
Moderator: Site Mediator: SDSCA Specific Diet	0.00 (.000)	(-0.00, 0.00)	0.01 (0.00)	(-0.01, 0.00)	-0.03(0.09)	-0.02	0.02 (0.01)	0.13
Moderator: Site Mediator: SDSCA Physical Activity	0.00 (0.00)	(-.000, 0.01)	0.00 (0.00)	(-0.01, 0.00)	-0.02(0.06)	-0.02	0.04 (0.02)	0.22
Moderator: Site Mediator: SDSCA Blood Glucose Monitoring	0.01 (0.01)	(-0.00, 0.02)	0.00 (0.00)	(-0.01, 0.00)	0.14(0.05)	0.17**	0.00 (0.002)	-0.01
Moderator: Site Mediator: SDSCA Medication	0.00 (0.01)	(-0.00, 0.02)	0.00 (0.00)	(-0.01, 0.00)	0.21(0.09)	0.15	-0.001 (0.01)	-0.07

Note. Models controlled for age, sex, race-ethnicity, income, years since diagnosis, language, healthcare system, and days since lab draw. Unstandardized regression coefficients and standardized errors are displayed for the *a* and *b* paths. For the moderation and indirect effects, the unstandardized estimate is shown with bias-corrected bootstrapped 95% confidence intervals. β indicates

Table 18. Exploratory path models with systolic blood pressure (SBP) as the dependent variable, Patient Activation Measure as the independent variable, and self-management behaviors (SDSCA) total score and SDSCA subscales tested as the indirect effect (mediator) variable.

Model	Moderation effect		*ab* path		*a* path		*b* path	
			Indirect effect		SDSDCA on PAM		SBP on SDSCA	
	B (SE)	(95%CI)	*B* (SE)	(95%CI)	*B* (SE)	*β*	B (SE)	*β*
Moderator: Site Mediator: SDSCA total score	0.01 (0.02)	(-0.01, 0.08)	0.01 (0.02)	(-0.01, 0.06)	1.00 (0.92)	0.07	0.01 (0.01)	0.15
Moderator: Site Mediator: SDSCA General Diet	0.01 (0.02)	(-0.02, 0.06)	0.00 (0.01)	(-0.01, 0.03)	0.25 (0.43)	0.03	0.01 (0.02)	0.03
Moderator: Site Mediator: SDSCA Specific Diet	0.00 (0.02)	(-0.02, 0.05)	0.02 (0.02)	(-0.03, 0.07)	1.00 (0.67)	0.1	0.02 (0.01)	0.13
Moderator: Site Mediator: SDSCA Physical Activity	0.00 (0.02)	(-0.02, 0.05)	-0.01 (0.02)	(-0.04, 0.03)	-0.11 (0.41)	-0.017	0.04 (0.02)	0.22*
Moderator: Site Mediator: SDSCA Blood Glucose Monitoring	0.01 (0.02)	(-0.03, 0.06)	0.00 (0.01)	(-0.01, 0.02)	0.15 (0.40)	0.03	0.00 (0.02)	0.01
Moderator: Site Mediator: SDSCA Medication	0.00 (0.01)	(-0.02, 0.03)	0.00 (0.01)	(-0.02, 0.01)	0.067 (0.63)	0.01	-0.01 (0.01)	-0.04

Note. Models controlled for age, sex, race-ethnicity, income, years since diagnosis, language, healthcare system, and days since lab draw. Unstandardized regression coefficients and standardized errors are displayed for the *a* and *b* paths. For the moderation and indirect effects, the unstandardized estimate is shown with bias-corrected bootstrapped 95% confidence intervals. β indicates standardized regression coefficient. *p <0.05, **p <0.001

Table 19. Exploratory path models with lipoprotein cholesterol (LDL-C) as the dependent variable, Patient Activation Measure as the independent variable, and self-management behaviors (SDSCA) total score and SDSCA subscales tested as the indirect effect (mediator) variable.

Model	Moderation effect		*ab* path		*a* path		*b* path	
			Indirect effect		SDSDCA on PAM		LDL-C on SDSCA	
	B (SE)	(95%CI)	*B* (SE)	(95%CI)	*B* (SE)	*β*	B (SE)	*β*
Moderator: Site Mediator: SDSCA total score	-0.02 (0.10)	(-0.25, 0.17)	0.00 (0.04)	(-0.07, 0.08)	-0.66 (3.76)	-0.02	-0.00 (0.00)	-0.01
Moderator: Site Mediator: SDSCA General Diet	0.11 (0.13)	(-0.05, 0.50)	-0.04 (0.08)	(-0.30, 0.05)	2.22 (1.97)	0.10	-0.02 (0.02)	-0.10
Moderator: Site Mediator: SDSCA Specific Diet	0.02 (0.07)	(-0.07, 0.26)	-0.00 (0.04)	(-0.11, 0.07)	1.17 (2.78)	0.04	-0.00 (0.01)	-0.010
Moderator: Site Mediator: SDSCA Physical Activity	0.01 (0.06)	(-0.06, 0.23)	0.01 (0.05)	(-0.04, 0.20)	1.13 (1.40)	0.06	0.01 (0.03)	0.06
Moderator: Site Mediator: SDSCA Blood Glucose Monitoring	-0.04 (0.09)	(-0.32, 0.06)	-0.01 (0.04)	(-0.14, 0.04)	-1.02 (1.45)	-0.06	0.01 (0.02)	0.03
Moderator: Site Mediator: SDSCA Medication	-0.02 (0.08)	(-0.29, 0.06)	0.02 (0.06)	(-0.04, 0.24)	-1.54 (2.55)	-0.06	-0.01 (0.02)	-0.08

Note. Models controlled for age, sex, race-ethnicity, income, years since diagnosis, language, healthcare system, and days since lab draw. Unstandardized regression coefficients and standardized errors are displayed for the *a* and *b* paths. For the moderation and indirect effects, the unstandardized estimate is shown with bias-corrected bootstrapped 95% confidence intervals. β indicates standardized regression coefficient.

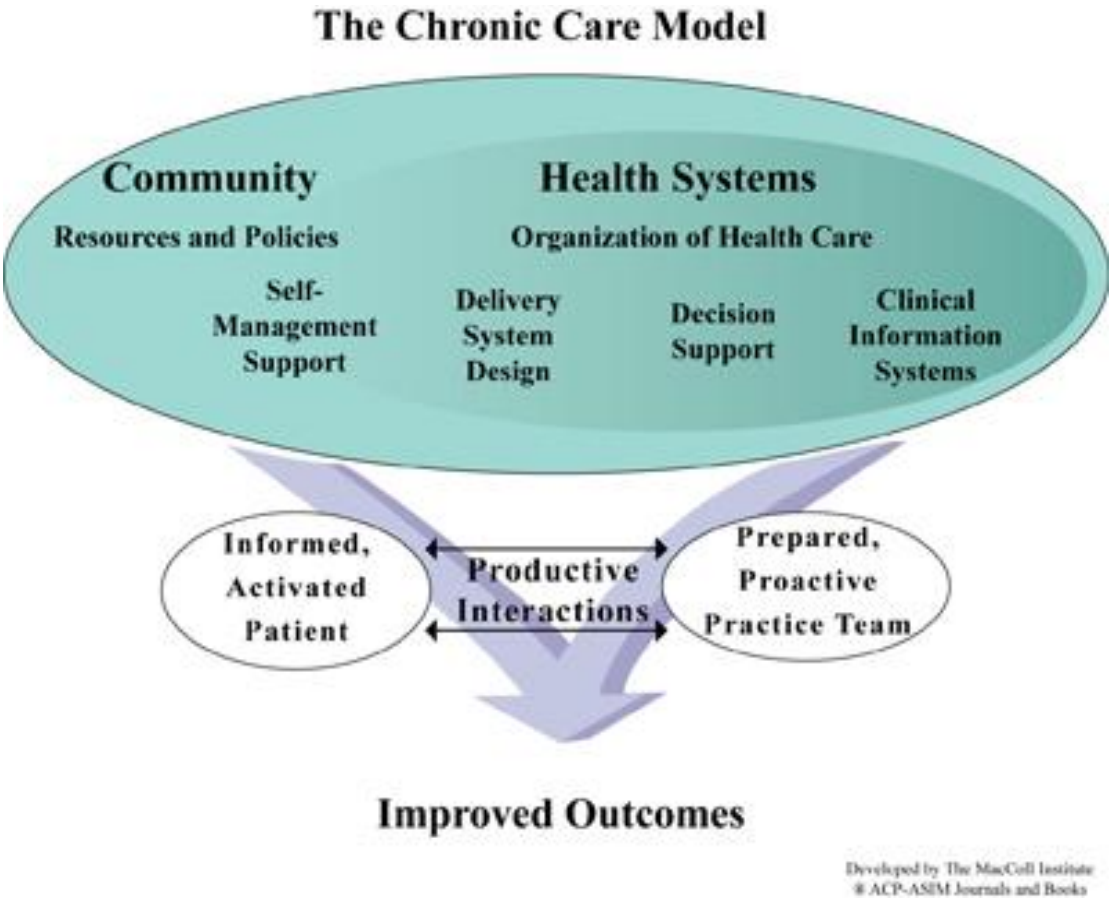

Figure 1. The Chronic Care Model integrates community and health system components to optimize care and improve health outcomes (Wagner et al.,1996; Wagner et al., 2001).

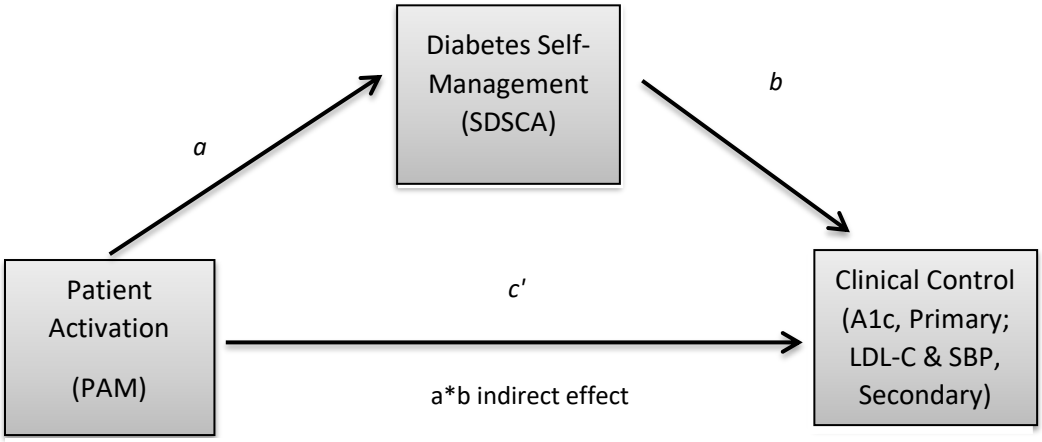

Figure 2. Summary of primary study aims. Aim 1 tested the direct associations of patient activation (i.e., PAM score) and clinical control indicators (A1c, primary; LDL-C and SBP, secondary) (c). Aim 2 tested the direct associations of patient activation and self-management behaviors (indicated by SDSCA total and subscale scores) (a). Aim 3 tested the hypothesis that associations between patient activation and clinical control (c') are explained in part by indirect effects through self-management behaviors (indirect pathway a*b).

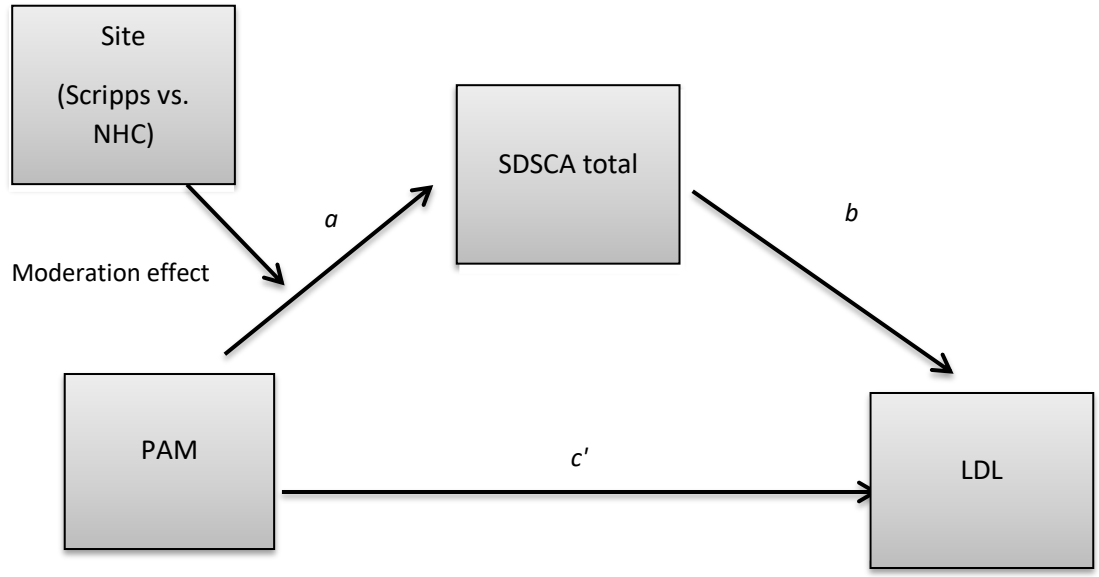

Figure 3. The exploratory aim tested whether the associations between patient activation and diabetes self-management vary by healthcare system (i.e., moderation test of interaction) and examined if the indirect pathway was significant (would suggest moderated mediation).

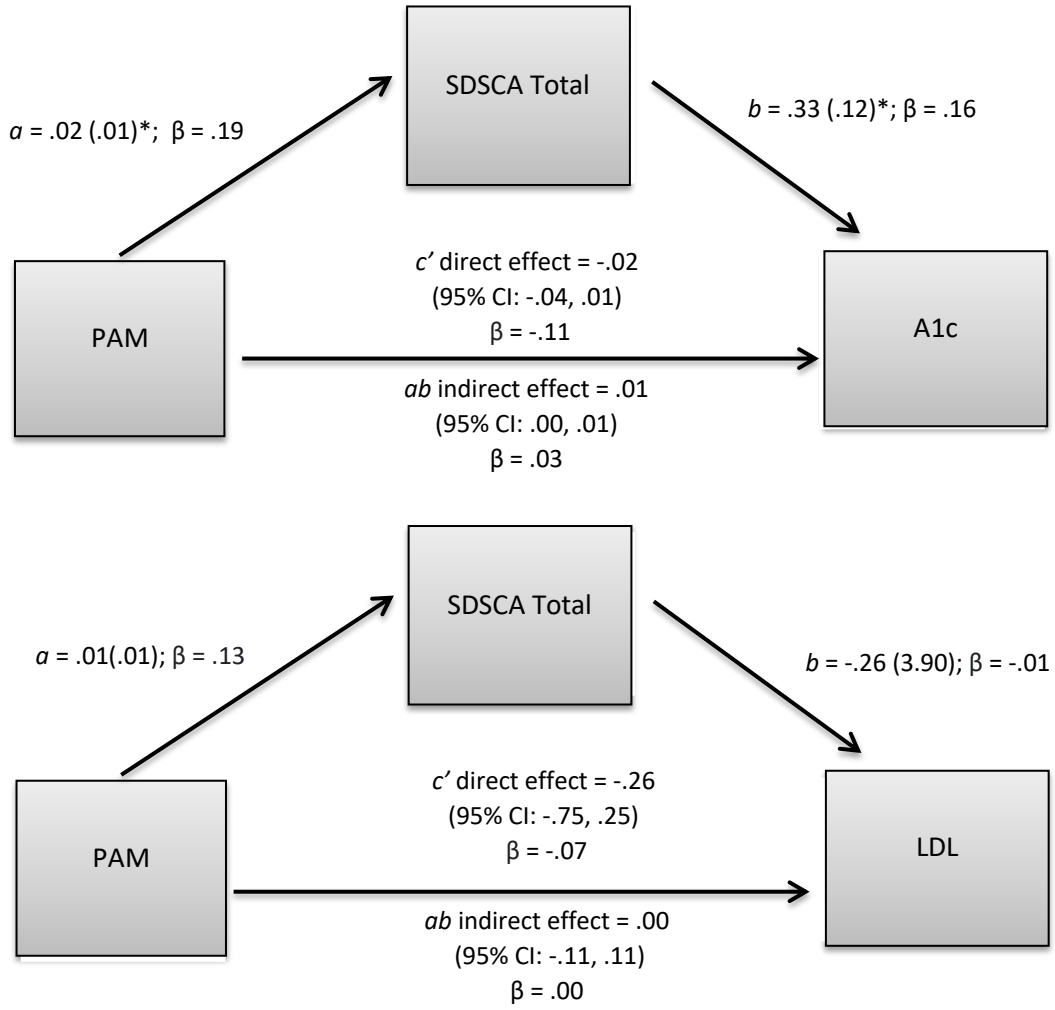

Figure 4: Objective 3 path models with diabetes indicators of control (glycosylated hemoglobin [A1c]; low-density lipoprotein cholesterol [LDL-C]; systolic blood pressure [SBP]) as the outcome variables, patient activation (Patient Activation Measure [PAM] score) as the exposure variable, and overall adherence to self-management behaviors (Summary of Diabetes Self-Care Activities Measure [SDSCA] total score) as the indirect effect (mediator) variable. The following covariates were controlled for (not shown in figure): age, sex, race-ethnicity, income, years since diabetes diagnosis, language, study site, and days since lab draw. For the *a* and *b* paths, unstandardized regression coefficients and standard errors (in parentheses) are displayed. For the direct (*c'*) and indirect effects (*ab*), the unstandardized estimate with bias-corrected bootstrapped 95% confidence intervals are displayed. β indicates standardized regression coefficient. * $p < .05$; ** $p < .0001$.

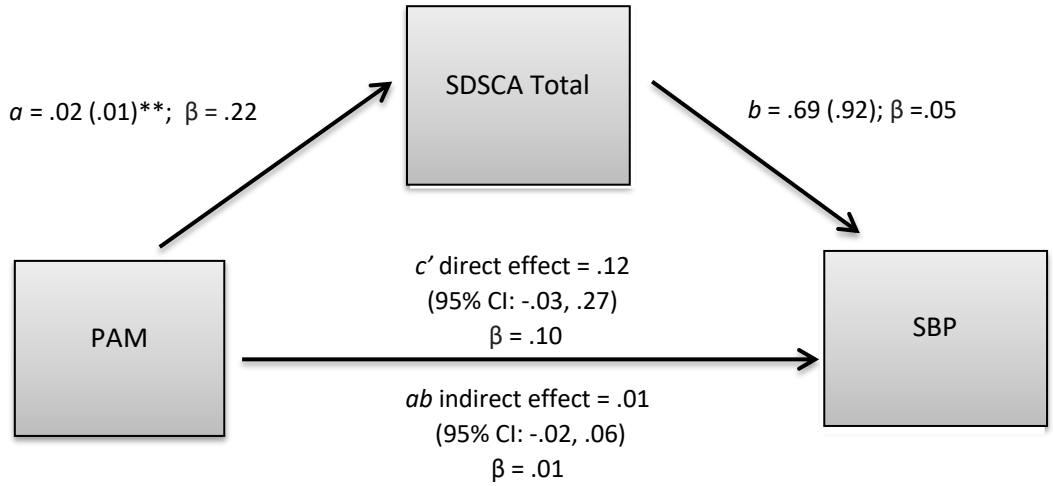

Figure 4: (Continued) Objective 3 path models with diabetes indicators of control (glycosylated hemoglobin [A1c]; low-density lipoprotein cholesterol [LDL-C]; systolic blood pressure [SBP]) as the outcome variables, patient activation (Patient Activation Measure [PAM] score) as the exposure variable, and overall adherence to self-management behaviors (Summary of Diabetes Self-Care Activities Measure [SDSCA] total score) as the indirect effect (mediator) variable. The following covariates were controlled for (not shown in figure): age, sex, race-ethnicity, income, years since diabetes diagnosis, language, study site, and days since lab draw. For the *a* and *b* paths, unstandardized regression coefficients and standard errors (in parentheses) are displayed. For the direct (*c'*) and indirect effects (*ab*), the unstandardized estimate with bias-corrected bootstrapped 95% confidence intervals are displayed. β indicates standardized regression coefficient. * $p < .05$; ** $p < .0001$.

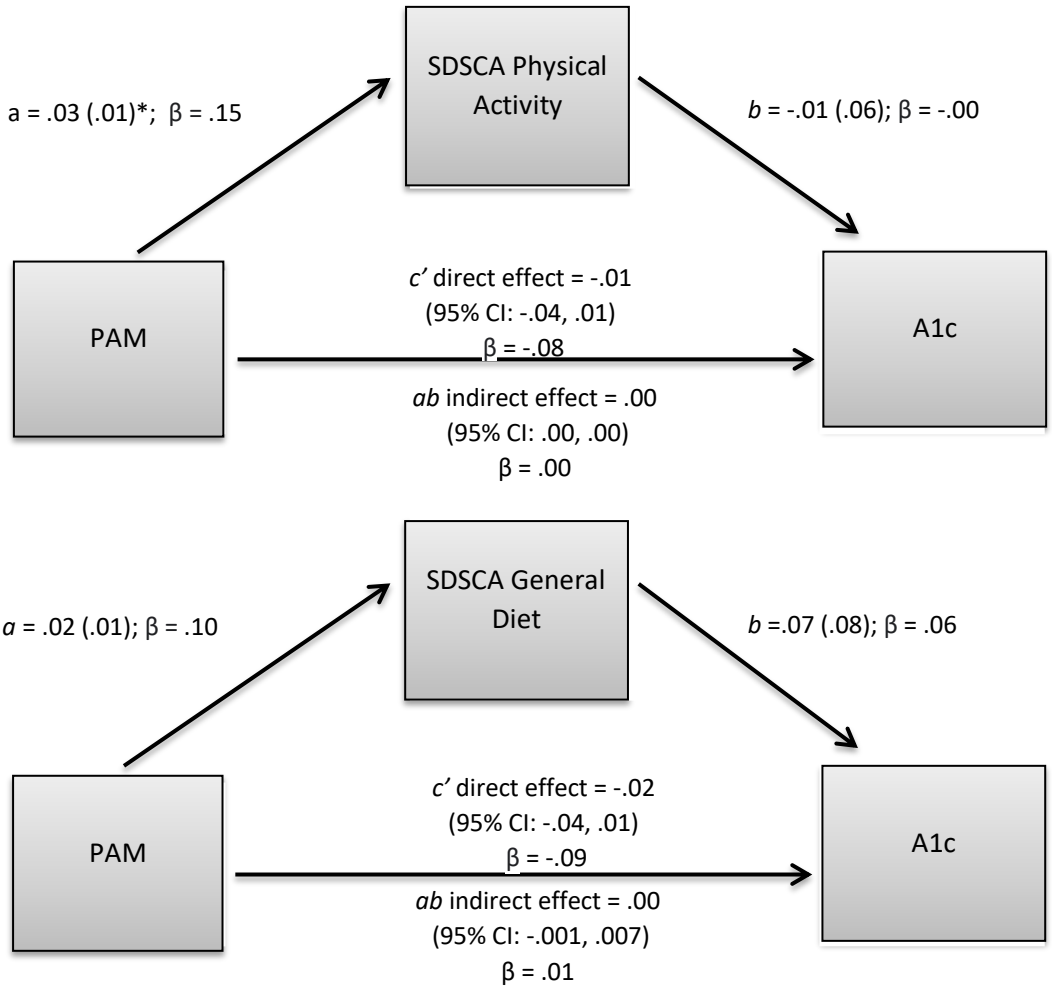

Figure 5: Objective 3 path models with glycosylated hemoglobin A1c as the dependent variable, patient activation (PAM score) as the independent variable, and individual self-management behaviors (Summary of Diabetes Self-Care Activities Measure [SDSCA] subscales) tested as the indirect effect (mediator) variable. The following covariates were controlled for (not shown in figure): age, sex, race-ethnicity, income, years since diagnosis, language, healthcare system, and days since lab draw. For the *a* and *b* paths, unstandardized regression coefficients and standard errors (in parentheses) are displayed. For the direct (*c'*) and indirect effects (*ab*), the unstandardized estimate with bias-corrected bootstrapped 95% confidence intervals are displayed. β indicates standardized regression coefficient. * $p < .05$

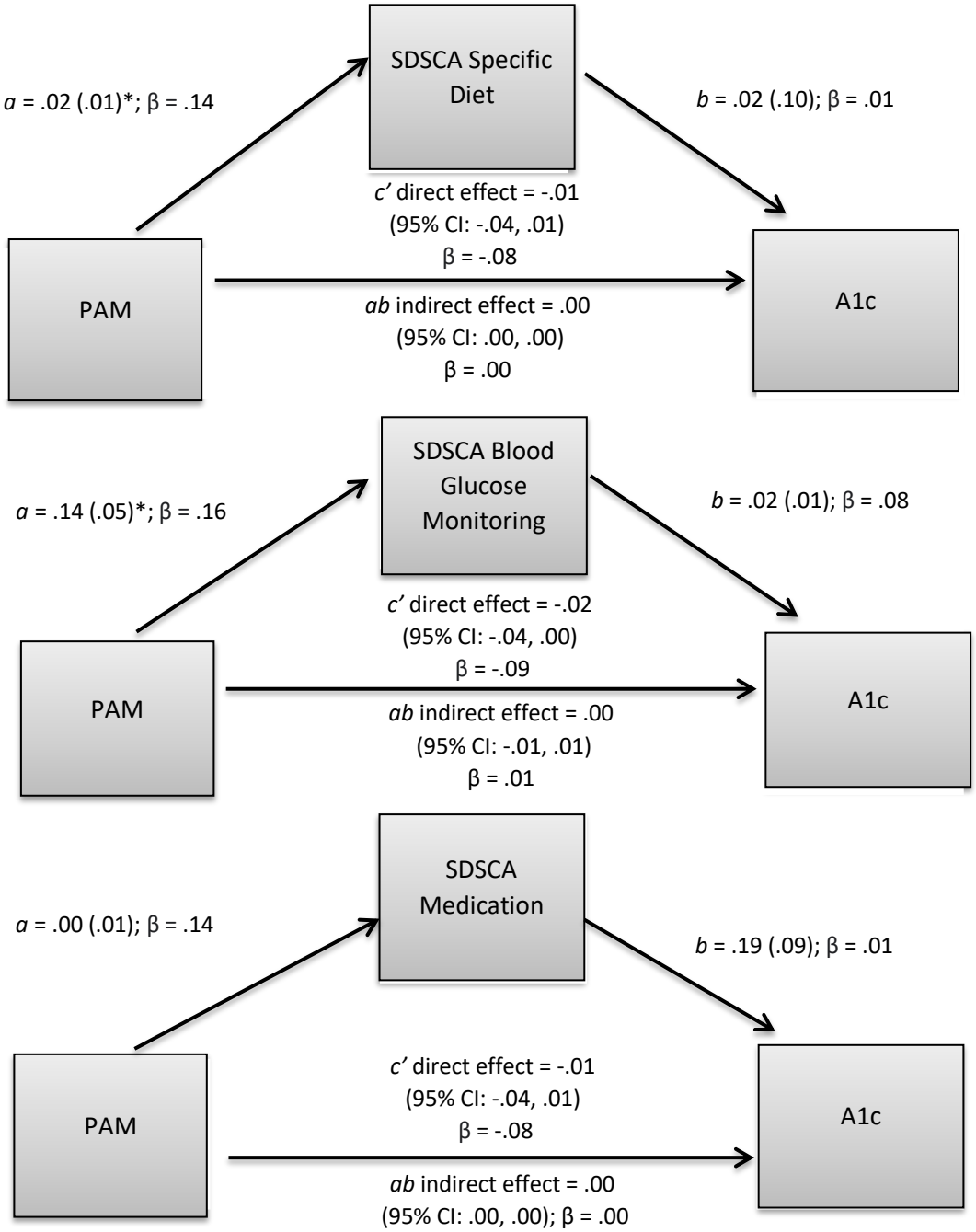

Figure 5: (Continued) Objective 3 path models with glycosylated hemoglobin A1c as the dependent variable, patient activation (PAM score) as the independent variable, and individual self-management behaviors (Summary of Diabetes Self-Care Activities Measure [SDSCA] subscales) tested as the indirect effect (mediator) variable. The following covariates were controlled for (not shown in figure): age, sex, race-ethnicity, income, years since diagnosis, language, healthcare system, and days since lab draw. For the *a* and *b* paths, unstandardized regression coefficients and standard errors (in parentheses) are displayed. For the direct (*c'*) and indirect effects (*ab*), the unstandardized estimate with bias-corrected bootstrapped 95% confidence intervals are displayed. β indicates standardized regression coefficient. * $p < .05$.

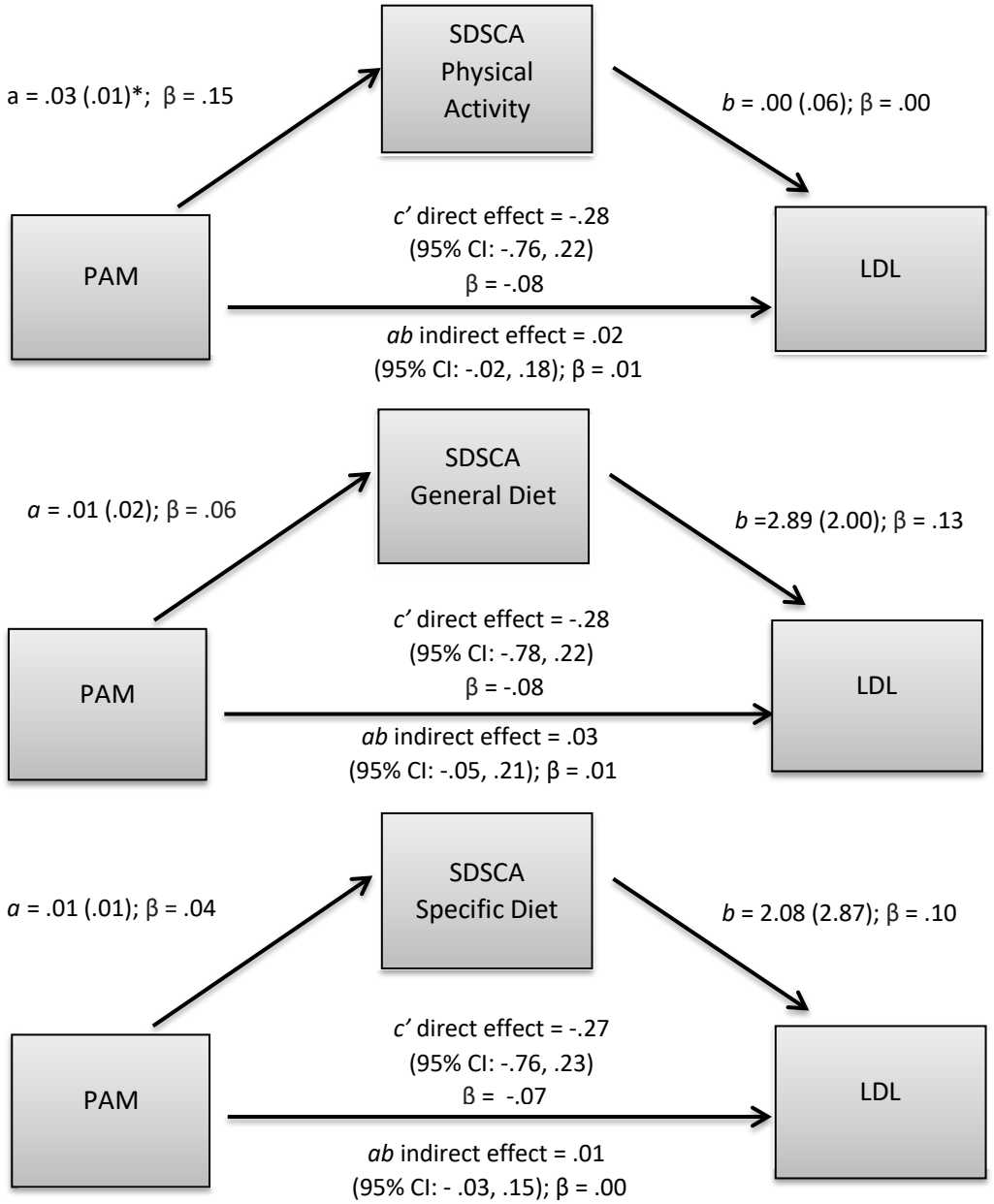

Figure 6: Objective 3 path models with low-density lipoprotein cholesterol (LDL-C) as the dependent variable, patient activation (PAM score) as the independent variable, and individual self-management behaviors (Summary of Diabetes Self-Care Activities Measure [SDSCA] subscales) tested as the indirect effect (mediator) variable. The following covariates were controlled for (not shown in figure): age, sex, race-ethnicity, income, years since diagnosis, language, healthcare system, and days since lab draw. Unstandardized regression coefficients and standardized errors are displayed for the *a* and *b* paths. For the *a* and *b* paths, unstandardized regression coefficients and standard errors (in parentheses) are displayed. For the direct (*c'*) and indirect effects (*ab*), the unstandardized estimate with bias-corrected bootstrapped 95% confidence intervals are displayed. β indicates standardized regression coefficient. * $p < .05$; ** $p < .0001$.

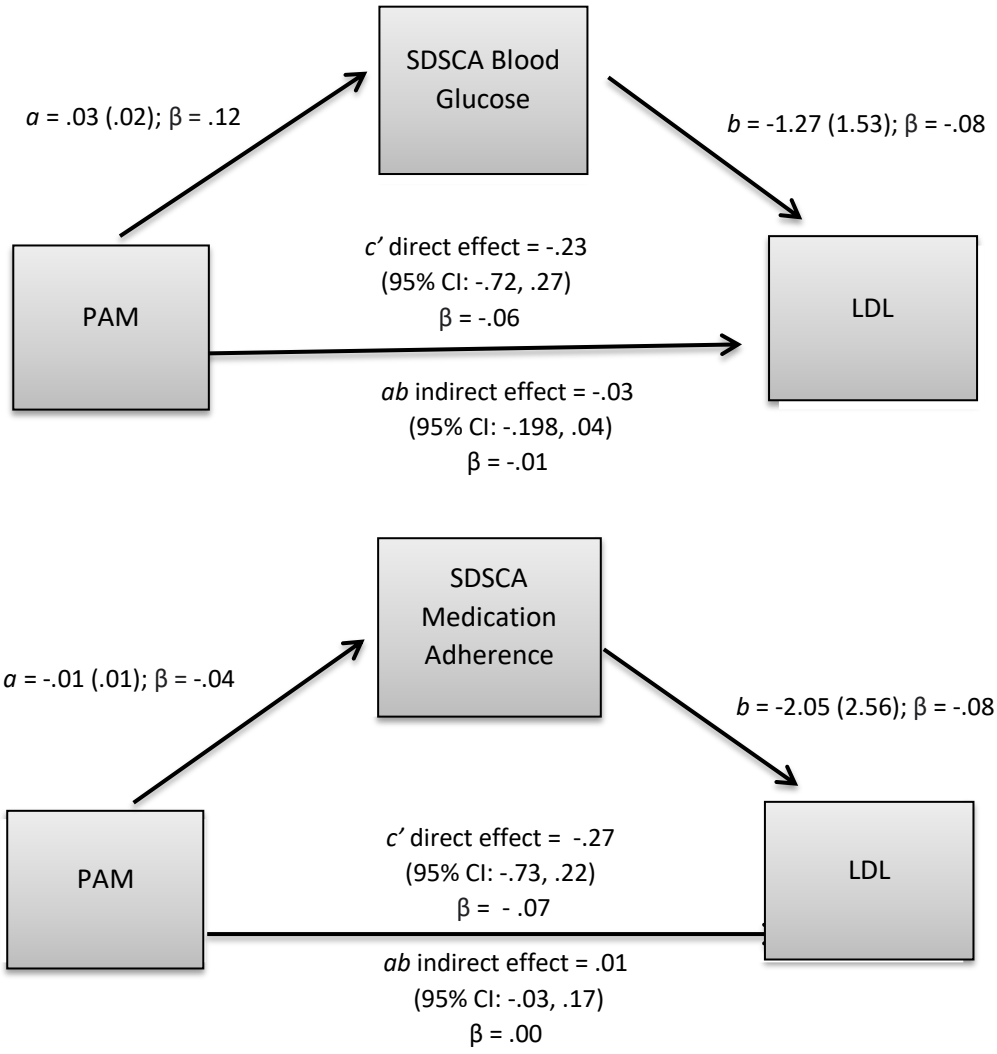

Figure 6: (Continued) Objective 3 path models with low-density lipoprotein cholesterol (LDL-C) as the dependent variable, patient activation (PAM score) as the independent variable, and individual self-management behaviors (Summary of Diabetes Self-Care Activities Measure [SDSCA] subscales) tested as the indirect effect (mediator) variable. The following covariates were controlled for (not shown in figure): age, sex, race-ethnicity, income, years since diagnosis, language, healthcare system, and days since lab draw. Unstandardized regression coefficients and standardized errors are displayed for the *a* and *b* paths. For the *a* and *b* paths, unstandardized regression coefficients and standard errors (in parentheses) are displayed. For the direct (*c'*) and indirect effects (*ab*), the unstandardized estimate with bias-corrected bootstrapped 95% confidence intervals are displayed. β indicates standardized regression coefficient. * $p < .05$; ** $p < .0001$.

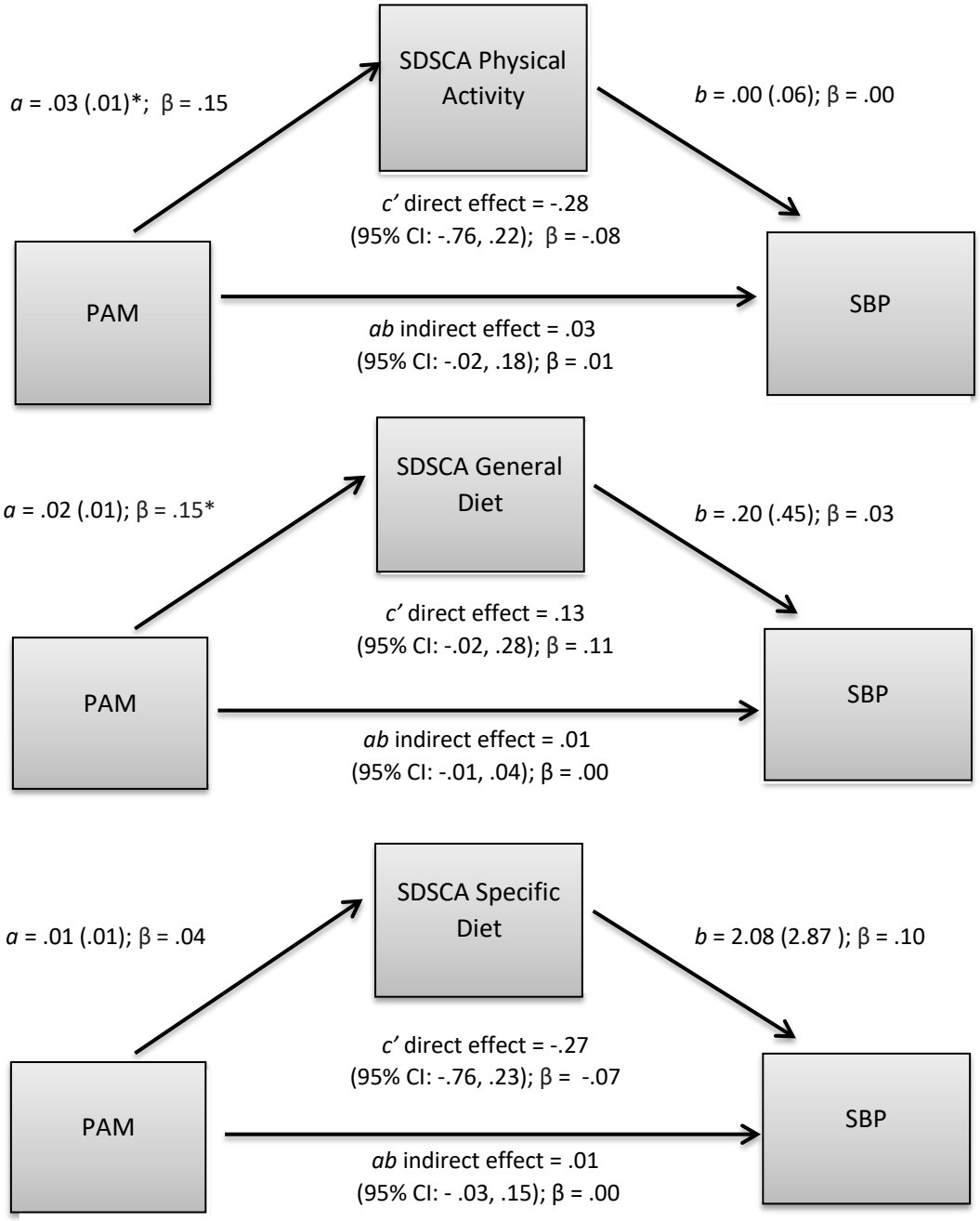

Figure 7: Objective 3 path models with systolic blood pressure (SBP) as the dependent variable, patient activation (PAM score) as the independent variable, and individual self-management behaviors (Summary of Diabetes Self-Care Activities Measure [SDSCA] subscales) tested as the indirect effect (mediator) variable. The following covariates were controlled for (not shown in figure): age, sex, race-ethnicity, income, years since diagnosis, language, healthcare system, and days since lab draw. For the *a* and *b* paths, unstandardized regression coefficients and standard errors (in parentheses) are displayed. For the direct (*c'*) and indirect effects (*ab*), the unstandardized estimate with bias-corrected bootstrapped 95% confidence intervals are displayed. β indicates standardized regression coefficient. * $p < .05$; ** $p < .0001$.

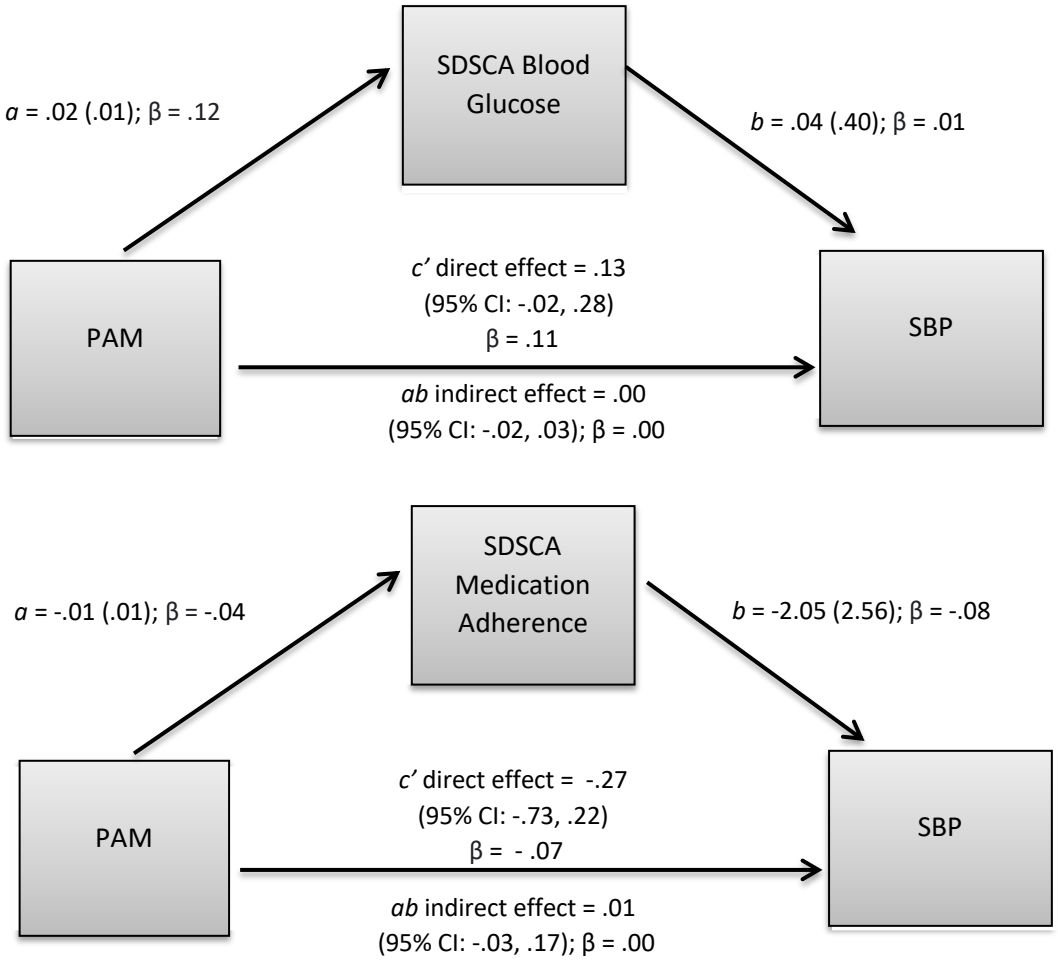

Figure 7: (Continued) Objective 3 path models with systolic blood pressure (SBP) as the dependent variable, patient activation (PAM score) as the independent variable, and individual self-management behaviors (Summary of Diabetes Self-Care Activities Measure [SDSCA] subscales) tested as the indirect effect (mediator) variable. The following covariates were controlled for (not shown in figure): age, sex, race-ethnicity, income, years since diagnosis, language, healthcare system, and days since lab draw. For the *a* and *b* paths, unstandardized regression coefficients and standard errors (in parentheses) are displayed. For the direct (*c'*) and indirect effects (*ab*), the unstandardized estimate with bias-corrected bootstrapped 95% confidence intervals are displayed. β indicates standardized regression coefficient. * $p < .05$; ** $p < .0001$.