Social Support as a Moderator of the Relationship between Patient Activation, Self-Management of Diabetes, and Diagnosed Diabetes Complications, among Adults with Type 2 Diabetes

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Introduction

- Type II diabetes mellitus (T2DM) impacts an estimated 32 million adults in the European Union (EU) and has increased prevalence across all EU countries since 1990.[1]
- Prevention and intervention efforts for T2DM have primarily focused on motivating patients to play a more active role in monitoring and managing their health and lifestyle behaviors — a concept known as patient activation.[2]
- While patient activation can motivate health self-management, the magnitude of benefits associated with increased activation are likely to depend upon a variety of environmental determinants — specifically social support (e.g., family and friends to lean on, individuals who can provide transport/childcare when needed).[3] However, few studies have examined these interactions in relation to patient activation.

Objective

- To assess whether access to social support moderates the effectiveness of patient activation on health outcomes among adults with T2DM.

Methods

Data Source

- Data were collected across five European countries (5EU; consisting of the United Kingdom [UK], France, Germany, Italy, and Spain) queried as part of the 2021 National Health and Wellness Survey (NHWS). The NHWS is an internet-based, self-reported survey designed to represent the general adult population, relative to age and gender distributions reported in the US Census Bureau's International Database (N=62,028).[4]

Key Variables

- Patient activation and social support were entered as independent variables predicting various health behaviors and health outcomes, including recommended lifestyle behaviors related to prevent/offset diabetes (e.g., exercise, diet), common diabetes complications (e.g., kidney disease, ulcers), and hospitalizations.

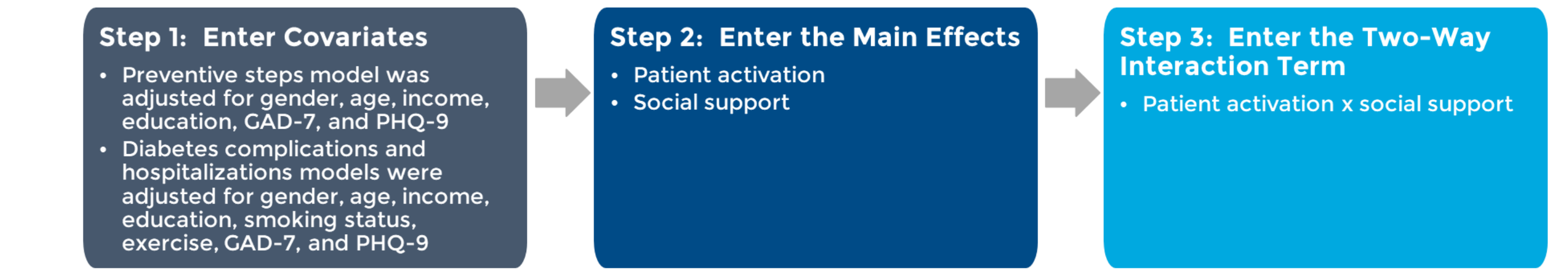| Variable	Operationalization
Patient Activation (predictor; categorical)	The Patient Activation Measure (PAM) includes 13 items that quantify respondents' knowledge, skills, and confidence in their ability to manage their health on a scale from 0-100. Respondents can be classified into 4 categories: • Level 1 — Disengaged and overwhelmed • Level 2 — Becoming aware but still struggling • Level 3 — Taking action • Level 4 — Maintaining behaviors and pushing further
Social Support (predictor; binary)	Modified Medical Outcomes Study Social Support Survey (MMoSSS) includes 8 items that measure the availability of support; we dichotomized the summary score using a median split (≤30=low support; >30=high support).
Steps Taken to Prevent Diabetes (outcome; count)	Patients were asked to report on which (if any) lifestyle behaviors they used to prevent diabetes (e.g., "*eat less sugar*," "*weight loss*"); analyzed as a sum total (0-9). Used as a proxy for health motivation/self-management.
Number of Diabetes Complications (outcome; count)	Patients were asked to report on which (if any) complications had resulted from their diabetes (e.g., "*macular edema or diabetic retinopathy*," "*foot or leg ulcer*"); analyzed as a sum total (0-6). Used as a proxy for mismanaged diabetes.
Number of Hospitalizations in the Past 6 Months (outcome; continuous)	Patients were asked to report on all hospitalizations over the past 6 months. Used as a proxy for severely mismanaged diabetes. *Note: hospitalizations were queried as an overall/not specific to diabetes.*

Eligibility

- Patient activation and social support were entered as independent variables predicting various health behaviors and health outcomes.
- Patients were included if they were participants in the 5EU NHWS, age 18+, reported a diagnosis of T2DM, and had a valid PAM and MMoSSS score. Patients were excluded if they had ever experienced type 1 diabetes mellitus.

Statistical Analyses

- Descriptive (means, standard deviations [SD], percentages, sample sizes) and bivariate (Chi-square test and one-way ANOVA) statistics were used to characterize the sample overall and according to PAM level.
- The moderating effect of social support was examined with three multivariable models (one for each outcome: preventive steps, diabetes complications, and number of hospitalizations) using hierarchical (sequential) regression modeling (**Figure 1**).

Figure 1. Steps in Hierarchical (Sequential) Regression Analysis with Self-Management Steps, Diabetes Complications, and Hospitalizations Modeled as the Outcome Variables Assuming a Negative Binomial Distribution

Step 1: Enter Covariates
- Preventive steps model was adjusted for gender, age, income, education, GAD-7, and PHQ-9
- Diabetes complications and hospitalizations models were adjusted for gender, age, income, education, smoking status, exercise, GAD-7, and PHQ-9

Step 2: Enter the Main Effects
- Patient activation
- Social support

Step 3: Enter the Two-Way Interaction Term
- Patient activation x social support

Note: The Likelihood Ratio Test (LRT) was used to evaluate the predictive validity of each modeling step (α=0.05). See Table 1 for details on each covariate.

Results

Sample Characteristics

- Our analytic sample consisted of 3,994 respondents: 241 (6%), 831 (21%), 2,388 (60%), and 534 (13%) were categorized as PAM Level 1, 2, 3, and 4, respectively (**Table 1**).
  - Mean age=63.7 years; 31.5% female
  - 51.3% low social support and 48.7% high social support
- Higher levels of PAM were associated with greater household income, greater educational attainment, lower comorbid mortality risk (CCI), and lower anxiety/depression (all $p \le 0.003$).
- Proportionally, a greater number of activated patients had access to high social support (Level 3=50%, Level 4=63%) than those with lower levels of activation (Level 1=27%, Level 2=42%) who were more likely to report low social support ($p <0.001$).

Table 1. Sample Characteristics by Patient Activation (Level 1 = Lowest Activation, Level 4 = Highest Activation)

Demographic and Health Characteristics	Total (N=3,994)	Level 1 (n=241)	Level 2 (n=831)	Level 3 (n=2,388)	Level 4 (n=534)	*p*-Value
Key Study Variables						
Social Support [n (%)]						
Low (MMoSSS ≤30)	2,049 (51.30%)	177 (73.44%)	485 (58.36%)	1,189 (49.79%)	198 (37.08%)	<0.001
High (MMoSSS >30)	1,945 (48.70%)	64 (26.56%)	346 (41.64%)	1,199 (50.21%)	336 (62.92%)	
Sociodemographic Characteristics						
Gender, male [n (%)]	2,737 (68.53%)	169 (70.12%)	572 (68.83%)	1,622 (67.92%)	374 (70.04%)	0.731
Age (Mean ± SD)	63.68 ± 11.37	61.41 ± 14.33	64.07 ± 10.76	63.74 ± 11.24	63.81 ± 11.30	0.013
Household Income[1] [n (%)]						
Low	994 (24.89%)	75 (31.12%)	222 (26.71%)	587 (24.58%)	110 (20.60%)	<0.001
Medium	1,959 (49.05%)	115 (47.72%)	408 (49.10%)	1,163 (48.70%)	273 (51.12%)	
High	820 (20.53%)	35 (14.52%)	154 (18.53%)	495 (20.73%)	136 (25.47%)	
Declined to answer	221 (5.53%)	16 (6.64%)	47 (5.66%)	143 (5.99%)	15 (2.81%)	
Educational Attainment [n (%)]						
Less than 4-year degree	2,554 (63.95%)	175 (72.61%)	558 (67.15%)	1,504 (62.98%)	317 (59.36%)	0.002
4-year degree or higher	1,402 (35.10%)	66 (27.39%)	264 (31.77%)	863 (36.14%)	209 (39.14%)	
Declined to answer	38 (0.95%)	. (X)	9 (1.08%)	21 (0.88%)	8 (1.50%)	
General Health Characteristics						
Body Mass Index [kg/m²] (Mean ± SD)	29.14 ± 8.99	29.54 ± 11.27	29.73 ± 8.57	28.90 ± 8.82	29.09 ± 9.24	0.120
Modified CCI Score (*omitting diabetes-related variables*) (Mean ± SD)	0.60 ± 1.11	0.77 ± 1.24	0.69 ± 1.27	0.56 ± 1.05	0.57 ± 1.03	0.003
Number of Days Exercised in the Past Month (Mean ± SD)	6.05 ± 8.90	4.27 ± 7.77	5.09 ± 8.58	6.21 ± 8.89	7.64 ± 9.58	<0.001
Smoking Status [n (%)]						
Active smoker	815 (20.41%)	41 (17.01%)	174 (20.94%)	495 (20.73%)	105 (19.66%)	0.534
Alcohol Use [n (%)]						
Active drinker	2,891 (72.38%)	154 (63.90%)	617 (74.25%)	1,737 (72.74%)	383 (71.72%)	0.016
GAD-7 Score[5] (Mean ± SD)	3.80 ± 4.54	5.52 ± 5.37	4.12 ± 4.77	3.69 ± 4.34	3.05 ± 4.37	<0.001
PHQ-9 Score[6] (Mean ± SD)	5.25 ± 5.74	8.10 ± 7.07	5.74 ± 5.88	5 ± 5.48	4.31 ± 5.55	<0.001

Note: [1]Household income reflects aggregate of pounds (UK) and euros (ex-UK), as reported by each 5EU country. [2]Patient Activation Measure (PAM) (possible range from 0 to 100; observed range: 23.60 to 89.10); a higher score indicates higher levels of activation. [5]General Anxiety Disorder (GAD-7) — 7 items (range 0 to 21); a higher score indicates more severe anxiety. Scores of 5, 10, and 15 represent cut points for mild, moderate, and severe anxiety, respectively. [6]Patient Health Questionnaire (PHQ-9) — 9 items (range 0 to 27); a higher score indicates more severe depression. Scores of 5, 10, 15, and 20 represent cut points for mild, moderate, moderately severe, and severe depression, respectively.

Results, continued

Moderation of Diabetes Outcomes by PAM x MMoSSS

Outcome 1: Preventive Steps

- Higher patient activation was significantly associated with greater participation in "health behaviors" (i.e., number of preventive steps taken to self-manage diabetes) (**Figure 2**). This effect was not significantly moderated by social support (LRT $X^2_{(df)}$ = 3.00[3]; p =0.392).
  - Even among already-activated patients, increasing PAM (from Level 3 to Level 4) was associated with a significant 16% increase in preventive behavior (p =0.003) (**Table 2**).
  - The most activated patients (Level 4) engaged in 71% more preventive behaviors than the least activated patients (Level 1) ($p <0.001$) (**Table 2**).

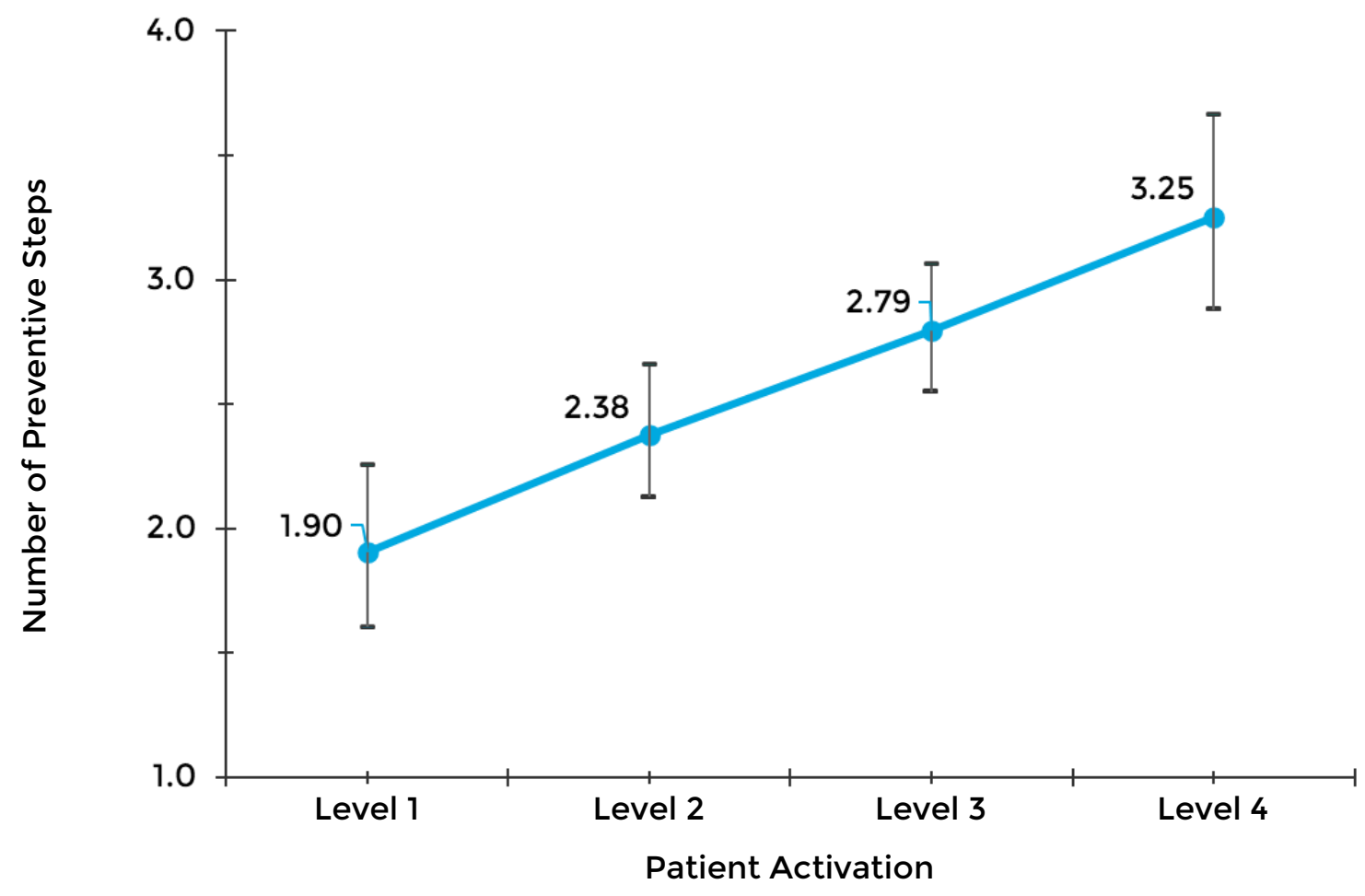**Figure 2. Estimated Mean Number of Preventive Steps Taken to Self-Manage Diabetes**

Table 2. Relative Rate of Preventive Steps Taken to Self-Manage Diabetes

PAM	RR	SE	95% Confidence Interval		*p*-Value
			Lower Bound	Upper Bound	
Level 4 vs. 1	1.71	0.15	1.43	2.03	<0.001
Level 4 vs. 2	1.37	0.08	1.21	1.54	<0.001
Level 4 vs. 3	1.16	0.06	1.05	1.28	0.003

Note: Estimates are controlling for social support, gender, income, education, age (mean=63.68 years), GAD-7 score (mean=3.80), and PHQ-9 score (mean=5.25).

Outcome 2: Diabetes Complications

- Social support significantly modified the relationship between patient activation and patient-reported diabetes complications (LRT $X^2_{(df)}$ = 9.23[3], p =0.026). Interestingly, this relationship appeared to be specific to the most disengaged patients (Level 1).
  - Patients with the lowest PAM (Level 1) exhibited the greatest number of diabetes complications. However, higher activation was only predictive of decreased complications among those with high social support (**Table 3**).
  - Increasing PAM (from Level 1 to Level 4) was associated with a 37% decrease in diabetes complications for those with high social support (RR=0.63 [SE=0.11]; p =0.010) but only a 16% decrease for those with low social support (RR=0.84 [SE=0.06]; p =0.115) (**Table 3**).

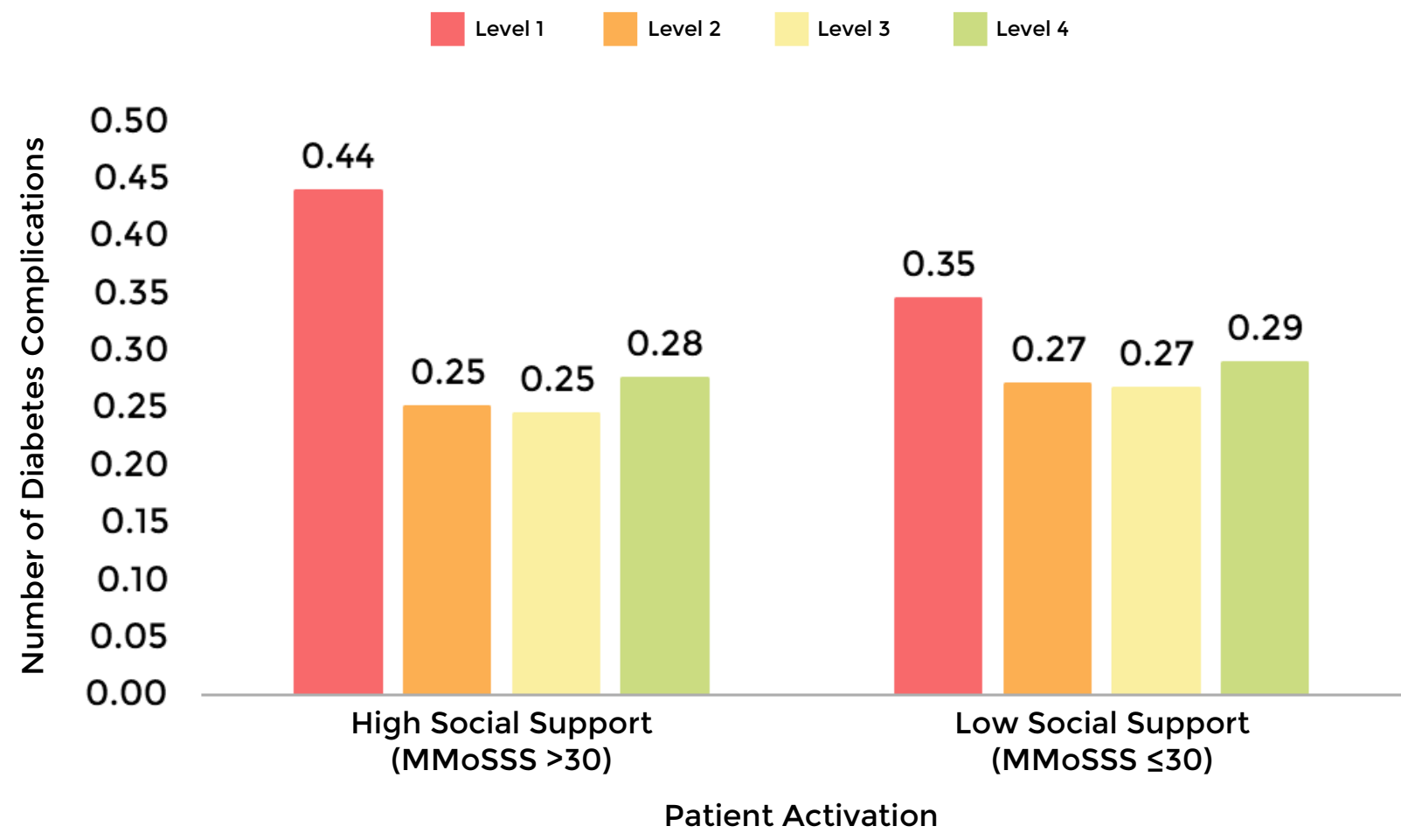**Figure 3. Estimated Mean Number of Diabetes Complications**

Legend: Level 1 | Level 2 | Level 3 | Level 4

Table 3. Relative Rate of Diabetes Complications

PAM	High Social Support (MMoSSS >30)				
	RR	SE	95% Confidence Interval		*p*-Value
			Lower Bound	Upper Bound	
Level 4 vs. 1	0.63	0.11	0.44	0.89	0.010
Level 4 vs. 2	1.10	0.13	0.87	1.38	0.424
Level 4 vs. 3	1.12	0.10	0.94	1.34	0.198

PAM	Low Social Support (MMoSSS ≤30)				
	RR	SE	95% Confidence Interval		*p*-Value
			Lower Bound	Upper Bound	
Level 4 vs. 1	0.84	0.09	0.68	1.04	0.115
Level 4 vs. 2	1.07	0.08	0.92	1.24	0.372
Level 4 vs. 3	1.09	0.06	0.97	1.22	0.159

Note: Estimates are adjusted for gender, age (mean=63.68 years), income, education, number of days exercised in the past month (mean=6.05 days), smoking status, GAD-7 score (mean=3.80), and PHQ-9 score (mean=5.25).

Outcome 3: Hospitalizations in the Past 6 Months

- Mimicking the results observed for diabetes complications, social support significantly modified the relationship between patient activation and hospitalizations (LRT $X^2_{(df)}$ = 10.64[3]; p =0.014).
  - Patients with the lowest PAM (Level 1) exhibited the greatest number of hospitalizations, and increased PAM was only associated with decreased hospital visits among those with high social support (**Figure 4**).
  - Increasing PAM (from Level 1 to Level 4) was associated with a 51% decrease in hospitalizations for those with high social support (RR=0.49 [SE=0.14]; p =0.012) but only a 24% decrease in hospitalizations for those with low social support (RR=0.76 [SE=0.13]; p =0.117) (**Table 4**).

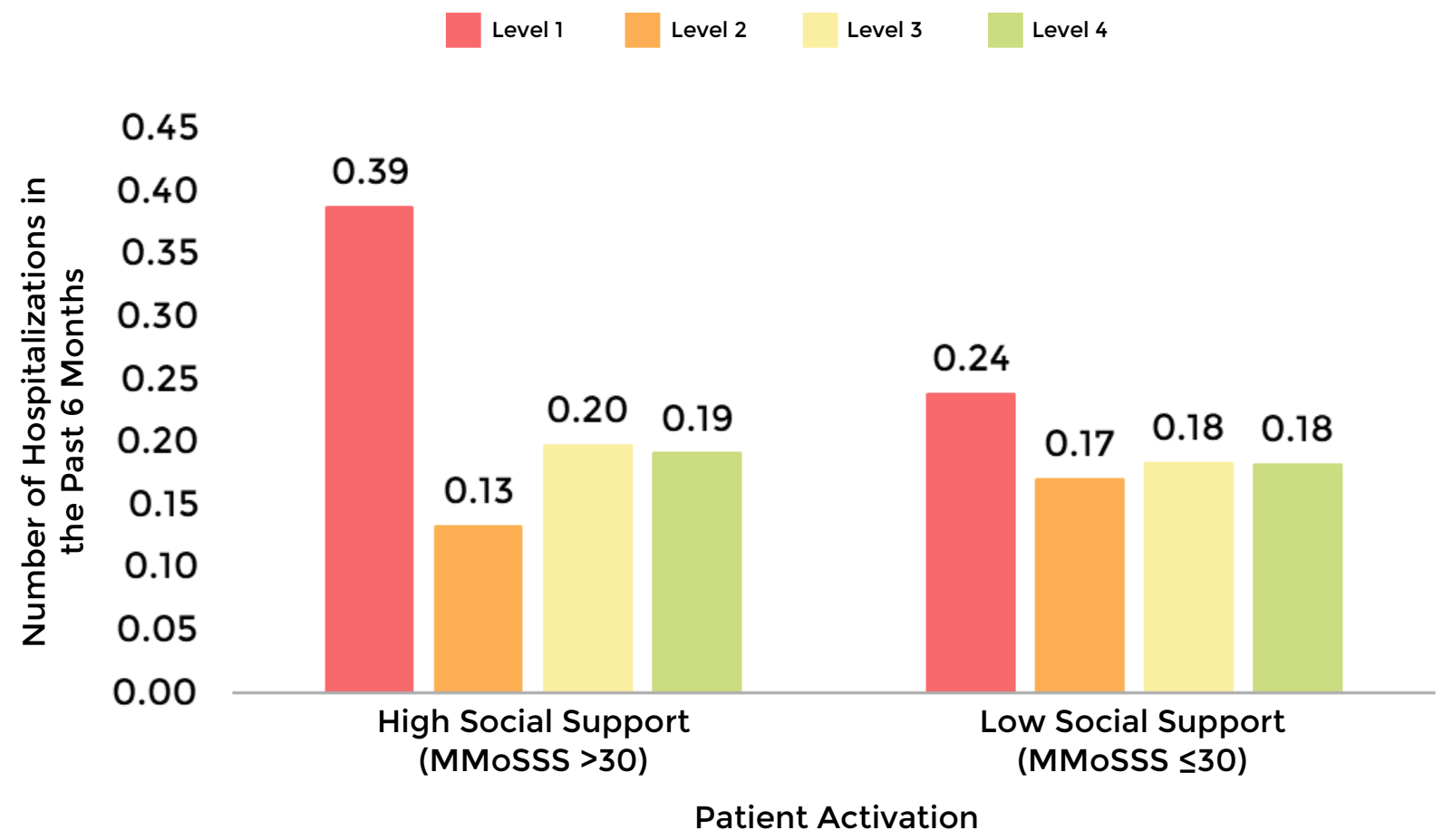**Figure 4. Estimated Mean Number of Hospitalizations in the Past 6 Months**

Legend: Level 1 | Level 2 | Level 3 | Level 4

Table 4. Relative Rate of Hospitalizations in the Past 6 Months

PAM	High Social Support (MMoSSS >30)				
	RR	SE	95% Confidence Interval		*p*-Value
			Lower Bound	Upper Bound	
Level 4 vs. 1	0.49	0.14	0.29	0.85	0.012
Level 4 vs. 2	1.44	0.27	0.99	2.09	0.055
Level 4 vs. 3	0.97	0.13	0.74	1.27	0.815

PAM	Low Social Support (MMoSSS ≤30)				
	RR	SE	95% Confidence Interval		*p*-Value
			Lower Bound	Upper Bound	
Level 4 vs. 1	0.76	0.13	0.54	1.07	0.117
Level 4 vs. 2	1.06	0.13	0.84	1.34	0.595
Level 4 vs. 3	0.99	0.09	0.83	1.19	0.942

Note: Estimates are adjusted for gender, age (mean=63.68 years), income, education, number of days exercised in the past month (mean=6.05 days), smoking status, GAD-7 score (mean=3.80), and PHQ-9 score (mean=5.25).

Discussion

- Lifestyle changes are important for managing chronic diseases like diabetes, and patient activation plays a critical role in motivating patients to take ownership of their health and lifestyle. However, less is known about how real-world constraints moderate the impact of patient activation on health outcomes.
- We found that the effectiveness of patient activation can be bolstered by increased access to social support. Specifically, we observed that higher PAM was associated with reduced rates of diabetic complications and hospitalizations but only among those who had access to high levels of social support. In contrast, PAM was associated with increased participation in health prevention activities (e.g., diet, exercise), regardless of access to social support.
- These results suggest that patients can be highly motivated to change their behaviors but may only realize the full benefits of patient activation (e.g., reduced rates of complex events, like hospitalizations) when given access to necessary resources like social support.

Limitations

- The internet-based survey administration may result in an overrepresentation of certain diabetic individuals in this study (e.g., those with access/familiarity with technology; healthier individuals).
- As a cross-sectional study, all relationships are correlational, and causation cannot be assumed.
  - Study design does not allow for investigation of likely bidirectional relationships between study variables or changes that may occur over time.

References
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4. U.S. Census Bureau, 2021. International Database: World Population Estimates and Projections [WWW Document]. URL https://www.census.gov/programs-surveys/international-programs/about/idb.html (accessed 6.14.22).