

Perceived Health Status among Patients with Norovirus and Acute Gastroenteritis

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INTRODUCTION

- Norovirus gastroenteritis (NGE) is the leading cause of acute gastroenteritis (AGE) worldwide, estimated to cause 685 million illnesses globally each year, with 21 million illnesses annually in the United States (U.S.).¹
- Although often self-limiting, there are between 1.7–3 million health care visits annually in the U.S. due to NGE, representing a significant burden on communities and healthcare systems.^{2,3}
- While there is a clear association between NGE illness and health care utilization, less is known about how AGE affects patient health / health-related quality of life (HRQoL) and whether perceptions of health status differ between those who are NGE-positive vs. NGE-negative.

OBJECTIVE

- To assess the impact of NGE-positivity on perceived health status of individuals with medically-attended AGE (MA-AGE) 18 years and older and parents/legal guardians of children aged 5-17 years with MA-AGE.

METHODS FOR STUDY OF ACUTE GASTROENTERITIS (SAGE)

Study Design and Population

- SAGE was a prospective study conducted from November 2023–September 2024 at Kaiser Permanente Northwest (KPNW), an integrated healthcare system in Oregon and Washington, U.S.
- Included KPNW members ≥5 years who had ≥1 MA-AGE encounter during a virtual, outpatient [OP], emergency department [ED] or inpatient [IP]) encounter from 11/17/2023–8/30/2024.
- Participants (adult members or parents/legal guardians for children aged <18 years) were recruited via email and, following consent to participate, were asked to complete a survey and self-collect a stool sample for gastrointestinal (GI) pathogen testing.

Data Collection

- An electronic enrollment survey was completed (by enrolled participants or parents/ legal guardian for children <18 years) and included the EuroQol 5-Dimensions, 5-Level version (EQ-5D-5L), a validated generic HRQoL questionnaire comprised of:
 - EQ Visual Analogue Scale (EQ-VAS)** to assess perceived health status, participants rate their overall health on a scale from 0 (‘worst health’) to 100 (‘best possible health’)
 - EQ-5D ‘health state’ descriptive system** Participants indicate levels of perceived problems on a scale of 1 (‘no problems at all’) to 5 (‘extreme problems’) across five health dimensions: 1) mobility, 2) self-care, 3) usual activities, 4) pain and discomfort, and 5) anxiety and depression.
- Participants completed the EQ-5D-5L twice and were asked to rate their perceived health status prior to their AGE illness (‘before illness’) and on their worst day of AGE illness (‘worst day’)
- Home-collected stool specimens were returned to the Oregon State Public Health Laboratory for NGE testing.

Statistical Analyses

- Analyses were restricted to those individuals who reported their health status for both time points.
 - Analyses of perceived health status (EQ-VAS)**
 - We compared decrements in the median VAS between time points by NGE positivity, and stratified by age group, using Wilcoxon rank-sum tests.
 - Analyses of health state (EQ-5D descriptive system)**
 - We scored the EQ-5D descriptive system to generate a derived single ‘index value’⁴ (range 0-1) for overall health state for all ages combined and compared the change in the index value score from ‘before’ to the ‘worst day’ of illness between NGE-positive and NGE-negative, adjusted for age and baseline health state.
 - We descriptively summarized the proportion of participants who reported worsening health states across the three most impacted domains.

RESULTS

- A total of 906 individuals—866 adults and 40 children (aged 5–17 years)—participated in the SAGE study.
- 806 (90%) completed the EQ-VAS question for both time points.
- 838 (92.5%) completed the five dimensions of the EQ-5D descriptive system for both time points.
- 137 (16%) participants tested positive for NGE.
 - Positivity rates ranged from 10% among participants aged 65–74 years to 47% among children aged 5–17 years.

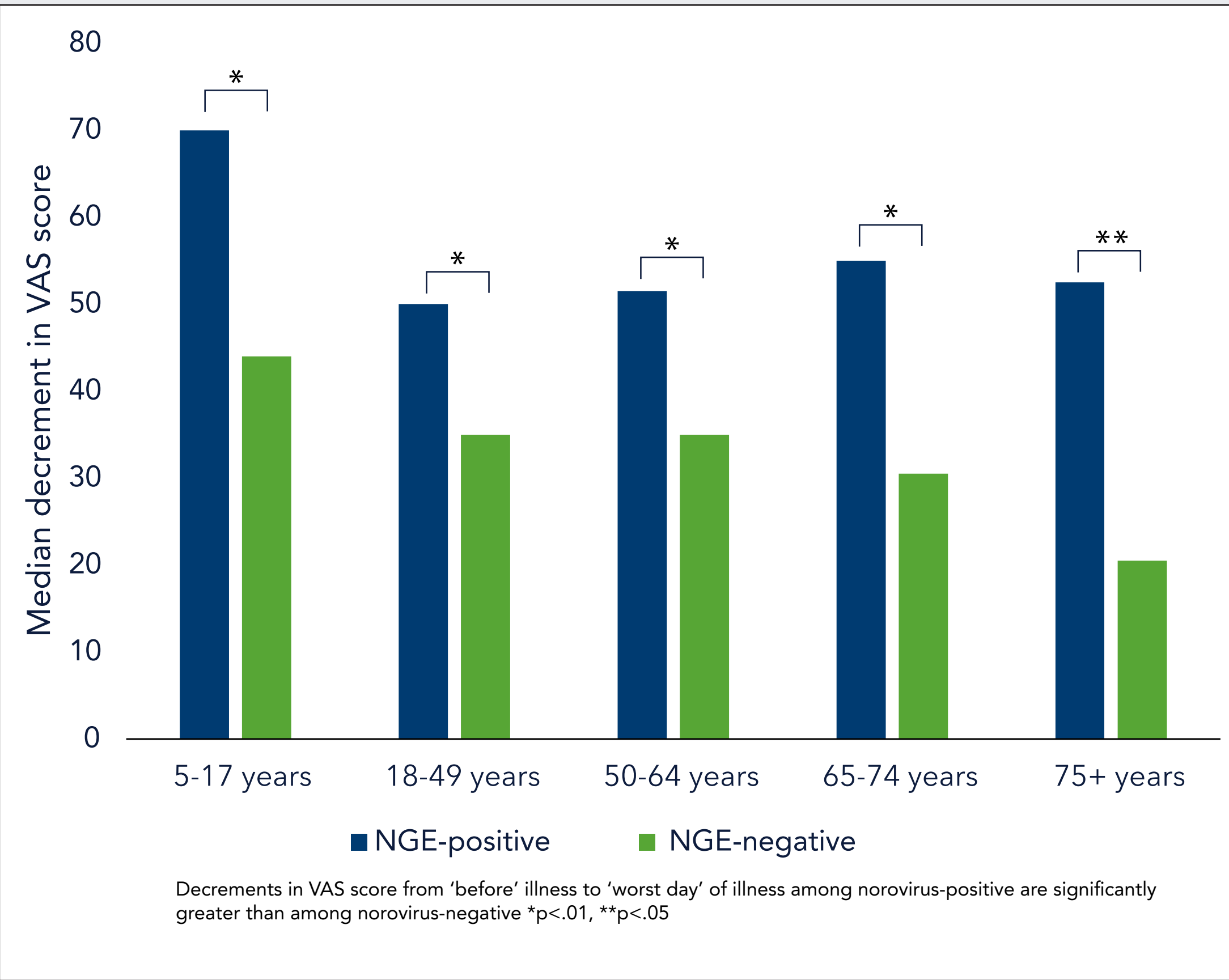
Table 1. Characteristics of study participants, overall and by norovirus laboratory testing results

	Total	NGE-negative	NGE-positive
Overall	838	701 (83.7)	137 (16.3)
Age			
5-17 years	36	19 (52.8)	17 (47.2)
18-49 years	414	339 (81.9)	75 (18.1)
50-64 years	179	159 (88.8)	20 (11.2)
65-74 years	133	120 (90.2)	13 (9.8)
75+ years	76	64 (84.2)	12 (15.8)
Sex			
Female	598	508 (85.0)	90 (15.0)
Male	240	193 (80.4)	47 (19.6)

Perceived Health Status (EQ-VAS) (Fig 1)

- The decrement in median VAS from pre-illness to worst day was significantly greater among NGE-positive vs. NGE-negative patients across all age groups.
- These differences were most apparent among children 5-17 years of age (70 vs. 44, p<.01) and adults ≥75 years of age (52.5 vs. 20.5, p<.05).

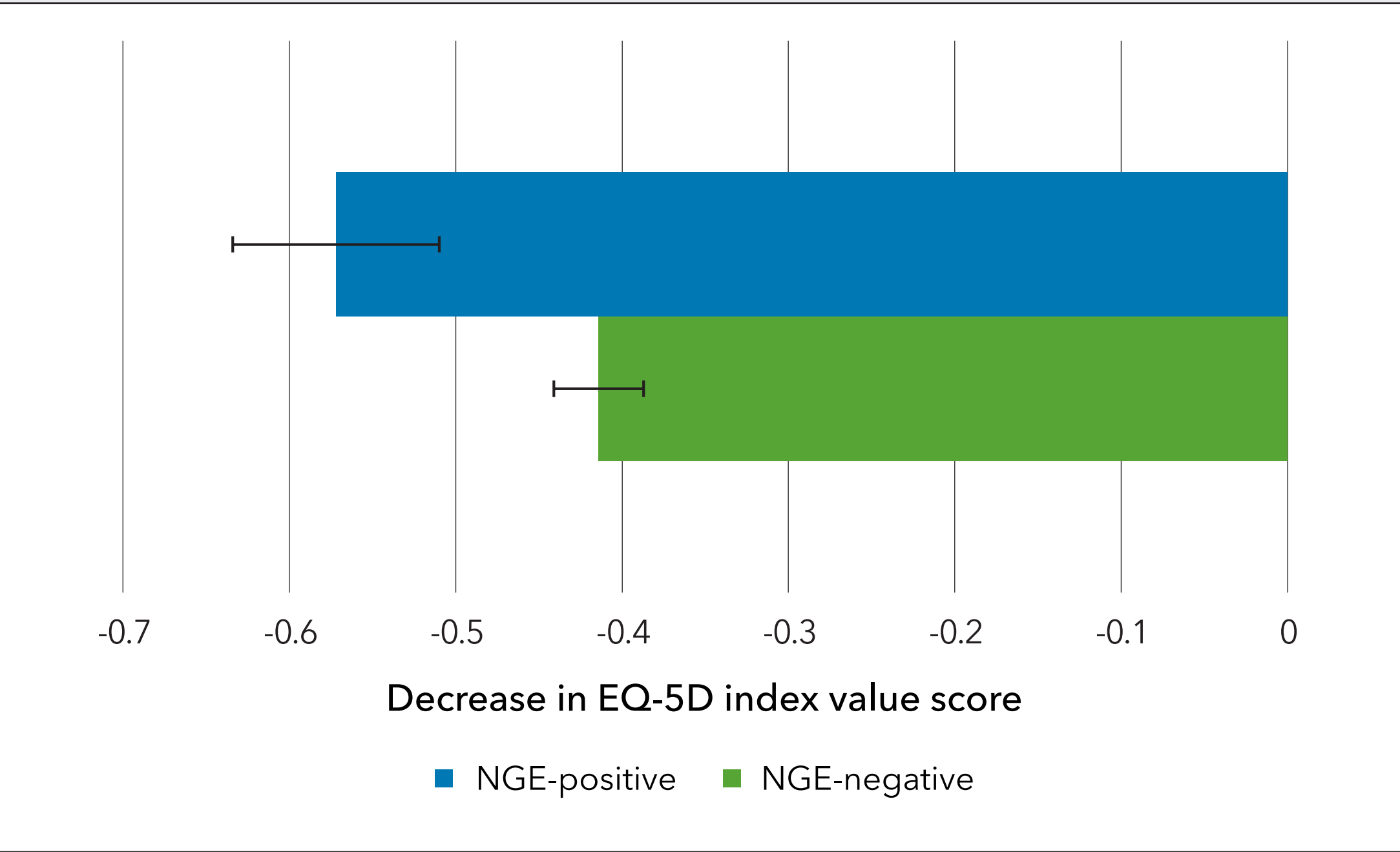
Figure 1. Median decrement in perceived health status Visual Analog Scale scores between before and worst day of illness, comparison between participants who were NGE-positive (n=134) and NGE-negative (n=672).



Health State (EQ-5D Descriptive System) (Fig 2)

- With adjustments for age and baseline (‘before’ illness) index value, the decrease in the EQ-5D index value from pre-illness to worst day was significantly greater among NGE-positive (-0.57) vs. NGE-negative patients (-0.41, p<.0001) (Fig 2).
- The index value changed from 0.89 before illness to 0.24 on their worst day of illness among NGE-positive; and from 0.80 to 0.40 among NGE-negative.

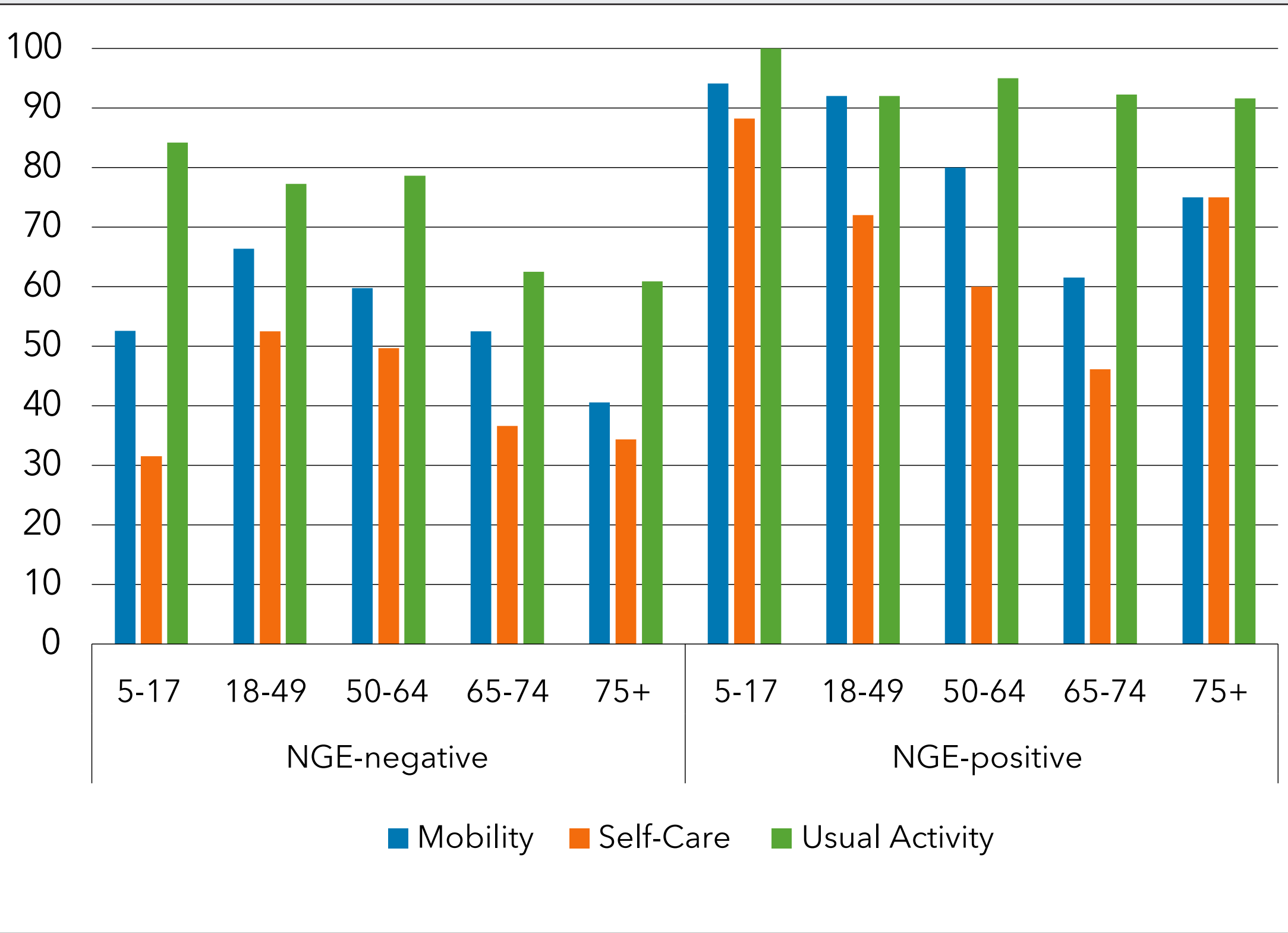
Figure 2. Decrease in EQ-5D-5L index value score measuring health status among participants ≥5 years. Change from before illness to worst day of illness, NGE-negative (n=701) and NGE-positive (n=137).



Health State Before and on Worst Day of Illness, by age group (Fig 3)

- Across all age groups, participants who were NGE-positive more commonly reported worsened ‘mobility’, ‘self-care’, and ability to do ‘usual activities’ than those who were NGE-negative.
- Over 90% of NGE-positive participants had worsening ability to do usual activities across all age groups, compared to between 61-84% of NGE-negative participants.
- Between 88-94% of parents/legal guardians of children with NGE reported worsening ‘mobility’ and ‘self-care’ domains, compared to 31-52% of children who were NGE-negative.

Figure 3. Percent of participants whose health state worsened for mobility, self-care, and usual activities from before illness to worst day of illness, comparison between NGE-negative (n=701) and NGE-positive (n=137).



CONCLUSIONS

- In a real-world study of MAAGE patients in the U.S., participants reported declines in health status from their pre-illness state to their worst day of illness. Notably, patients with confirmed NGE- associated AGE experienced significantly greater reductions in their perceived health status than those with AGE from other causes.
- Within specific domains measured by the EQ-5D, participants who were NGE-positive reported greater diminishments in mobility, self-care, and ability to participate in usual activities compared to participants who were NGE-negative, highlighting the significant impact of norovirus on HRQoL across all age groups.
- Prevention of NGE could contribute to significant reduction in patient reported health status burden.

LIMITATIONS

- NGE-positive study participants had a younger age distribution compared to NGE-negative participants and self-reported a higher health status before illness, across all five domains of the EQ-5D-5L survey. However, differences remained significant even after analyses were adjusted for age and higher baseline health status.
- Surveys for children aged <18 years were completed by their parents/legal guardians and thus caregiver ratings of health status may have differed from those based on self-report.
- Study participants completed the ‘before’ and ‘worst day of illness’ surveys at one point, following their AGE illness. Recall of health status ‘before’ illness may have been biased by their AGE illness experience.
- This population represents individuals who sought medical care for their AGE illness and likely represent more severe AGE illness episodes. Therefore, the results may not be generalizable to all AGE cases.

REFERENCES

- Pires SM, Fischer-Walker CL, Lanata CF, et al. Aetiology-specific estimates of the global and regional incidence and mortality of diarrhoeal diseases commonly transmitted through food. PLoS One 2015; 10:e0142927.
- Burke RM, Mattison CP, Pindick T, et al. Burden of norovirus in the United States, as estimated based on administrative data: updates for medically attended illness and mortality, 2001–2015. Clin Infect Dis 2021; 73:e1–8
- Hall AJ, Lopman BA, Payne DC, et al. Norovirus disease in the United States. Emerg Infect Dis. Aug 2013;19(8):1198-205. doi:10.3201/eid1908.130465
- EQ-5D-5L User Guide, 2013 [euroqol.org/wp-content/uploads/2023/11/EQ-5D-5Luserguide-23-07.pdf]



FUNDING

Funding for this study was provided through an institutional research collaborative agreement between Moderna, Inc. and the Kaiser Permanente Center for Health Research.

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