The association between perioperative frailty and ability to complete a web-based geriatric assessment among older adults with cancer

Andrea Cuadra [a], [*], Amy L. Tin [b], Gordon Taylor Moffat [c], Koshy Alexander [d], Robert J. Downey [e], Beatriz Korc-Grodzicki [d], Andrew J. Vickers [b], Armin Shahrokni [d]

[a] Computer Science Department, Stanford University, Stanford, CA, USA
[b] Department of Epidemiology and Biostatistics, Memorial Sloan Kettering Cancer Center, New York, NY, USA
[c] Department of Oncology, Queen's University, Kingston, Ontario, Canada
[d] Geriatrics Service, Department of Medicine, Memorial Sloan Kettering Cancer Center, New York, NY, USA
[e] Thoracic Service, Department of Surgery, Memorial Sloan Kettering Cancer Center, New York, NY, USA

ARTICLE INFO

ABSTRACT

Introduction: The aim of this study was to assess the degree to which patient frailty is associated with both need for assistance and time required to complete the eRFA, a web-based GA tool.

Materials and Methods: We retrospectively identified patients who underwent surgery for cancer from 2015 to 2020, had a hospital length of stay ≥ 1 day, and completed the eRFA before surgery. Frailty was assessed using two methods: the MSK-FI (score 0–11) and the AGD (score 0–13). Time to complete the eRFA was automatically recorded by a web-based tool; assistance with eRFA completion was self-reported by the patient.

Results: In total, 3456 patients were included (median age, 78 years). Overall, 58% of surveys were completed without assistance, 30% were completed with assistance, and 12% were completed by someone other than the patient. Younger age (median age: without assistance, 77 years; with assistance, 80 years; completed by someone else, 80 years) and lower frailty score (median AGD: 4, 6, and 8, respectively; median MSK-FI: 2, 3, and 3, respectively) were associated with independency (all $p < 0.001$). Higher frailty score was associated with longer time to complete the eRFA (all nonlinear association $p < 0.001$).

Conclusion: Frail patients are more likely to benefit from completion of GA to determine appropriate treatment. Given that not all cancer patients have a caregiver who can assist completing a digital questionnaire, innovative solutions are needed to help frail patients complete the eRFA without assistance.

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1. Introduction

Frailty is defined as a limited ability of the body to tolerate stress, and is associated with poor surgical outcomes [1]. The geriatric assessment (GA) is an established tool [2] for assessing frailty in older adults. The GA evaluates functional, cognitive, nutritional, and emotional status, among other domains, such as social support. The GA can thus be used to determine fitness for surgery among older adults. Recently, owing to advances in digital health technologies, various web-based, patient-reported GAs have been tested. Hurria et al. [3] showed that older adults with cancer are able to complete the GA using touchscreen platforms in an equivalent manner to paper-based questionnaires. At our institution, we developed the electronic Rapid Fitness Assessment (eRFA) as a web-based GA. We have shown that the eRFA can be successfully used for preoperative evaluation in a cohort of older patients (N = 636; median age, 80 years) presenting to geriatrics clinics [4]. The median time to complete the eRFA in that study was 11 min, and approximately 90% of surveyed patients preferred the eRFA over a paper-based GA [4]. Approximately half of patients were able to complete the eRFA without assistance, 37% completed it with some assistance, and 13% relied on someone else to complete the assessment for them [4]. However, we did not explore the relationship between frailty (measured by the eRFA) and patient need for assistance or time required to complete the eRFA.

Several organizations, including the American Society of Clinical Oncology and the National Comprehensive Cancer Network, have rec-

ommended implementation of the GA in each phase of cancer care [5,6]. As more institutions are moving toward implementing the GA as a web-based tool, it is critical to assess the ability of patients to complete a web-based GA. Undue difficulty completing the GA among frail patients has the potential to prevent completion of the assessment, which is specifically needed to identify aging-related impairments and optimally plan treatment. Inability to complete the GA and the time required to complete it may themselves act as markers of frailty, adding further value to the assessment. In this study, we investigate the relationship between preoperative frailty and use of assistance and time required to complete the eRFA.

2. Materials and Methods

We retrospectively identified patients who presented to the Memorial Sloan Kettering Cancer Center Geriatrics Service for preoperative evaluation and who completed a web-based GA, the eRFA, as a part of their preoperative assessment from February 2015 (when the eRFA was first implemented in the clinic) to December 2020. Patients in this study underwent elective surgery and had a hospital length of stay ≥1 day.

This study was approved by the IRB at Memorial Sloan Kettering Cancer Center with a waiver of informed consent since the eRFA is part of routine care in the geriatric clinic.

2.1. Completion of the eRFA

Patients could complete the eRFA either at home (if they had access to email) or in the clinic using laptop or desktop computers. The eRFA was available only in English; non-English speaking patients could receive assistance from their caregivers or from the center's on-site interpreters. Patients were allowed to skip any questions they did not want to answer.

2.2. Ability to complete the eRFA

Whether the eRFA was completed with or without assistance was captured by a self-reported single item at the end of the eRFA. The question asked patients to state whether they completed the eRFA without any assistance, whether they completed it with some assistance, or whether someone else completed it on their behalf.

2.3. Time to complete the eRFA

Time to complete the eRFA was measured automatically by our web-based tool from the time the user clicked the start button to the time they clicked the complete button.

2.4. Frailty

Frailty was assessed using two methods: the Memorial Sloan Kettering Frailty Index (MSK-FI) and the accumulative geriatric deficit (AGD). The MSK-FI is an 11-item frailty index with 10 items reflective of comorbidities and 1 item related to the functional activity of patients. Scores range from 0 to 11, with a higher score reflecting a higher degree of frailty [7]. MSK-FI score has been found to be associated with surgical outcomes of older adults with cancer, surgical decision-making, and clinical trial participation [7,8]. The AGD has 13 components—12 components from the eRFA that assess functional status, cognitive function, social support, emotional well-being, and nutritional status; and one component to assess whether patients have ≥4 comorbidities. Scores range from 0 to 13, with a higher score reflecting a higher degree of frailty. This system is based on the Rockwood theory [9] of accumulative aging-related impairments. As the AGD score is based on the number of deficits out of 13 components, the count of deficits for patients without all components available would be on a different scale

(n = 1372, 40%). Therefore, we used a scaled variation of the score, in which we divided the number of deficits by the number of components available and multiplied by 13. We previously demonstrated that AGD score is associated with 6-month postoperative mortality among older adults with cancer, even after adjustment for confounding factors such as age and American Society of Anesthesiologists Performance Status classification [10].

2.5. Analysis

Our primary aim was to determine the association between frailty and the patient's ability to complete the eRFA independently. We tested for differences among the three groups (no assistance, with assistance, completed by someone else) by use of the Kruskal-Wallis test for continuous variables and the Chi-square test for categorical variables. Our secondary aim was to assess the association between frailty and time to complete the survey. This aim was based on the hypothesis that, within the group of patients who complete the survey without help, longer time to completion indicates greater frailty. To assess this, we used two separate linear regression models—one defined by the MSK-FI and one defined by the AGD—with frailty as the outcome and minutes to complete the eRFA as the predictor. Time to complete the eRFA was included in the model as a nonlinear term with restricted cubic splines with knots at the tertiles. We prespecified that we would exclude completion times < 2 min, as we anticipated this would correspond to not fully reading the questions, and completion times > 40 min, as this would likely correspond to not completing the survey in one sitting (for instance, the patient started the survey, took a break, and then returned later to complete the survey). Our tertiary aim was to determine the association between frailty and time to complete the eRFA among patients who completed the eRFA with assistance. We specifically looked at this group separately from patients who completed the survey without assistance as we were unsure of the assistance-related factors that affected time to completion. For example, the assistance may have been in the form of the patient asking their caregiver to retrieve their prescription bottles. Alternatively, patients may have asked their caregiver for clarification about the content of specific questions, which would account for added time to complete the survey. Another source of added time could have been related to the use of interpretation services. This analysis was performed similarly to that for our secondary aim. As the length of time it takes someone other than the patient to complete the eRFA is unrelated to the patient's functional status, we did not evaluate time to survey completion in the group of patients for whom someone else completed the survey. All statistical analyses were conducted using Stata version 15.0 (StataCorp).

3. Results

In total, 3537 patients met the inclusion criteria. Patients were excluded for the following reasons: missing time to complete the eRFA (n = 4), did not respond to the question regarding who completed the eRFA (n = 14), and no available MSK-FI score (n = 63). The eRFAs of the remaining 3456 patients were analyzed. Median age was 78 years (interquartile range, 75–82), with an approximately equal proportion of men and women.

Of the study population, 58% completed the survey alone, 30% completed the survey with help from someone else, and 12% had someone else complete the survey for them. Younger age (median age: without assistance, 77 years; with assistance, 80 years; completed by someone else, 80 years) was associated with independency (all p < 0.001). Table 1 lists demographics and Table 2 lists medical characteristics.

Table 3 lists select characteristics within the three groups.

MSK-FI scores were higher for patients for whom someone else completed the survey (median score, 3) or who required assistance (median score, 3) than for patients who completed the survey without assistance

Table 1

Demographics (N = 3456). Data are given as frequency (%) or median (quartiles).

Characteristic	All Patients
Age, years	78 (75–82)
Male	1693 (49)
Race	
White	2892 (84)
Black	147 (4.3)
Asian	243 (7.0)
Other	70 (2.0)
Unknown	104 (3.0)
English as primary language	
Yes	3094 (90)
No	360 (10)
Unknown	2 (<0.1)

Table 2

Medical characteristics (N = 3456). Data are given as frequency (%) or median (quartiles).

Characteristic	All Patients
MSK-FI score	
0	361 (10)
1	816 (24)
2	910 (26)
3	654 (19)
4	388 (11)
5	180 (5.2)
≥6	147 (4.3)
AGD score	
0	132 (3.8)
≥1 and < 3	645 (19)
≥3 and < 5	834 (24)
≥5 and < 7	620 (18)
≥7 and < 9	623 (18)
≥9	602 (17)
Surgical category[a]	
Colorectal	1149 (33)
Head and neck	899 (26)
Thoracic	882 (26)
Hepatopancreatobiliary	455 (13)
Dermatology	67 (1.9)
Gastric and mixed tumor	236 (6.8)
Gynecology	669 (19)
Breast	12 (0.3)
Neurosurgery	210 (6.1)
Orthopedic	158 (4.6)
Ophthalmology	49 (1.4)
Plastics	218 (6.3)
Urology	435 (13)
Vascular	24 (0.7)
Operating room time, min	159 (93–240)
ASA score	
2	250 (7.2)
3	2781 (80)
4	275 (8.0)
5	1 (<0.1)
Unknown	149 (4.3)

AGD, accumulative geriatric deficit; ASA, American Society of Anesthesiologists; MSK-FI, Memorial Sloan Kettering Frailty Index.

[a] Does not sum to 100% as patients may be in multiple surgical categories.

Table 3

Patient characteristics by category of completing the eRFA. Data are given as frequency (%) or median (quartiles). All p ≤ 0.001 for difference between groups.

Characteristic	Without Assistance (N = 2021 [58%])	With Assistance (N = 1028 [30%])	Completed by Someone Else (N = 407 [12%])
Age at completion of eRFA, years	77 (69–80)	80 (77–84)	80 (77–85)
Male	1028 (51)	452 (44)	213 (52)
ASA score			
1-2	191 (9.5)	44 (4.3)	15 (3.7)
≥3	1720 (85)	963 (94)	374 (92)
Unknown	110 (5.4)	21 (2.0)	18 (4.4)
MSK-FI score	2 (1–3)	3 (2–4)	3 (2–4)
AGD score	4 (2–6)	6 (4–9)	8 (6–10)
Time to complete the eRFA, min	9.0 (6.7–12.3)	10.5 (7.8–15.5)	9.1 (6.7–13.3)

AGD, accumulated geriatric deficit; ASA, American Society of Anesthesiologists; eRFA, electronic Rapid Fitness Assessment; MSK-FI, Memorial Sloan Kettering Frailty Index.

For both groups of patients and for both MSK-FI and AGD, frailty increases as time to complete the eRFA increases (all nonlinear association p < 0.001), before ultimately plateauing. For example, for surveys completed with no help in 5 min, the estimated MSK-FI was 1.4 (95% confidence interval [CI] 1.3–1.6); for surveys completed with no help in 15 min, the estimated MSK-FI was 2.3 (95% CI 2.2–2.4); and for surveys completed with no help in 25 min, the estimated MSK-FI was 2.3 (95% CI 2.1–2.6). Respective AGD scores were 3.5 (95% CI 3.3–3.8), 5.4 (95% CI 5.2–5.7), and 5.4 (95% CI 5.0–5.9).

We performed two *post hoc* sensitivity analyses that repeated our analyses separately in patients who reported English as their primary language and patients with all 13 components of the AGD available. These analyses yielded similar results to the analysis above (data not shown).

4. Discussion

In our patient population, frailty was associated with the ability to complete the eRFA independently and with the time required to complete the eRFA with or without assistance. These findings are important for multiple reasons. Several oncologic societies, such as the American Society of Clinical Oncology and the National Comprehensive Cancer Network, recommend implementation of the GA in each phase of cancer care [5]. Such recommendations are based on evidence that results of the GA are associated with cancer-related outcomes [11,12]. Moreover, recent studies have shown that use of the GA is associated with lower rates of chemotherapy toxicity and better oncologist-patient communication [13,14]. Web-based GAs are attractive to many institutions, as the data captured via a web-based GA can inform individual patient care and act as real-world data for future analyses [15,16]. Previous studies have shown that a web-based GA is feasible among older adults with cancer [3]. A recent multi-institutional study showed that such tools are also feasible among racially and ethnically diverse populations [17]. In the present study, approximately 58% of older adults with cancer who presented to our geriatrics clinics for preoperative evaluation were able to complete the eRFA independently; the rest needed some degree of assistance.

Institutions interested in implementing a web-based GA should be aware that a significant portion of older adults with cancer may need assistance to complete a web-based GA. Of note, those who needed assistance were more likely to be frail, and even though age is a contributing factor, age ranges are too short to be clinically significant. Frail patients are more likely to benefit from completion of GA, as doing so identifies aging-related impairments that can then be managed. Therefore, the inability of frail patients to complete the web-based GA inde-

(median score, 2) (p < 0.001). Similarly, AGD scores were higher for patients for whom someone else completed the survey (median score, 8) or who required assistance (median score, 6) than for patients who completed the survey without assistance (median score, 4) (p < 0.001).

Fig. 1 shows the association between frailty and time to complete the eRFA among patients who completed the eRFA without or with assistance.
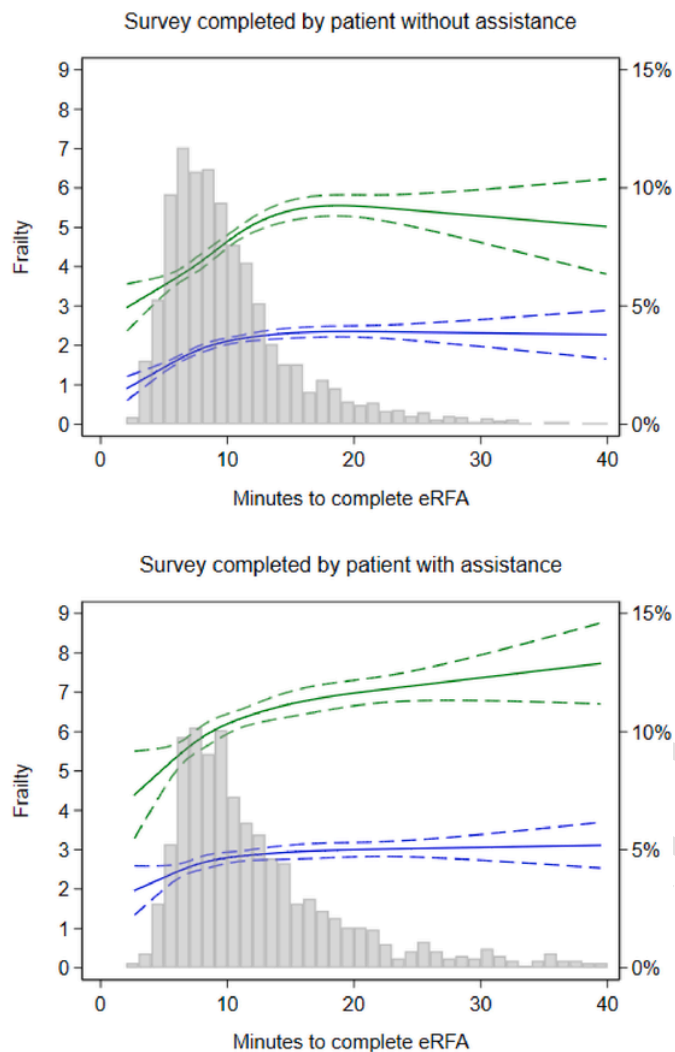
Fig. 1. Association between time to completion of the electronic Rapid Fitness Assessment (eRFA) and frailty, as defined by the Memorial Sloan Kettering Frailty Index (black) and accumulative geriatric deficit (grey), overlaid on the distribution of minutes to complete the eRFA. Shown are results for patients who completed the eRFA without assistance (A) and with assistance (B). The dashed lines represent 95% confidence intervals.

pendently may result in suboptimal care or missed treatment opportunities for these patients. Although patients may seek assistance from others to complete the assessment, it is important to note that not all older adults with cancer have caregivers with them in the clinic or at home. For frail patients without caregiver assistance, institutions should provide either the option to use a paper-based GA or personnel to assist in completion of the web-based GA.

Innovative solutions that aid frail patients to complete the web-based GA are also worth exploring. One possible solution is the use of intelligent voice assistants, which have gained popularity during the previous five years [18]. Voice assistants (e.g., Alexa [Amazon], Google Assistant, or Siri [Apple]) use artificial intelligence to respond to voiced questions or commands. Abdi et al. [19] cite voice assistants as one of eight emerging technologies that could be used to address the needs of older people in various care and support domains. Voice assistants have been championed because their ease of use makes them inherently inclusive of individuals with low digital literacy [20,21]. Moreover, Zubatiy et al. [22] found that voice assistants empowered both older adults with mild cognitive impairments and their caregivers. Voice assistants have become practically ubiquitous, as they exist in many devices that connect to the Internet, such as smart speakers, watches, and mobile phones. It is estimated that, by 2024, >8 billion voice assistant–equipped devices will be in use globally [23]. To put this growth into perspective, 2024 will mark only 10 years since the first voice assistant–based smart speaker, Echo (Amazon), was announced and <15 years since the release of the first commercialized voice assistant, Siri.

Several groups have investigated how older adults interact with voice assistants. O'Brien et al. [24] identified five major themes for older adults' use of voice assistants: (1) entertainment, (2) companionship, (3) home control, (4) reminders, and (5) emergency communication. Kim and Choudhury [25] found that, as older adults transitioned from novice to more experienced users of voice assistants, they felt less worried about making mistakes and enjoyed the digital companionship the devices offered. As voice assistants begin to enter the healthcare environment, it will be important to anticipate and address the challenges that may arise, such as algorithmic bias [26], the need for proactive interactions [27], and the use of these devices among people with hearing loss or speech impairments [28]. Future research should investigate how patients with varying levels of frailty may benefit from the use of this technology.

Our study has several limitations. It is a retrospective, single-institution study conducted in a metropolitan city, and a significant majority of our study population were non-Hispanic White patients who spoke English as their primary language. While we do not expect this to influence the generalizability of our findings, we cannot be completely sure that they can be applied to other groups. Moreover, the ability of patients to complete the eRFA was based on their own reporting and, as a result, was not controlled for personal preferences. That is, even though someone could be able to complete the eRFA independently, they might prefer to do so using assistance. However, the preference for assistance may be related to frailty.

The present study is the largest study, to date, of older adults with cancer whose frailty status was assessed by the AGD during preoperative evaluation. We additionally include another measure of frailty, the MSK-FI which is composed primarily of comorbidities and one functional component. The AGD and MSK-FI give a comprehensive overview of a patient's frailty based on both aging-related impairments and comorbidities. Moreover, our GA was implemented as part of routine care, limiting the likelihood of healthy volunteer bias.

5. Conclusion

Frailty was associated with both use of assistance and time required to complete the eRFA. Frail patients are more likely to benefit from completion of GA to determine appropriate treatment. Given that not all cancer patients have a caregiver who can assist completing a digital questionnaire, innovations that aid patients to complete the eRFA independently, such as voice assistant technology, should be empirically investigated.

Presentation

A previous version of this study was presented, in part, at the International Society of Geriatric Oncology annual meeting in 2018. In addition, an abstract based on this paper will be published by ASCO on May 26, 2022.

Financial support

authors and do not necessarily reflect the views of the funding organizations.

CRediT authorship contribution statement

Andrea Cuadra : Writing - original draft, Writing - review & editing. **Amy L. Tin :** Formal analysis, Data curation, Visualization, Writing - original draft, Writing - review & editing. **Gordon Taylor Moffat :** Writing - original draft. **Koshy Alexander :** Writing - review & editing. **Robert J. Downey :** Writing - review & editing. **Beatriz Korc-Grodzicki :** Writing - review & editing. **Andrew J. Vickers :** Formal analysis, Methodology, Supervision, Writing - review & editing. **Armin Shahrokni :** Formal analysis, Formal analysis, Conceptualization, Data curation, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Writing - original draft, Writing - review & editing.

Declaration of competing interest

The authors declare no conflicts of interest and have nothing to disclose.

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