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Validation of the Chinese-Canadian study of health and aging clinical frailty scale (CSHA-CFS) telephone version

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ABSTRACT

This was a cross-sectional validation study of the Chinese-Canadian study of health and aging clinical frailty scale telephone version (CSHA-CFS TV). The study pool consisted of 67 patients of outpatient clinics at a tertiary medical center in Taipei, Taiwan. They were enrolled in the program comprehensive geriatric assessment and the frailty study of elderly patients (CGAFSEP). The Chinese-Canadian study of health and aging clinical frailty scale physician version (CSHA-CFS PV) is a 7-point scale assigned after comprehensive geriatric assessments. Higher score indicates frailer status. The Chinese-Canadian study of health and aging clinical frailty scale (CSHA-CFS) telephone version (TV) included 17 questions adapted from the physician version. Two trained research assistants conducted the telephone interviews. Administration time was <3 min. Standard reliability and validity measures were applied. Three-fifths of the subjects were older than 75 years, and half of them were females. Inter-rater reliability was achieved with weighted kappa of 0.684, ($p = 0.002$) between first 20 ratings from 2 interviewers. Criterion validity was achieved with weighted kappa of 0.689 ($p < 0.0001$) and Kendal's tau of 0.612 ($p < 0.0001$) between the TV and the PV scores. Divergent validity was demonstrated with significant correlation but only fair agreements comparing both TV and PV scores with the cardiovascular health survey (CHS) phenotypic definition of frailty. One could conclude that the CSHA-CFS TV appears to be a quick, reliable, and valid frailty screening instrument for community-dwelling elderly.

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1. Introduction

Frailty is defined as “a state of age-related physiologic vulnerability resulting from impaired homeostatic reserve and a reduced capacity of the organism to withstand stress” (Fried and Walston, 2003). Many common geriatric syndromes including cognitive impairments, depression, osteoporosis, and malnutrition have been proposed as contributors of frailty (Lally and Crome, 2007). Frailty can lead to worse outcomes for elderly populations including acute illnesses, falls and injuries, disabilities, poorer quality of life, higher health care utilizations, and even death (Fried et al., 2001; Fried and Walston, 2003; Lally and Crome, 2007). However, clinical applications of frailty have been limited without

efficient assessment tools. Operationalization of frailty varied significantly across studies (Fried et al., 2001; Fried and Walston, 2003; Lally and Crome, 2007). While some researchers have included multiple co-morbidities and disability as indicators of frailty (Studenski et al., 2004; Rockwood et al., 2005; Rolfson et al., 2006), others feel that frailty is a related but separable concept from disability and multiple co-morbidities (Fried et al., 2001; Fried and Walston, 2003). Most instruments for assessing frailty are time consuming, requiring many elements of comprehensive geriatric assessments (CGAs) (Fried et al., 2001; Studenski et al., 2004; Rockwood et al., 2005). While being good research tools, this limits their clinical utility. Recently, the Edmonton frail scale (EFS) (Rolfson et al., 2006) was reported as a shorter feasible instrument for routine use by non-geriatricians. However, it is probably still too lengthy as a screening tool for large scale population based studies.

In the CSHA three instruments were developed to assess frailty (Rockwood et al., 2005). Among them, the CFS has the highest area under the receiver operating characteristic (ROC) curve for predicting adverse outcomes within 70 months (Rockwood

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1. Very fit: robust, active, energetic, well motivated and fit; these people commonly exercise regularly and are in the most fit group for their age.
2. Well: without active disease, but less fit than people in category 1.
3. Well, with treated comorbid disease: disease symptoms are well controlled compared with those in category 4.
4. Apparently vulnerable, although not frankly dependent: these people commonly complain of being “slowed down” or have disease symptoms.
5. Mildly frail: with limited dependence on other for IADL items.
6. Moderately frail: help is needed with both IADL and ADL.
7. Severely frail: completely dependent on others for ADL, or terminally ill.

Fig. 1. The items of CSHA-CFS, based on the Box 1 of Rockwood et al. (2005) (with permission).

et al., 2005). The Chinese-Canadian study of health and aging clinical frailty scale physician version (CSHA-CFS PV) is to be filled out as a global impression of frailty by a physician after CGA. The score ranges from 1 (very fit) to 7 (severely frail) (Fig. 1).

We intended to design a telephone interview tool to quickly identify potentially frail elders in the community for more thorough in-person assessments of frailty in clinics. With the permission from Dr. Rockwood from the CSHA, we modified the CSHA-CFS PV into the Chinese-Canadian study of health and aging clinical frailty scale telephone version (CSHA-CFS TV).

The objective of the current study is to validate this newly developed instrument on 67 elderly outpatients from a tertiary medical center base in Taipei, Taiwan.

2. Methods

2.1. Instrument development

The CSHA-CFS TV is designed to screen out the severely frail (category 7) subjects first (Fig. 1) (Appendix A). Using a step-by-step process, subjects with lower levels of frailty (from 6 to 1) are identified subsequently. For time efficiency, when a frailty level is determined, the interview is terminated.

In the original CSHA-CFS PV, category 7 (severely frail) is defined as “... completely dependent on others for activities of daily living (ADL) or terminally ill”. It is culturally inappropriate to ask elders if they are “terminally ill” from telephone interviews. Furthermore, most elders may not know if they are in fact terminally ill. We decided to only classify those with complete dependency for ADLs as category 7.

Subjects are first asked if they need assistance on any of the five basic ADLs (bathing, dressing, eating, toileting, and transferring) (Katz et al., 1963). If all the five answers are yes, they are categorized as “7: severely frail” (Fig. 1; Appendix A). Otherwise they are asked if they need assistance on any of the 8 Instrumental ADL (IADLs) (using telephone, shopping, preparing food, house-keeping, transportation, laundry, taking medicine, and financing) (Lawton and Brody, 1969). Subjects who required assistance on at least one ADL and one IADL are categorized as “6: moderately frail” and subjects with only IADLs impairments are categorized as “5: mildly frail” (Fig. 1; Appendix A).

Next, subjects are asked if they feel slowed up recently. If they answer yes, they are categorized as “4: apparently vulnerable” (Fig. 1; Appendix A). Next, subjects are asked if they have any chronic diseases that require treatments. If yes, they are asked if symptoms from those chronic diseases are well-controlled. Subjects with poor controlled symptoms of chronic diseases are categorized as “4: apparently vulnerable”. Subjects with well

controlled chronic diseases are categorized as “3: well, with treated co-morbid diseases”. Subjects without any treated chronic diseases are asked if they are fitter compared to people about their ages. If yes, they are categorized as “1: very fit”. If not, they are categorized as “2: well”.

The minimum number of questions to be answered to determine a frailty category is 5 and maximum number is 17. The instrument was first drafted in Chinese by the first author and revised by another author (Dr. Chin-Ying Chen) (Appendix A).

We also created the CSHA-CFS PV (Appendix B) and assignment algorithm from translations of the English instrument (Fig. 1) as the gold standard for the validation purpose.

2.2. Validation process of the CSHA-CFS telephone version

2.2.1. Face validity

The face validity of both telephone and physician versions was approved by expert geriatricians with suggestions of wording modifications.

2.2.2. Validation cohort

A lengthy CGA process is a necessary step for completing the CSHA-CFS PV score. To save time and effort, we used geriatric outpatients underwent CGAs from the CGAFSEP at the National Taiwan University Hospital (NTUH), Taipei, Taiwan. The NTUH Institutional Review Board approved the validation study in 2008.

Subjects in the CGAFSEP are followed for 2 years after their enrollments in 2007. They received baseline and semiannual assessments of the CHS phenotypic definition of frailty (Fried et al., 2001). Subjects were assessed with many standardized tools including ADL (Katz et al., 1963), IADL (Lawton and Brody, 1969), mini-mental state examination (MMSE) (Folstein et al., 1975), geriatric depression scale-15 (GDS-15) (Liu et al., 1998), and mini-nutritional assessment (MNA) (Guigoz et al., 1996) every 6 or 12 months for CGAs. They were evaluated by geriatricians quarterly. At least 20 subjects were needed to test inter-rater reliability with the assumption of achieving substantial agreements of weighted κ (0.61–0.8) and α of 0.05 (Sim and Wright, 2005). To estimate the sample size for criterion validity using a Kendall tau-correlation, we reckoned an expected correlation of 0.6, with $\alpha = 0.05$ and 90% power showing a need for 25 subjects (Kraemer and Thieman, 1987). Our study included 67 subjects (out of the 189 participants) who completed both the CSHA-CFS TV and PV assessments. The administration time for the CSHA-CFS TV was within 3 min for most patients.

2.3. Statistical analysis

2.3.1. Reliability

Test-retest reliability analysis was not performed because most variables included in the TV were not expected to change within a short-time period. Inter-rater reliability was assessed with weighted kappa between the first 20 frailty scores from 2 research assistants at 2 different time points (Landis and Koch, 1977).

2.3.2. Validity

Criterion validity was evaluated by weighted kappa (Landis and Koch, 1977) for agreements and Kendall's tau (Kruskal, 1958) for correlation between the TV scores and the PV scores (the gold standard). To complete the physician version, information needed in Fig. 1 were pulled from the latest CGAs. The physicians talked to the patient, evaluated the relevant data, performed a focused physical examination and then assigned the PV score. To avoid bias, research assistant A prepared CGA data of her own set of patients for geriatricians to review, then she called research assistant B's patients for telephone interviews, and vice versa.

Divergent validity was assessed with weighted kappa (Landis and Koch, 1977) and Kendall's tau (Kruskal, 1958) by comparing both TV and PV scores with the CHS phenotypic definition of frailty proposed by Fried et al. (2001). This instrument measures weight loss, exhaustion, low energy expenditure, slowness, and weakness. Subjects with ≥ 3 area of impairments are considered as frail, 1–2 area as pre-frail, and 0 as robust. It does not include disability or multiple co-morbidities. It measures different aspects of frailty compared with both Chinese-Canadian study of health and aging clinical frailty scale (CSHA-CFS) instruments. However, since all three instruments are used to capture the construct of frailty, they should still concur significantly. Therefore, we expected high correlation from Kendal tau but only fair agreements (weighted kappa ≤ 0.4) between both CSHA-CFS scores and the above mentioned frailty index categorization. To make comparisons, we equated category 1–3 of CSHA-CFS to the robust category of the CHS frailty definition, category 4–5 to the pre-frail category, and category 6–7 to the frail category.

Finally, the correlation of both the PV and TV score with 14 clinical assessments (numbers of chronic conditions, total medication numbers, ADL impairments, IADL impairments, MMSE scores, GDS scores, MNA scores, prevalence of fall, osteoporosis, osteoporotic fracture, stool incontinence, urinary incontinence, pain, and insomnia) were assessed with Kendall's tau (Kruskal, 1958).

Data was analyzed using the SAS version 9.1 (Cary, NC). Significant α was set at $p < 0.05$. All tests were two tailed.

3. Results

3.1. Characteristics of the validation cohort

3.1.1. Demographics

Among the 67 subjects in the validation cohort, 37% were between 65 and 74 years of age, 52% were between 75 and 84 years old, and 11% were older than 85 years. Half of them were females and 81% received at least 6 years of education (Table 1).

3.1.2. Frailty-related characteristics

None of the clinic patients were classified into category 1 (very fit) or 2 (well) using either the CSHA-CFS TV, or the PV (Table 1). The CSHA-CFS TV results showed that 22% were classified as cat. 3, 40% cat. 4, 28% cat. 5, 8% cat. 6, and 2% cat. 7. The distribution of frailty categories from the CSHA-CFS PV were 42% (3), 25% (4), 18% (5), 10% (6), and 5% (7), respectively. Twenty-eight percents were classified as robust, 60% as pre-frail, and 12% as frail using the CHS phenotypic definition of frailty (Fried et al., 2001; Table 1).

3.1.3. Health-related characteristics

Mean number of chronic diseases was 6.1 ± 2.3 from a list of 33 chronic problems. Mean number of prescription drugs was 5.4 ± 2.2 , mean number of complementary and alternative medications was 1.6 ± 1.7 , and mean total number of medications was 7.0 ± 3.0 .

3.1.4. Geriatric assessment-related characteristics

Mean number of ADL impairment was 0.3 ± 0.9 (range 0–5), and mean number of IADL impairment was 1.4 ± 2.2 (range 0–8). Mean MMSE score was 25.8 ± 4.6 (range 7–30), mean GDS score was 3.7 ± 3.4 (range 0–13) with 6% classified as having major depression (score ≥ 10), and mean MNA score was 25.8 ± 2.1 (range 20.5–29.0) with 15% classified as high-risk for malnutrition. Nearly two-fifths (37%) had falls in the preceding 12 months, 19% had history of osteoporosis, 8% had history of osteoporotic fracture, 4% had stool incontinences, 24% had urinary incontinences, 81% had pain and 48% had insomnia.

Table 1

Baseline characteristics of the validation cohort, total patient number = 67.

	n (%)
<i>Demographic characteristics</i>	
Age, years	
65–74	25 (37)
75–84	35 (52)
85+	7 (11)
Gender, females	34 (51)
Education, years	
<6	13 (19)
6–9	30 (45)
>9	24 (36)
<i>Frailty-related characteristics</i>	
CSHA-CFS (TV)	
3	15 (22)
4	27 (40)
5	19 (28)
6	5 (8)
7	1 (2)
CSHA-CFS (PV)	
3	28 (42)
4	17 (25)
5	12 (18)
6	7 (10)
7	3 (5)
CHS phenotypic definition of frailty ^a	
Robust	19 (28)
Pre-frail	40 (60)
Frail	8 (12)
	Mean $\pm$ S.D. (range) n (%)
<i>Health-related characteristics</i>	
Number of chronic diseases ^b	6.1 ± 2.3 (1–13)
Number of prescription medications	5.4 ± 2.2 (1–11)
Number of complementary and alternative medications	1.6 ± 1.7 (0–8)
Total medication number	7.0 ± 3.0 (2–18)
<i>Geriatric assessment-related characteristics</i>	
ADL	0.3 ± 0.9 (0–5)
IADL	1.4 ± 2.2 (0–8)
MMSE	25.8 ± 4.6 (7–30)
GDS	3.7 ± 3.4 (0–13)
Major depression	4(6)
MNA	25.8 ± 2.1 (20.5–29.0)
At risk of malnutrition	10(15)
Fall	Yes 25 (37)
Osteoporosis	Yes 13 (19)
Osteoporotic fracture	Yes 5 (8)
Stool incontinence	Yes 3 (4)
Urinary incontinence	Yes 16 (24)
Pain	Yes 54 (81)
Insomnia	Yes 32 (48)

^a Definition by Dr. Fried and her colleague.

^b From 33 diseases.

3.2. Instrument validation

Table 2 shows results of the validation tests of the CSHA-CFS TV and the physician version. Inter-rater reliability of the TV was achieved with weighted kappa of 0.684 ($p = 0.002$) between first 20 ratings from 2 interviewers (Table 2). Criterion validity was achieved with weighted kappa of 0.689 ($p < 0.0001$) in substantial agreement range and Kendal's tau of 0.612 ($p < 0.0001$) between the TV and the PV scores (Table 2). The fact that none of the subjects were rated as very fit (cat. 1) and well (cat. 2) was another proof of instrument validity since all clinic patients had chronic diseases. By definition, they would be graded as cat. 3. Divergent validity was demonstrated with high correlation (Kendal's

Table 2

Validation tests of the CSHA-CFS TV and PV.

Tests	<i>n</i>	Weighted kappa <i>p</i> < /=	Kendal's tau <i>p</i> < /=
Inter-rater reliability	20	0.684 (<i>p</i> = 0.002)	NA
Criterion validity TV vs. PV	67	0.689 (<i>p</i> < 0.0001)	0.612 (<i>p</i> < 0.0001)
Divergent validity TV vs. CHS phenotypic definition of frailty	67	0.334 (<i>p</i> = 0.006)	0.279 (<i>p</i> = 0.015)
PV vs. CHS phenotypic definition of frailty	67	0.379 (<i>p</i> < 0.0001)	0.478 (<i>p</i> < 0.0001)

tau = 0.279, *p* = 0.015) but only fair agreements (weighted kappa = 0.334, *p* = 0.0006) between the CSHA-CFS TV categorizations and the CHS phenotypic definition of frailty (Table 2). A similar finding was also found between the CSHA-CFS PV categorizations and the CHS phenotypic definition of frailty (Kendal's tau = 0.478, *p* < 0.0001 and weighted kappa = 0.379, *p* < 0.0001; Table 2).

3.3. Correlations of both TV and PV scores with other clinical assessments

Both of the CSHA-CFS PV and TV scores correlated well with ADL impairments, IADL impairments, MMSE scores and MNA scores (Table 3). The PV scores also correlated with total medication numbers, numbers of chronic diseases, GDS scores, and presence of pain (Table 3). Overall, the PV performed better in predicting important clinical outcomes than the telephone version.

4. Discussion

Among the elderly attendants of general medicine clinics at a tertiary center in Taiwan, the CSHA-CFS TV was a valid measure of frailty compared with the CSHA-CFS PV derived from CGAs. It also demonstrated substantial inter-rater reliability. Both the telephone and physician assessments differentiated well against the CHS phenotypic definition of frailty (Fried et al., 2001) which measured similar but distinct aspects of frailty.

The greatest advantages of the CSHA-CFS TV were its short administration time (<3 min) and easy implementation by trained interviewers without formal training in geriatric care. After completing this validation process, we implemented this instrument on a cohort of 2100 population representative community-dwelling elders in Northern Taiwan to identify subjects at risk for frailty. We invited subjects scored 3–6 from the TV to a community

hospital for more thorough interviews using the CHS phenotypic definition of frailty (Fried et al., 2001). We intended to enroll the pre-frail and frail subjects into a randomized trial testing the effectiveness of integrated interventions to improve patient outcomes. This screening tool, saved significant time and costs when conducting our randomized clinical trial.

In the validation process, all participants were already enrolled in the CGAFSEP. They had strong relations with both research assistants. No one refused the telephone interview. When applying the CSHA-CFS TV to the 2100 community samples, the response rate was only 35%, as 26% were not contactable by the registered telephone numbers and 39% refused the telephone interviews. Low response rate to telephone surveys is a common phenomenon not specific to our instrument. However, it would certainly affect the representativeness of the sample and limit future application of our instrument.

In the original CSHA-CFS PV (Fig. 1; Rockwood et al., 2005), cat. 7: severely frail includes subjects who are either terminally ill or totally dependence on ADLs. We did not include the terminal ill patients in both of our Chinese PV and telephone version. We would categorize those terminally ill patients into moderately or mildly frail categories depending on their functional status. However, most terminally ill cancer patients were cared by oncologists in Taiwan. Other patients with terminal conditions such as end stage dementia are most likely cared by specialty and sub-specialty physicians. This type of misclassification should be negligible in our samples from general medicine clinics. Dr. Rockwood also mentioned in his paper that users of the CSHA-CFS PV may separate category 7 into 2 sub-categories (terminally ill vs. totally functionally dependent) in appropriate settings (Rockwood et al., 2005).

Patients from general medicine clinics may not be the best candidates to validate this instrument. Unlike the CSHA community sample with relatively even distributions of subjects into 7 categories, our validation cohorts were highly concentrated in categories 3–5. There were no subjects in cat. 1–2 and very few in cat. 6–7. It certainly limits the generalizability and validity of our instrument. However, using an existing sample from another study as the validation cohort saved tremendous time and effort compared to implementing a new study for validation purposes. Cross validation of this instrument in other settings would improve the generalizability in the future.

Among the 14 clinical assessments in the cohort, the CSHA-CFS TV correlated with 4 characteristics and the PV correlated with 8. Both ADLs and IADLs are used to create the CSHA-CFS scores. We expect significant correlation between ADLs/IADLs and the CSHA-CFS (both PV and TV). Several researchers included cognitive function as components of frailty assessment (Studenski et al., 2004; Rockwood et al., 2005; Levers et al., 2006; Rolfsen et al., 2006). Cognition is not explicitly assessed with the CSHA-CFS. However, we found significant correlation between the MMSE score and both of our CSHA-CFS instruments. In the CSHA, higher CFS categories were also associated with worsen modified MMSE scores as well (Rockwood et al., 2005). Nutritional status has been proposed as an important contributing factor of frailty (Fried et al.,

Table 3

Correlation of the CSHA-CFS PV and TV with various clinical assessments, based on the calculation of Kendall's tau.

	PV		TV	
	τ	<i>p</i> (< /=)	τ	<i>p</i> (< /=)
CSHA-CFS vs. the following indices				
Number of chronic diseases	0.2205	0.0248	0.1071	0.2797
Total medication number	0.2034	0.0364	0.1022	0.2971
ADL	0.4023	0.0003	0.4803	0.00001
IADL	0.5672	0.00001	0.789	0.00001
MMSE	–0.2519	0.0097	–0.2908	0.0030
GDS	0.2893	0.0030	0.1745	0.0758
MNA	–0.2585	0.0072	–0.2946	0.0024
Falls	0.1278	0.2577	0.028	0.8057
Osteoporosis	0.1403	0.2141	0.1484	0.1925
Osteoporotic fracture	–0.1488	0.1877	–0.1918	0.092
Stool incontinence	–0.0432	0.7020	0.0291	0.7983
Urinary incontinence	0.0978	0.3864	0.0388	0.7331
Pain	0.2806	0.0130	0.1123	0.3242
Insomnia	0.126	0.2646	–0.009	0.9367

Notes: Significance limit was set to *p* < 0.05.

2001; Fried and Walston, 2003; Studenski et al., 2004; Levers et al., 2006; Rolfson et al., 2006). Both of our PV and TV were correlated well with the MNA scores. Our PV but not TV also correlated with several indicators used in other instruments to assess frailty such as depression (Studenski et al., 2004; Rolfson et al., 2006), numbers of co-morbidities (Studenski et al., 2004), numbers of medications (Studenski et al., 2004; Rolfson et al., 2006), and pain. It is expected that the CSHA-CFS PV scores assigned after CGAs would have higher correlation with more standardized tools used in the CGA process compared to the TV scores. These findings should not be interpreted as inadequacy of the telephone version. Cross-validation of both instruments in another cohort would be necessary to establish the comparative effectiveness between both tools.

5. Conclusion

In summary, the CSHA-CFS TV appears to be a quick, reliable, and valid screening tool of frailty for elderly outpatients. We are testing the tool in a large population cohort to enroll appropriate participants to a randomized clinical trial. This instrument can be easily modified into a self-administered version for routine clinical screening of frail elderly patients. However, without effective

management strategies for frailty, screening alone will not improve patient outcomes. Intervention trials to improve outcome of frail older adults are urgently needed.

Conflict of interests statement

None.

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Appendix A

The CSHA-CFS TV (English translation)

I am going to ask you regarding your activities of daily living. Please let me know if you need help from others to complete the listed tasks?

Function	1-No	2-Yes	
Eating	☐	☐	ADL(1)
Dressing	☐	☐	ADL(2)
Transferring	☐	☐	ADL(3)
Toileting	☐	☐	ADL(4)
Bathing	☐	☐	ADL(5)

If ADL(1)-(5) all answered Yes , assign frailty category 7 and stop.

Shopping	☐	☐	IADL(1)
Taking medications	☐	☐	IADL(2)
Using telephone	☐	☐	IADL(3)
Financing	☐	☐	IADL(4)
Transportation	☐	☐	IADL(5)
Preparing meals	☐	☐	IADL(6)
Doing light house works	☐	☐	IADL(7)
Doing laundry	☐	☐	IADL(8)

If at least one IADL item answered Yes , and at least one ADL item answered Yes , assign frailty cat. 6 and stop.

If all IADL item answered No , and at least one ADL item answered Yes , assign frailty cat. 6 and stop.

If at least one IADL item answered Yes , and all ADL item answered No , assign frailty cat. 5 and stop.

If all ADL items and all IADL items answered No, move to the next question.

Did you feel slow down recently ? ☐ ☐ 02
Yes: assign frailty cat. 4 and stop.

Do you have any chronic disease under treatment ? ☐ ☐ 03(1)
Yes: move to question number 03(2)
No: move to question number 04

Do those chronic diseases controlled well ? ☐ ☐ 03(2)
If 03(1) answered Yes , and 03(2) answered No, assign frailty cat. 4 and stop.
If both 03(1) and (2) answered Yes: assign frailty cat. 3 and stop.
If both answered No, move to the next question.

Do you think that you are fitter compared to someone of your age ? ☐ ☐ 04
No: assign frailty cat. 2 and stop.
Yes: assign frailty cat. 1 and stop.

Frailty category ☐ 05

Appendix B

The CSHA-CFS PV (English translation)

Physician signature:

Frailty Category

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