

The Case for Nutrition & Frailty Screening in Community-living Older Adults

March 29, 2017

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EDUCATION

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Enhancing the quality of life and care of older adults through partnerships in *research*, *education* and *practice*.

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Enhancing Life

Outline

- Nutrition risk in Canadian older adults
- Nutrition risk and frailty
- Nutrition and falls
- Overlap among malnutrition, frailty and sarcopenia
- Looking forward with nutrition and frailty screening
- Implementing screening in the community

What are older Canadians eating?

- **Poor intake of all four food groups** (Quebec, British Columbia, New Brunswick, Ontario & Canadian Community Health Survey)
- **A variety of nutrients consumed below recommendations; A, D, C, B6, B12, folate, B carotene, calcium, zinc, magnesium** (Levy-Milne, 2004; New Brunswick Dept Health, 2005; Shatenstein et al., 2004)
- **65% do not consume 5 servings of vegetables & fruit** (CCHS 2.2)



Why Poor Food Intake Occurs

- Food apathy
 - Reduced physical ability
 - Restricted income
 - Depression, social isolation, neglect
 - Medication use
 - Cognitive impairment
 - Dentition
 - Multi-morbidity
 - Other priorities
- Older Adults in Canada (CCHS, 2008)
 - 42% in lowest income
 - 49% living alone
 - 49% with low social support
 - 43% infrequent social participation
 - 42% don't drive
 - 62% report depression
 - 44% report disability
 - 54% 5+ medications
 - 46% poor oral health

German et al., 2011; Nykanen et al., 2013; Romero-Ortuno et al., 2011; Schilp et al., 2011; Ramage-Morin & Garriguet, 2013

What is nutrition risk?

- Risk factors are present that are known to impair food intake or affect nutrient utilization of the body
- Low or poor food intake
- Occurs before physical or overt signs of undernutrition e.g. significant weight loss
- Easier to improve nutritional risk than undernutrition
- Commonly measured by looking at accumulation of risk factors, food intake, and weight change; often based on self-report of risk factors
- Good tools predict outcomes associated with undernutrition, such as mortality

What is malnutrition?

- Inadequate intake of energy, macro or micronutrients
- Sustained inadequate intake leads to **functional change** in tissues of the body e.g. muscle loss, weakness, immune function, capacity for recovery, cognition
- **Responds to re-feeding**

(CMTF website adapted from: AW McKinlay:
Malnutrition: the spectre at the feast. *J R Coll
Physicians Edinb* 2008:38317–21.)

Prevalence of Nutrition Risk Factors In Canada (based on SCREENII)

Population Sample, Stats Canada, CCHS 2008
(Ramage-Morin & Garriguet, 2013)

- **34% nutrition risk**
- 47% weight change > 5lbs
- 27% poor appetite
- 26% swallowing problems
- 24% skip meals
- 37% low fruit/veg
- 42% eat alone
- 52% cooking difficulty



More vulnerable older adults...

Vulnerable Community Sample

(Keller & McKenzie, 2003)

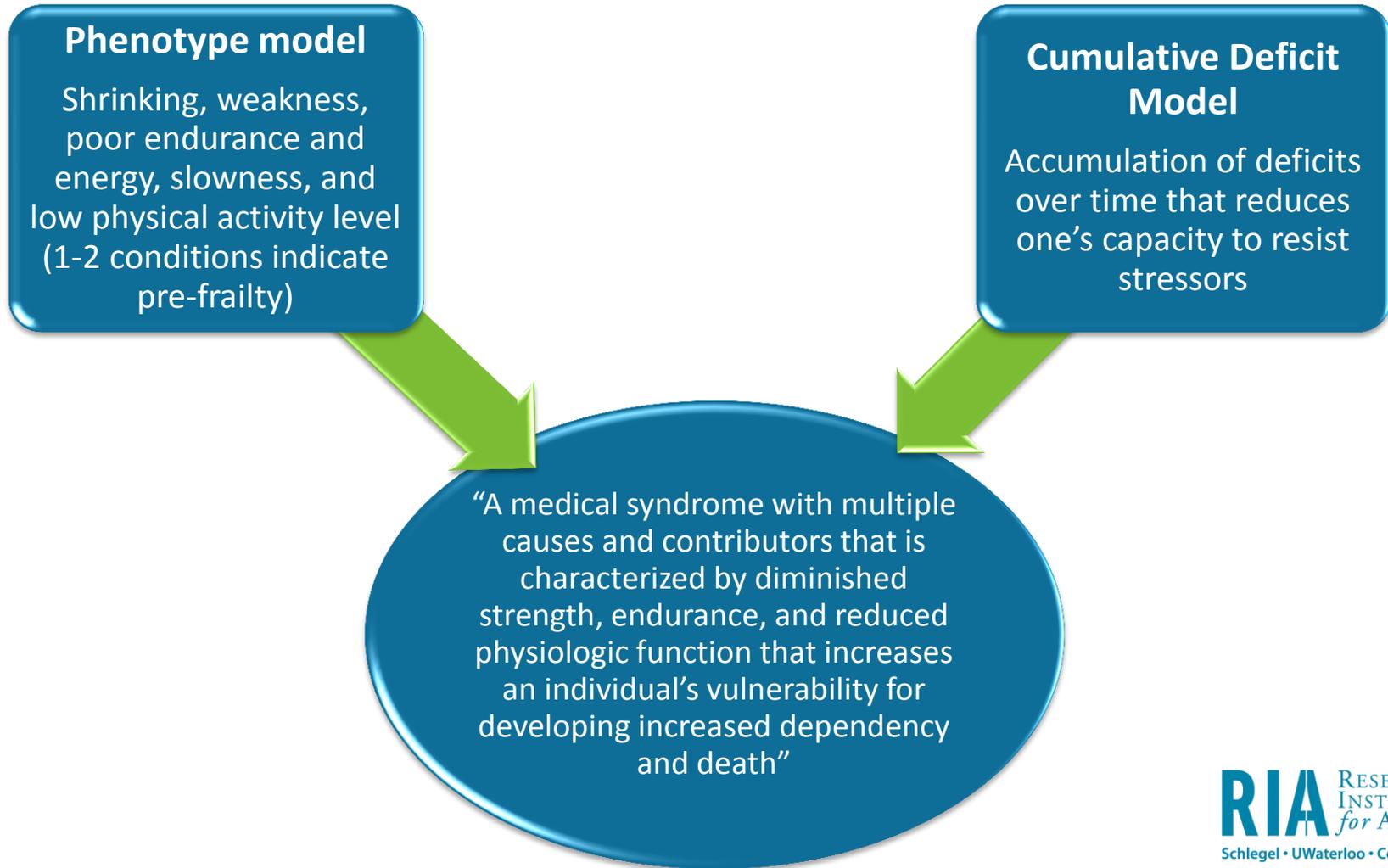
- 44% nutrition risk
- 22% weight loss
- 45% limit food & find difficult to manage
- 48% low fruit & veg
- 20% low milk products
- 35% chewing difficulty
- 23% swallowing difficulty
- 28% poor appetite
- 43% cooking difficulty
- 29% shopping



Consequences of nutrition risk in community living seniors

- Nutritional risk is independently associated with 5 year mortality in older men (Broeska et al., 2013); and with 18 month mortality in older adults who receive home care services (Keller & Østbye, 2003)
- Predicts health related quality of life in older adults who receive home care services (Keller & Østbye, 2004)
- Involuntary weight loss predicts death, institutionalization and poor emotional health and social functioning (Payette, 2005)

What is frailty?



Prevalence of Frailty - Community

- Community-dwelling older adults (>65 years)
 - At least 1 million (Hoover et al. 2013) and up to ¼ of Canadians (Muscedere et al. 2016)
 - 22.7% of a sample (age 65–102 years) with higher rates among women (25.3%) (Song et al. 2010)
 - 24% of those 90- to 94-year olds (95+ years = 39.5%) (Lee et al. 2016)

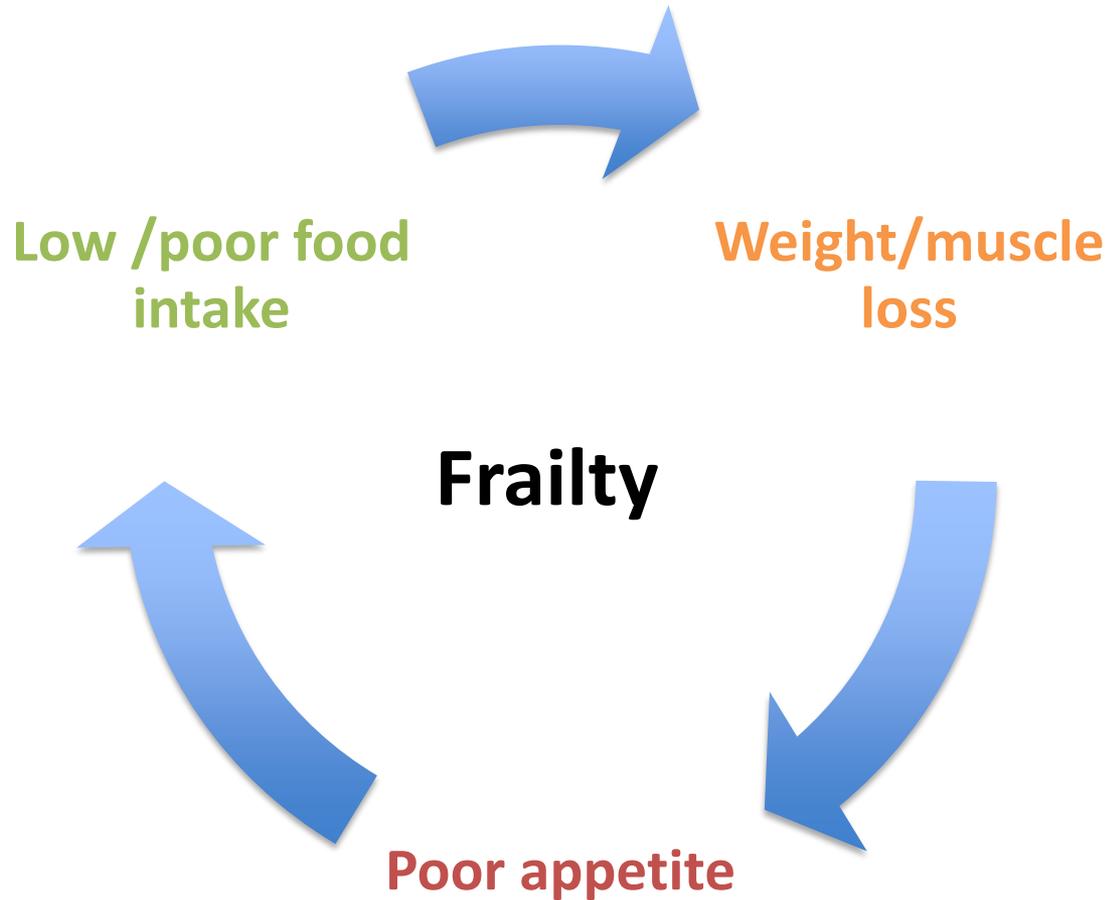
Pre-Frailty

- 35–50% in those over age 60 years
- More common in women
- Weakness is the most common criteria reported (Fernández-Garridoa et al. 2014)

Overlap between Malnutrition and Frailty

- Common symptoms of weight loss, exhaustion, weakness, and slowness (Fried et al. 2001)
- Common socio-demographic, physical, and cognitive risk factors (Boulos et al. 2016)
- Overlap in prevalence
 - ~98% non-frail = well-nourished
 - ~50% frail = malnourished (Bollwein et al. 2013)
- **Malnutrition/risk of malnutrition = 4x increase in risk of frailty** (Boulos et al. 2016)

Vicious and destructive cycle...



Inadequate intake may be the root cause of some frailty...

- 3 year study in older women
 - Those with lowest protein (0.7 g/kg/d) at baseline lost 40% more muscle mass than those with highest protein intake (1.1 g/kg)
 - Low levels of serum vitamin D, carotenoids, selenium, zinc, B6, B12 also predicted disability (Semba et al., 2006)

Common basis to treating malnutrition and frailty

- Oral Nutritional Supplement (ONS):
 - Potential benefits on weight status and mortality (Milne et al. 2009)
 - Frailty indicators (Artaza-Artabe et al. 2016; Manal et al. 2016)
 - Nutritional status (Manal et al. 2016)
- High Quality Diets
 - Protein associated with skeletal muscle mass (Huang et al., 2016)
 - Benefits when paired with exercise → improved QOL and strength in pre-frail (Kwon et al. 2015)
- Nutritional intervention alone and in combination with cognitive and physical activity intervention improves strength and energy (Ng et al, 2015)

Early intervention supports improved outcomes

Falls: a potential outcome of frailty

(Abrahamsen et al., 2014; Scott et al., 2015)

- Sarcopenia= loss of muscle mass and strength
 - A component of frailty (weakness, slowness, exhaustion)
- Sarcopenia associated with fracture and falls
 - may be more influential in men than women
- Dynapenia (strength, due to quality of muscle) likely more relevant for falls, function
 - Falls in the last 12 months was associated with decreased hand grip strength (Lenardt et al, 2016)

Falls: a potential outcome of nutrition risk

- Those with a history of falls as compared to non-fallers were:
 - Less active, more nutrition risk, poorer balance, lower extremity strength, functional endurance
 - When adjust for other covariates, nutrition risk still an important predictor of fall history, as were lower extremity strength and balance (Johnson et al., 2003)
- Longitudinal study of random sample in Taiwan (Chien & Guo, 2014)
 - N= 4440; Nutritional risk ~10%
 - Nutritional risk associated with a fall in past year [OR 1.73 (1.23, 2.42)]

Falls: a potential outcome of nutrition risk (con't)

- Malnourished patients identified in ER report falling in the past 6 months (Vivanti et al., 2009)
- Those who fall are more likely to be malnourished than those that do not (Meijer et al, 2012)
- Malnutrition is a predictor of falling (OR 1.978 95% CI 1.340-2.920) (Meijer et al, 2012)

Falls Prevention Intervention Recommendations

- *“A strategy to reduce the risk of falls should include multifactorial assessment of known fall risk factors and management of the risk factors identified.”* [Good evidence] (American Geriatrics Society)
- Frail, malnourished patients post discharge from hospital increase weight and improve function with ONS + dietitian support (Neelemaat et al, 2011)

→ Need to identify those who are at nutritional risk and treat

Vitamin D

- Vitamin D supplementation reduces falls by 20% (Meta-analysis- Bischoff-Ferrari et al., 2004; Michael et al., 2010)
 - Number needed to be treated to prevent 1 fall was 15
 - Improves muscle strength but not mass or power
 - Most effect in those with $< 30\text{nmol/l}$ 25(OH)D (deficient)
- Vitamin D supplements of at least 800 IU per day should be provided to older persons with proven vitamin D deficiency. **[Good Evidence]**
- Vitamin D supplements of at least 800 IU per day should be considered for people with suspected vitamin D deficiency or who are otherwise at increased risk for falls. **[At least fair evidence]**

http://www.americangeriatrics.org/health_care_professionals/clinical_practice/clinical_guidelines_recommendations/prevention_of_falls_summary_of_recommendations

Protein

- Need sufficient protein intake to stimulate muscle protein synthesis and inhibit breakdown
 - Whey (Leucine rich) more effective than casein or soy
 - 1.2 g/kg/d enhances benefits of progressive resistance training (Meta-analysis Cermak et al., 2012)
- Impact of protein seems to be greatest in those with more nutrition risk (Zoltick et al, 2011; Larocque et al, 2015; Michael et al, 2010)

Weight loss to prevent falls? (Scott et al., 2015;

JafariNasabian et al., 2017)

- Obesity may promote bone and muscle through mechanical loading
- Increased adiposity → pro-inflammatory cytokines and endocrine factors that impair muscle and bone
- Obese may be more likely to fall
- Unclear if obese more likely to fracture
- Caloric restriction results in loss of muscle and fat mass and potentially bone mass
 - need to combine weight loss with progressive resistance training

Treatment starts with identification:
What can we do to identify risk?

Nutrition Screening: What is it?

- A process to identify an individual who is:
 - ✓ At **risk** of malnutrition (risk factors are present that impair intake and/or increase the body's needs for nutrients and/or energy)
 - ✓ **Malnourished**
 - ✓ Likely to benefit from further nutrition assessment and treatment
- It is a **rapid and simple process** conducted by admitting or front line staff, typically a nurse, **not** a nutrition professional.

A.S.P.E.N. 2010 / ADA EAL © 2012 / Chen et al. 2001 /
ADA 2003 / ESPEN 2008 / Reuben, 1995 / Mueller et
al., 2011 / Kondrup et al., 2003 / Chen et al., 2001

Principles of “Ethical Screening”

- **Target** people in potential need of nutrition assessment and treatment
- **Identify** nutrition problems and appropriate course of action (e.g. assessment, treatment)
- Have a **referral/treatment algorithm** in place to promote appropriate and efficient referral
e.g. Integrated Nutrition Pathway for Acute Care
- Include follow-up and **monitoring** post treatment

Polling Question: If you don't already do nutrition screening, what is the likelihood of starting in the next 6 months?

- Very unlikely
- Likely
- Not sure if we are ready
- Getting ready
- Will definitely be doing
- We already do screening

Main considerations in selecting a screening tool

- **Easy**
- Front-line personnel can use
- Uses existing personnel, processes
- Inexpensive to collect on all clients
- On electronic medical chart
- Implemented as part of a general work-up
- Data readily available
- Appropriate for the setting in which it is to be used
- Specific to the population

Table 1
Simple screening tools 1 and 2 (1)^a

Risk factors	1 point ^b	2 points ^b
Tool 1		
BMI (≥ 65 years)	21 - 23.9 kg/m ²	<21 kg/m ²
% weight loss over time:		
1 week	<1%	$\geq 1\%$ - 2%
1 month	2%	25%
3 months	5%	$\geq 7.5\%$
6 months	7.5%	$\geq 10\%$
Unlimited/unknown time frame	<10%	$\geq 10\%$
Tool 2		
BMI (≥ 65 years)	21 - 23.9 kg/m ²	<21 kg/m ²
Albumin	28 - 35 g/L	<28 g/L

BMI = body mass index, PEM = protein-energy malnutrition
^aTool 1 = BMI and percentage of weight loss over time; tool 2 = BMI and albumin level
^bTotal score for each simple screening tool:
 0 - 1 point = low PEM risk
 2 - 4 points = high PEM risk
 Note: The total score can be based on one or both risk factors.

Malnutrition

Is your patient at risk?

Malnutrition Screening Tool¹ (MST)

- Have you/the patient lost weight recently without trying?
 - No 0
 - Unsure 2
 - Yes, how much (kg)?
 - 1 - 5 1
 - 6 - 10 2
 - 11 - 15 3
 - > 15 4
 - Unsure 2
- Have you/the patient been eating poorly because of a decreased appetite?
 - No 0
 - Yes 1

Total Score

Action

If your patients have lost weight and/or are eating poorly - ie, score two or more, or they are very underweight, then they may be at risk of malnutrition.

Applies to the last six months

If unsure, ask if they suspect they have lost weight - eg, clothes are looser

For example, less than three-quarters of usual intake may also be eating poorly due to chewing and swallowing problems

Of weight loss and appetite questions



Mini Nutritional Assessment MNA[®]

Last name: _____ First name: _____ Sex: _____

Date: _____ Age: _____ Weight, kg: _____ Height, cm: _____

Complete the screen by filling in the boxes with the appropriate numbers. Total the numbers for the final screening score.

Screening

A Has food intake declined over the past 3 months due to loss of appetite, digestive problems, chewing or swallowing difficulties?

0 = severe decrease in food intake
 1 = moderate decrease in food intake
 2 = no decrease in food intake

B Weight loss during the last 3 months

0 = weight loss greater than 3 kg (6.6 lbs)
 1 = does not know
 2 = weight loss between 1 and 3 kg (2.2 and 6.6 lbs)
 3 = no weight loss

C Mobility

0 = bed or chair bound
 1 = able to get out of bed/ chair but does not go out
 2 = goes out

D Has suffered psychological stress or acute disease in the past 3 months?

0 = yes 2 = no

E Neuropsychological problems

0 = severe dementia or depression
 1 = mild dementia
 2 = no psychological problems

F1 Body Mass Index (BMI) (weight in kg / (height in m)²)

0 = BMI less than 19
 1 = BMI 19 to less than 21
 2 = BMI 21 to less than 23
 3 = BMI 23 or greater

IF BMI IS NOT AVAILABLE, REPLACE QUESTION F1 WITH QUESTION F2. DO NOT ANSWER QUESTION F2 IF QUESTION F1 IS ALREADY COMPLETED.

F2 calf circumference (CC) in cm

0 = CC less than 31
 3 = CC 31 or greater

Screening score (max. 14 points)

12-14 points: Normal nutritional status
 8-11 points: At risk of malnutrition
 0-7 points: Malnourished

Table 1 Initial Screening

1	Is BMI < 20.5?	Yes	No
2	Has the patient lost weight within the last 3 months?		
3	Has the patient had a reduced dietary intake in the last week?		
4	Is the patient severely ill? (e.g. in intensive therapy)		

Yes: If the answer is "Yes" to any question, the screening in Table 2 is performed.
 No: If the answer is "No" to all question, the patient is re-screened at weekly intervals. If the patient e.g. is scheduled for a major operation, a preventive nutritional care plan is considered to avoid the associated risk status.

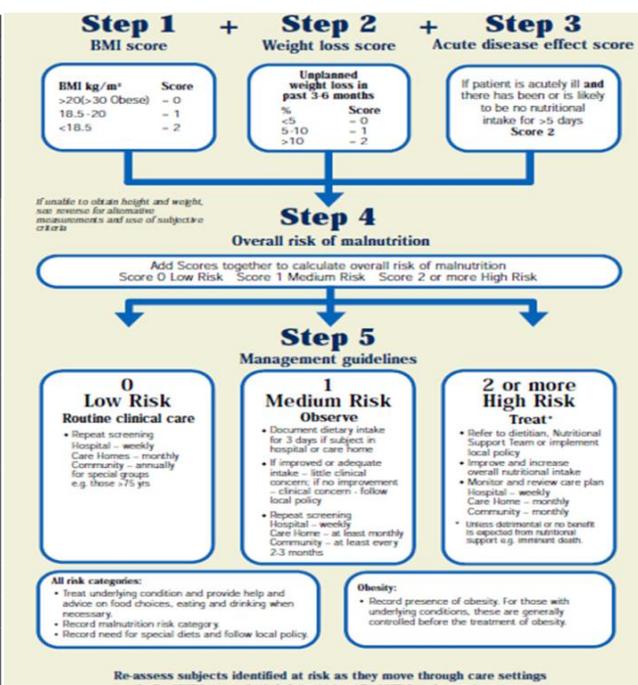
Table 2 Final Screening

Impaired nutritional status		Severity of disease (increase in requirements)	
Absent Score 0	Normal nutritional status	Absent Score 0	Normal nutritional status
Mild score 1	Wt loss >5% in 3 months or food intake below 50-75% of normal requirements in preceding week	Mild score 1	Hip fracture* Chronic patients, in particular with acute complications cirrhosis*, COPD*, Chronic hemodialysis, diabetes, oncology
Moderate score 2	Wt loss >5% in 2 months or BMI 18.5 - 20.5 + impaired general condition or food intake 25 - 60% of normal requirement in preceding week	Moderate score 2	Major abdominal surgery* Stroke* Severe pneumonia, hematologic malignancy
Severe score 3	Wt loss >5% in 1 month (>15% in 3 months) or BMI <18.5 + impaired general condition or food intake 0-25% of normal requirement in preceding week	Severe score 3	Head injury* Bone marrow transplantation* Intensive care patients (APACHE >10).

Score = Total score + Score:

Age = age-adjusted total score if > 70 years: add 1 to total score above

Score = / > 3: the patient is nutritionally at risk and a nutritional care plan is initiated
 Score < 3: weekly rescreening of the patient. If the patient e.g. is scheduled for a major operation, a preventive nutritional care plan is considered to avoid the associated risk status.



SNAO

Short Nutritional Assessment Questionnaire

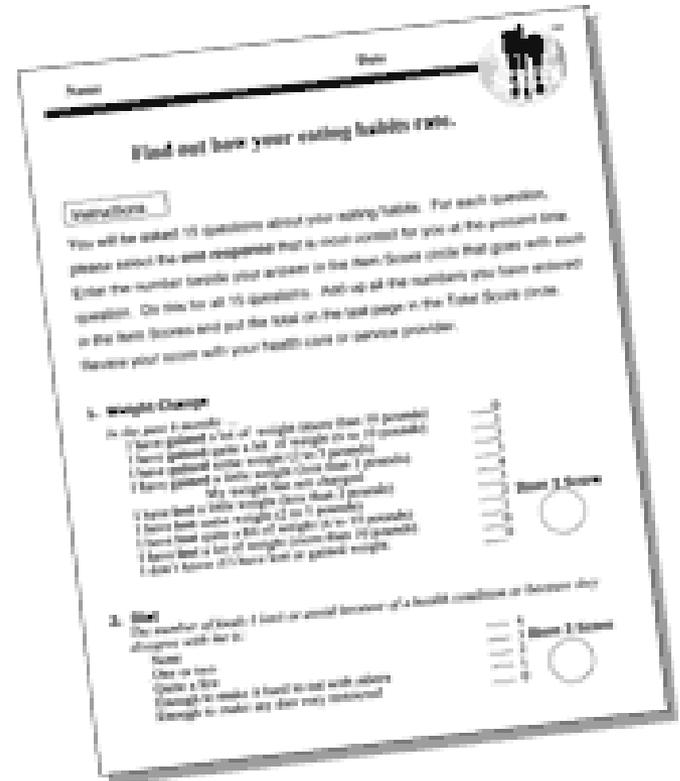
- Did you lose weight unintentionally?
 - More than 6 kg in the last 6 months
 - More than 3 kg in the last month
- Did you experience a decreased appetite over the last month?
- Did you use supplemental drinks or tube feeding over the last month?

● no intervention
 ●● moderately malnourished; nutritional intervention
 ●●● severely malnourished; nutritional intervention and treatment dietician

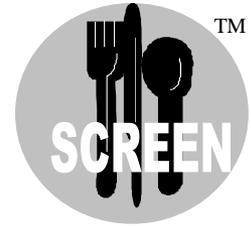
Re-assess subjects identified at risk as they move through care settings
 See the 'MST: Explanatory Booklet' for further detail and the 'MST: Aip' for supporting evidence.

What is SCREEN II?

Seniors in the
Community:
Risk
Evaluation for
Eating and
Nutrition



SCREEN II



- SCREEN can be self or interviewer administered
- Expert involvement in wording
- Seniors involved in development
- Abbreviated version also available
- Validated against a dietitian's rating of nutritional risk
- Demonstrated test-retest reliability
- Intermodal, inter-rater reliability
- SCREEN program
 - Referral process based on identified risk items
- Can be included on EMR or other platforms

Items on SCREENII

- Weight change*
 - Loss/gain
 - Intentionality
 - Perception
- Skipping meals*
- Diet restrictions/difficulty
- Appetite*
- Eating alone*
- Use of meal replacements
- Intake
 - F&V*
 - Milk products
 - Meat & alternatives
 - Fluid*
- Swallowing*
- Chewing
- Grocery difficulty
- Cooking difficulty*

* On abbreviated version

Example Question

How much fluid do you drink in a day?

Examples are water, tea, coffee, herbal drinks, juice, and soft drinks, but not alcohol.

- 4 Eight or more cups
- 3 Five to seven cups
- 2 Three to four cups
- 1 About two cups
- 0 Less than two cups

Nutri-eSCREEN ... for self-management

www.eatrightontario.ca/escreen

Eating Habits Survey



Click For Audio Help

Welcome! If you are an older adult, this questionnaire will help you find out how you are doing with choosing foods that help you stay healthy and active.



Welcome



Answer 14 short questions about your eating habits. This should take about 10 minutes.



Your Benefits

- What you eat impacts your health
- Find out what you are doing well
- Find out where you can improve
- Learn about some steps you can take to improve your eating habits



Your Results

- **Step 1** Tell us a bit about yourself
- **Step 2** Complete all 14 questions
- **Step 3** When you are finished, we will tell you your results
- **Step 4** Find nutrition resources and links to help you to improve your habits

[Click Here To Start](#)

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Connecting Frailty and Nutrition Screening

- Overlapping characteristics in screening/assessment tools include:
 - Weight loss/decreased body mass
 - Functional capacity
 - Weakness (grip strength)
 - Cognitive status
- Frailty/pre-frailty could be used as a justification for nutrition screening.
 - The five Fried criteria, self-reported or observed slowness, weakness or exhaustion at routine visits could be a trigger.
 - The seven-point Clinical Frailty Scale could also be used to identify frailty based on clinical judgment.
 - Pre-frailty assessment with key indicators: handgrip strength, 5 meter walk
 - Target a segment of the population with increased frailty/undernutrition e.g. >75 years

Clinical Frailty Scale



1. **Very Fit** – People who are robust, active, energetic and motivated. These people commonly exercise regularly. They are among the fittest for their age.



2. **Well** – People who have no active disease symptoms but are less fit than Category 1. Often, they exercise or are very active occasionally, e.g. seasonally.



3. **Managing Well** – People whose medical problems are well controlled, but are not regularly active beyond routine walking.



4. **Vulnerable** – While not dependent on others for daily help, often symptoms limit activities. A common complaint is being "slowed up," and/or being tired during the day.



5. **Mildly Frail** – These people often have more evident slowing, and need help in high order IADLs (finances, transportation, heavy housework, medications). Typically, mild frailty progressively impairs shopping and walking outside alone, meal preparation and housework.



6. **Moderately Frail** – People need help with all outside activities and with keeping house. Inside, they often have problems with stairs and need help with bathing and might need minimal assistance (cuing, standby) with dressing.



7. **Severely Frail** – Completely dependent for personal care, from whatever cause (physical or cognitive). Even so, they seem stable and not at high risk of dying (within ~ 6 months).



8. **Very Severely Frail** – Completely dependent, approaching the end of life. Typically, they could not recover even from a minor illness.



9. **Terminally Ill** – Approaching the end of life. This category applies to people with a life expectancy < 6 months, who are not otherwise evidently frail.

Where dementia is present, the degree of frailty usually corresponds to the degree of dementia:

- **Mild dementia** – includes forgetting the details of a recent event, though still remembering the event itself, repeating the same question/story and social withdrawal.
- **Moderate dementia** – recent memory is very impaired, even though they seemingly can remember their past life events well. They can do personal care with prompting.
- **Severe dementia** – they cannot do personal care without help.

Polling Question: Do you think frailty should be used as a trigger for nutrition screening in the community?

- Yes
- No
- Not sure
- It would not work in my practice
- It is already done in my practice

Getting Frailty and Nutrition Screening in the Community

- The whole team, including physicians, nurses, dietitians and other health professionals, **needs to be aware** of importance of nutrition and frailty
- Screening does not need to be done by the professional who will treat.
- For implementation of screening to be effective and sustainable, practices should outline a feasible and realistic plan to follow.
- Start small and don't jump into full screening before the team is aware of its importance or before you have tested a few tools.

Questions to consider before starting screening...

- Who will do the screening/ask the questions?
- When will screening be done? Will we target a specific group?
- Which tool will be used?
- What happens if a person is at risk?
- Who will provide a diagnosis (in the case of malnutrition) and treatment?
- What are the training needs of those involved in screening and diagnosis?
- How often should a person be screened?
- What community services are available to provide support to frail and/or malnourished patients?

Implementing Screening

- Staff (including nurses) education about impact of malnutrition and frailty and importance of screening
- Make sure screening connects to assessment and that staff are aware that a referral follows a positive screening
- Work with staff until they are comfortable with the form/process (i.e. tweaking layout)
- Embed the questions into nursing admission forms, electronic medical records
- Use reminders, and small group interactions to reinforce
- Conduct audits and report back results to staff
- Celebrate success

In Summary...

- 34% of Canadians are at nutrition risk
- There is an overlap in nutrition risk and frailty, with malnutrition/risk of malnutrition = 4x increase in risk of frailty
- There is a connection between nutrition risk, frailty and falls
- Multifactorial interventions are required to prevent falls, which may include: ONS, vitamin D, protein, high quality diets, and physical activity
- Nutrition screening can be used to identify nutrition risk
- There are many factors to consider for implementing screening in the community

Questions?

References

Abrahamsen B, Brask-Lindemann D, Rubin KH, Schwarz P. 2014. A review of lifestyle, smoking and other modifiable risk factors for osteoporotic fractures. *Bonekey Rep.* 3;3:574.

American Geriatrics Society. Accessed at:

http://www.americangeriatrics.org/health_care_professionals/clinical_practice/clinical_guidelines_recommendations/prevention_of_falls_summary_of_recommendations

Artaza-Artabe, I., Saez-Lopez, P., Sanchez-Hernandez, N., Fernandez-Gutierrez, N., and Malafarina, V. 2016. The relationship between nutrition and frailty: Effects of protein intake, nutritional supplementation, vitamin D, and exercise on muscle metabolism in the elderly. A systematic Review. *Maturitas*, 93: 89–99. doi:10.1016/j.maturitas.2016.04.009. PMID:27125943.

Beath H, Keller HH. 2007. Nutrition screen showed good agreement when self- and interviewer administered. *J Clin Epi*, 60(10); 1085-1089.

Bischoff-Ferrari HA, Dawson-Hughes B, Willett WC, Staehelin HB, Bazemore MG, Zee RY, Wong JB. 2004. Effect of Vitamin D on falls: a meta-analysis. *JAMA*. 2004 Apr 28;291(16):1999-2006.

Bollwein, J., Volkert, D., Diekmann, R., Kaiser, M.J., Uter, W., Vidal, K., et al. 2013. Nutritional status according to the mini nutritional assessment (MNA®) and frailty in community dwelling older persons: a close relationship. *J. Nut. Health Aging* 17(4):351-356. doi: 10.1007/s12603-013-0009-8.

Boulos, C., Salameh, P., and Barberger-Gateau, P. 2016. Malnutrition and frailty in community dwelling older adults living in a rural setting. *Clin. Nutr.* 35(1): 6–11. doi:10.1016/j.clnu.2015.01.008.

Broeska VE, Lengyel CO, Tate RB. 2013. Nutritional Risk and 5-Year Mortality of Older Community-Dwelling Canadian Men: The Manitoba Follow-Up Study. 32(4)

Cermak NM, Res PT, de Groot LC, Saris WH, van Loon LJ. 2012. Protein supplementation augments the adaptive response of skeletal muscle to resistance-type exercise training: a meta-analysis. *Am J Clin Nutr.* 96(6):1454-64.

Chen CC, Schilling LS, Lyder CH. 2001. A concept analysis of malnutrition in the elderly. 36(1), 131-142.

Clegg, A., Young, J., Iliffe, S., Rikkert, M. O., Rockwood, K. 2013. Frailty in elderly people. *Lancet* 381(9868):752–762. doi: 10.1016/S0140-6736(12)62167-9.

Fernández-Garridoa, J., Ruiz-Rosa, V., Buigues, C., Navarro-Martinez, R., Caulia, O. 2014. Clinical features of prefrail older individuals and emerging peripheral biomarkers: A systematic review. *Arch. Gerontol. Geriatr.* 59(1):7-17. doi: 10.1016/j.archger.2014.02.008.

Fried, L.P., Tangen, C.M., Walston, J., Newman, A.B., Hirsch, C., Gottdiener, J., et al. 2001. Frailty in Older Adults: Evidence for a Phenotype. *J. Gerontol. A. Biol. Sci. Med. Sci.* 56(3):808–813. PMID: 11253156.

References (con't)

- Hoover, M., Rotermann, M., Sanmartin, C., and Bernier, J. 2013. Validation of an index to estimate the prevalence of frailty among community-dwelling seniors. *Health Rep.* 24(9): 10–17. PMID:24258362.
- JafariNasabian P, Inglis JE, Kelly OJ, Ilich JZ. 2017. Osteosarcopenic obesity in women: impact, prevalence, and management challenges. *Int J Womens Health.* 9: 33–42.
- Johnson CS. (2003) The association between nutritional risk and falls among frail elderly. *J Nutr Health Aging.* 7(4):247-50.
- Keller, H.H., McKenzie, J.D., and Goy, R.E. 2001. Construct validation and test-retest reliability of the seniors in the community: risk evaluation for eating and nutrition questionnaire. *J. Gerontol. A Biol. Sci. Med. Sci.* 56(9): M552–M558. doi:10.1093/gerona/56.9.M552. PMID:11524447.
- Keller HH, Østbye T. 2003. Nutritional risk and time to death; predictive validity of SCREEN (Seniors in the Community Risk Evaluation for Eating and Nutrition). *J Nutr Health Aging.* 7(4):274-9.
- Keller, H.H., Brockest, B., Haresign, H. (2006). Building Capacity for Nutrition Screening. *Nutr Today.* 41(4):164-170
- Keller HH. 2005. Validity and reliability of SCREEN II (Seniors in the Community: Risk evaluation for eating and nutrition, Version II). *EJCN.* 59, 1149-1157.
- Kondrup J, Allison P, Elia M, Vellas B, Plauth M. 2003. ESPEN Guidelines for Nutrition Screening 2002. *Clinical Nutrition.* 22(4): 415–421
- Kwon J, Yoshida Y, Yoshida H, Kim H, Suzuki T, Lee Y. 2015. Effects of a combined physical training and nutrition intervention on physical performance and health-related quality of life in prefrail older women living in the community: a randomized controlled trial. *J Am Med Dir Assoc.* 16(3):263.e1-8.
- Larocque S, Kerstetter J, Cauley J, Insogna K, Ensrud K, Ma LL, et al. (2015) Dietary Protein and Vitamin D Intake and Risk of Falls: A Secondary Analysis of Postmenopausal Women from the Study of Osteoporotic Fractures *J Nutr Gerontol Geriatr.* 2015 Jul-Sep; 34(3): 305–318. doi:10.1080/21551197.2015.1054574
- Lee, D., Kawas, C.H., Gibbs, L., Corrada, M.M. 2016. Prevalence of frailty and factors associated with frailty in individuals aged 90 and older: The 90+ study. *J. Am. Geriatr. Soc.* 64(1):2257-262. doi: 10.1111/jgs.14317.
- Lenardt, Carneiro, Betiolli, Binotto, Ribeiro, Teixeira, 2016. Factors associated with decreased hand grip strength in the elderly *Esc. Anna Nery,* 20(4)
- Manal, B. Suzana, S., and Singh, D.K. 2016. Nutrition & frailty: A review of clinical intervention studies. *J. Frailty Aging* 4(2):100-106. doi: 10.14283/jfa.2015.49.
- Meijers, J. M., Halfens, R. J., Neyens, J. C., Luijing, Y. C., Verlaan, G., & Schols, J. M. (2012). Predicting falls in elderly receiving home care: The role of malnutrition and impaired mobility. *The journal of nutrition, health & aging,* 16(7), 654-658. doi:10.1007/s12603-012-0010-7
- Michael YL, Lin JS, Whitlock EP, Gold R, Rongwei F, O'Connor E et al. 2010. Interventions to Prevent Falls in Older Adults. An Updated Systematic Review. Evidence Syntheses, No. 80 Rockville (MD): Agency for Healthcare Research and Quality (US); Report No.: 11-05150-EF-1
- Milne, A.C., Potter, J., Vivanti, A., Avenell, A. 2009. Protein and energy supplementation in elderly people at risk from malnutrition (review). *Cochrane Database Syst. Rev., Issue 2.* doi: 10.1002/14651858.CD003288.pub3
- Ming-Hung Chien, How-Ran Guo. (2014). Nutritional Status and Falls in Community-Dwelling Older People: A Longitudinal Study of a Population-Based Random Sample. <http://dx.doi.org/10.1371/journal.pone.0091044>

References (con't)

- Morley, J.E., Vellas, B., Abellan van Kan, G., Anker, S.D., Bauer, J.M., Bernabei, R., et al. 2013. Frailty consensus: A call to action. *J. Am. Med. Dir. Assoc.* 14(6):392–397. doi: 10.1016/j.jamda.2013.03.022.
- Mueller, C., Compher, C., Ellen, D.M. (2011). American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.) Board of Directors. A.S.P.E.N. clinical guidelines: Nutrition screening, assessment, and intervention in adults. *J Parenter Enteral Nutr.* 35:16-24.
- Muscudere J, Andrew MK, Bagshaw SM, Estabrooks C, Hogan D, Holroyd-Leduc J, Canadian Frailty Network (CFN) et al. 2016. Screening for Frailty in Canada's Health Care System: A Time for Action. *Can J Aging.* 2016 Sep;35(3):281-97. doi: 10.1017/S0714980816000301.
- Neelemaat F, Bosmans JE, Thijs A, Seidell JC, van Bokhorst-de van der Schueren MA. 2011. Post-discharge nutritional support in malnourished elderly individuals improves functional limitations. *J Am Med Dir Assoc.* 12(4):295-301.
- Ng TP, Feng L, Nyunt MS, Feng L, Niti M, Tan BY, et al. 2015. Nutritional, Physical, Cognitive, and Combination Interventions and Frailty Reversal Among Older Adults: A Randomized Controlled Trial. *Am J Med.* 128(11):1225-1236.e1.
- Nykänen I, Lönnroos E, Kautiainen H, Sulkava R, Hartikainen S. 2013. Nutritional screening in a population-based cohort of community-dwelling older people. *Eur J Public Health.* Jun;23(3):405-9.
- Payette, H., Shatenstein, B. (2005). Determinants of healthy eating in community-dwelling elderly people. *Canadian Journal of Public Health.* 96:S30a-S35a.
- Ramage-Morin, P., and Garriguet, D. 2013. Nutritional Risk Among Older Canadians. *Statistics Canada.* 82-003-x; 24:3.
- Reuben DB, Greendale GA, Harrison GG. 1995. Nutrition Screening in Older Persons. *JAGS.* 43(4), 415-425.
- Rockwood, K., and Mitnitski, A. 2007. Frailty in relation to the accumulation of deficits. *J. Gerontol. A. Biol. Sci. Med. Sci.* 62(7):722–727. PMID: 17634318.
- Romero-Ortuno R, O’Shea D, Kenny RA. 2011. The SHARE frailty instrument for primary care predicts incident disability in a European population-based sample. *Qual Prim Care.* 2011;19(5):301-9.
- Ryna Levy-Milne. 2004. British Columbia Nutrition Survey: Report on Seniors’ Nutritional Health. Accessed at: http://www.health.gov.bc.ca/library/publications/year/2004/seniors_report.pdf.
- Schilp J1, Wijnhoven HA, Deeg DJ, Visser M. 2011. Early determinants for the development of undernutrition in an older general population: Longitudinal Aging Study Amsterdam. *Br J Nutr.* 106(5):708-17.
- Song, X., Mitnitski, A., and Rockwood, K. 2010. Prevalence and 10-year outcomes of frailty in older adults in relation to deficit accumulation. *J. Am. Geriatr. Soc.* 58(4):681-7. doi: 10.1111/j.1532-5415.2010.02764.x.
- Vivanti AP, McDondald CK, Palmer MA, Sinnott M. 2009. Malnutrition associated with increased risk of frail mechanical falls among older people presenting to an emergency department. 21(5), 386-394.
- Zoltick ES, Sahni S, McLean RR, Quach L, Casey VA, Hannan MT. Dietary protein intake and subsequent falls in older men and women: the Framingham Study. *J Nutr Health Aging.* 15(2):147-52.