Predictors of Nutritional Risk in Community-dwelling Seniors

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ABSTRACT

Objectives: At any age, good nutrition is important for maintaining good health. Seniors are at risk of declining nutritional status due to the physiological, psychological, economic and social changes that accompany aging. We investigated medical, psychological, social and environmental characteristics as both correlates and predictors of elevated nutritional risk in community-dwelling seniors.

Methods: Data came from a prospective study of 839 seniors aged 75 and over, in Montreal. Face-to-face interviews were conducted at baseline and at 12 months. The validated Elderly Nutrition Screening (ENS©) tool was administered and subjects were assigned a level of "nutritional risk" based on the risk for energy and nutritional intake deficiencies. Using risk factors identified in the literature, analyses were performed to characterize those factors associated with both the level of risk at baseline and a change in risk over 12 months.

Results: At baseline, more than half (60%) of the participants were at elevated nutritional risk. Cross-sectional analyses supported the findings of previous research examining correlates of elevated nutritional risk. Longitudinal results showed that among those at low nutritional risk, only poor self-rated health was found to be a statistically significant predictor of elevated risk at 12 months (OR=3.30, $p<0.05$).

Conclusion: Proper nutrition can promote healthy aging by preventing disease and disability, improving health outcomes and maintaining autonomy, resulting in decreased health care utilization and costs. The findings of this research highlight the need for longitudinal studies in order to better understand and target nutritional risk in community-dwelling seniors.

MeSH terms: Aging; elderly; nutrition; free-living; longitudinal

La traduction du résumé se trouve à la fin de l'article.

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At any age, good nutrition is recognized as an important factor in the maintenance of good health and the prevention and treatment of chronic disease. The nutritional needs of seniors are different from those of younger adults due to the physiological, psychological, economic and social changes that accompany aging.[1] These changes make older adults more vulnerable to malnutrition, a condition difficult to reverse.[2,3]

Seniors who do not yet show clinical signs of malnutrition, but who are progressing towards that state due to chronic insufficient dietary intake, are said to be at nutritional risk.[4,5]

While overt malnutrition in community-dwelling seniors is believed to be relatively rare (approximately 5%), the true prevalence remains unknown.[6,7] Table I summarizes the literature examining the prevalence of poor nutritional status in Canadian community-dwelling seniors.[3,5,8-14] The variation across studies is likely due to differences in study recruitment, measurement tools and the definition of 'nutritional risk'.

The list of negative health outcomes associated with malnutrition in the elderly is long. It includes muscle wasting, hip fracture, decreased autonomy, early institutionalization, increased health care costs,[5,15-25] and mortality from heart disease, cancer, cardiovascular disease and diabetes mellitus.[17,26,27]

Dietary intake can be compromised due to a person's inability to acquire, prepare or consume sufficient high quality food.[28] Thus, impairment in either basic or instrumental activities of daily living (ADLs or IADLs respectively) could be detrimental to nutritional status.[29,30] Problems can also arise when the gastro-intestinal tract is unable to effectively absorb energy and nutrients from ingested food. There are many medical, psychological (e.g., cognitive decline[27] and depression[28,31]) and environmental (e.g., social support[3,32,33]) characteristics that work in consort to compromise (or promote) sufficient dietary intake and absorption through these means.[28,34]

Food intake may also change subsequent to disease,[35] leading to nutrient deficiencies and/or unintentional weight loss.[34,36,37] Medication side-effects can affect nutritional status by reducing food consumption[33,38,39] and impacting nutrient absorption and metabolism.[15,30,33,38]

TABLE I

Studies Examining the Prevalence of Nutritional Risk in Community-dwelling Seniors in Canada

Reference	Study Sample	n	Age Range (mean)	Dietary Measurement Tool: Outcome Measured	Scale Classification/ Diagnosis Criteria	Prevalence of Nutritional Outcome
Keller and Hedley, 2002[9]	Random sample of members of a seniors centre	247	55-91 (71.7)	SCREEN: nutritional risk	Significant risk, risk, no risk	Significant risk: 23.5% (17%M/27%F) Risk: 56.7% (53%M/57%F)
Keller and McKenzie, 2003[10] and Keller, 2004[5]	Combination of volunteers and random samples from 23 service providers, "vulnerable seniors"	367	54-100 (79.3)	SCREEN: nutritional risk	Significant risk, risk, no risk	Significant risk: 44.4% (34%M/48%F) Risk: 24.3%
Keller et al., 2001[8]	Volunteer sample from 10 community sites	128	mean: 74	Dietician judgement/ assessment: nutritional risk	None given	High risk: 19.5% Moderate risk: 28.1%
				SCREEN: nutritional risk	Significant risk, risk, no risk	Significant risk: 40.6% Risk: 25.8%
MacLellan and Van Til, 1998[11]	Canadian Study of Health and Aging II, random, age-stratified sample of people aged 65 and over	215	70+	DETERMINE: nutritional risk	High risk, moderate risk, no risk	High risk: 10.0% Moderate risk: 27.0%
Payette et al., 1995[3]	Convenience sample of individuals receiving community home-care services	145	60+	Three non-consecutive 24-hour dietary recalls: dietary intake	Daily energy intake <RNI/kg; daily protein intake<0.8g/kg	72.4% low energy intake; 73.1% low protein intake
Payette et al., 1996[12]	Convenience sample of individuals receiving community home-care services	145	mean: 77.7	Three non-consecutive 24-hour dietary recalls: nutritional risk	High risk = a) energy intake<RNI AND b) protein intake<0.8g/kg AND c) intake of more than 3 nutrients<RNI; moderate risk = a) AND b) or c)	High risk: 24% Moderate risk: 41%
Payette et al., 1997[13]	Randomized clinical trial of community-dwelling individuals identified as being at risk for functional impairment	60	75+ (81.5)	"Valid, reliable screening tool": nutritional risk	None given	11.9% at risk
Shatenstein et al., 2004[14]	1990 Quebec Nutrition Survey (EQN)	460	55-74 (63.5)	24-hour dietary recall: diet quality	Dietary Diversity Score (Kant et al., 1991), range 0-4, 4=adequate	Males/Females: 54.8%/49.6% inadequate
				24-hour dietary recall: diet quality	Dietary Adequacy Score (Guthrie and Scheer, 1981), range 0-18	Males/Females: mean score 14.96/13.72

Although the body of research addressing nutritional risk in community-dwelling seniors is growing, most studies are cross-sectional, making the longitudinal nature of this study unique. By elucidating the factors involved in the transition from low to elevated nutritional risk – the first step in nutritional status decline – this study will help extend our current knowledge and expose where early interventions will be most beneficial.

METHODS

This is a secondary analysis of the Montreal Unmet Needs Study, a prospective cohort study of a random sample of seniors living in the community in Montreal, Quebec, Canada. Recruitment (between February 2001 and February 2002) and sampling methods are described elsewhere.[40] Briefly, random digit dialling was used to recruit subjects aged 75 and over, community-dwelling, English- or French-speaking, with no more than mild cognitive impairment according to a score of 14 or more on the Adult Lifestyles and Function Interview, Mini Mental State Exam (ALFI-MMSE).

A detailed face-to-face questionnaire was administered by an interviewer at baseline and at 12 months. Information was obtained about socio-demographics, physical health, nutrition, psychological well-being, social support and self-perceived health. More than 90% of subjects agreed to the release of additional data on medical service and prescription use, from the Régie de l'Assurance-Maladie du Québec (RAMQ).

Ethics approval for the study was obtained from the McGill University Institutional Review Board, the Jewish General Hospital ethics committee and the ethics committee at the Institut Universitaire de Gériatrie de Montréal.

The 10-item Elderly Nutrition Screening ENS© tool classified subjects by level of nutritional risk ('low', 'moderate' or 'high'). The ENS© was designed and validated to detect the presence of independent determinants of energy and protein intakes and identify asymptomatic nutritional problems in community-dwelling seniors.[3] In this study, moderate- and high-risk categories were combined into a single "elevated-risk" category.

TABLE II

Demographic Characteristics Measured at Baseline by Level of Nutritional Risk at Baseline (Frequencies with Column Percentages Indicated in Parentheses; p-values from Chi-square or T-tests)

	Level of Nutritional Risk at Baseline Low (n=335) (%)	Moderate or High (n=504) (%)	p-value
Sex			
Male	127 (37.91)	136 (26.98)	
Female	208 (62.09)	368 (73.02)	<0.01
Age at baseline			
75-79	206 (61.49)	261 (51.79)	
80-84	99 (29.55)	166 (32.94)	
85-89	25 (7.46)	69 (13.69)	
90+	5 (1.49)	8 (1.59)	<0.01
mean(SD)	79 (3.68)	80 (4.04)	<0.01
Education			
Elementary or less	47 (14.03)	93 (18.45)	
High School Incomplete	76 (22.69)	120 (23.81)	
High School Complete	67 (20.00)	114 (22.62)	
Technical, Trade School or College	61 (18.21)	74 (14.68)	
University	84 (25.07)	103 (20.44)	0.16
Income			
<$15,000	47 (14.03)	115 (22.82)	
$15,000-$24,999	63 (18.80)	116 (23.02)	
$25,000-$34,999	65 (19.40)	98 (19.44)	
$35,000-$44,999	46 (13.73)	49 (9.72)	
$45,000-$59,999	46 (13.73)	47 (9.33)	
>$59,999	48 (14.33)	48 (9.52)	
Missing	20 (5.97)	31 (6.15)	<0.01
Marital status			
Married	113 (33.73)	144 (28.57)	
Widow/Widower	161 (48.06)	265 (52.58)	
Separated/Divorced	29 (8.66)	45 (8.93)	
Single	32 (9.55)	47 (9.33)	
Other	0 (0.00)	3 (0.60)	0.11
Type of housing			
House	94 (28.06)	90 (17.86)	
Apartment	186 (55.52)	297 (58.93)	
Senior's Residence	33 (9.85)	72 (14.29)	
Subsidized or non-profit housing	16 (4.78)	41 (8.13)	
Other	6 (1.79)	4 (0.79)	<0.01

TABLE III

Proportion of Subjects at Each Level of Nutritional Risk After 12 Months, by Level of Nutritional Risk at Baseline (Frequencies with Row Percentages Indicated in Parentheses)

		Level of Nutritional Risk at 12 Months Low	Moderate	High	Lost to follow-up	Total
Level of Nutritional Risk at Baseline	Low	191 (57.0)	123 (36.7)	5 (1.5)	16 (4.8)	335 (100)
	Moderate	92 (23.0)	223 (55.8)	52 (13.0)	33 (8.3)	400 (100)
	High	3 (2.9)	42 (40.4)	48 (46.2)	11 (10.6)	104 (100)
	Total	286 (34.1)	388 (46.2)	105 (12.5)	60 (7.2)	839 (100)

Independent variables were determinants of nutritional intake identified in current literature, encompassing demographic characteristics, medical conditions, psychological factors and environmental/social factors.

Demographic variables included sex, age at baseline, highest level of education and income satisfaction (a self-report of whether or not the participant felt their current income satisfied their "basic needs").

Medical conditions were captured using a chronic disease score (CDS), calculated using an adaptation[41] of Von Korff's method[42] using RAMQ data.

A summary measure of physical limitations was obtained by summing the number of reported problems in the past year, including paralysis, problems with feet or ankles, dizziness or balance problems and falls.

The need for assistance with ADLs and IADLs was assessed following the algorithms of Allen and Mor (1997).[43] For ADLs and IADLs separately, subjects were dichotomized: those who reported 'need' for one or more activity and those without any reported 'need'.

Subjects rated both their current health status and their current health status compared to their own health a year earlier.

Psychological variables included the ALFI-MMSE score and psychological distress, evaluated using the 14 "indices de détresse psychologique de l'enquête Santé Québec" (IDPESQ-14).[44,45]

Measures of environmental/social factors were: type of housing, number of cohabitants, marital status and perceived satisfaction with social support.

Cross-sectional and longitudinal analyses were conducted. Cross-sectional analyses examined the correlates of nutritional risk at baseline in the 839 subjects who completed the baseline interview. The bivariate association between each independent variable and nutritional risk was evaluated using simple logistic regression to generate an odds ratio (OR) with 95% confidence intervals. A multivariable model was built using the methods of Hosmer and Lemeshow (2000).[46]

The subset of 335 subjects found to be at low nutritional risk at baseline was extracted into a subcohort for the longitudinal analysis. Using baseline variables and the nutritional risk score obtained at 12 months, the same model-building procedures used for the cross-sectional analyses were employed.

Low nutritional risk was the reference category in all regression models. Multivariable models were adjusted for age and sex and analyses were done using the SAS System for Windows V8.

RESULTS

The socio-demographic characteristics of the baseline sample are presented in Table II. The sample was predominantly female (68.7%) with a mean age of 79.6 years (79.9 in females and 79.1 in males). The oldest enrolled subject was 96 years old. At baseline, 335 participants (39.9%) were classified as being at low nutritional risk and 60.1% were at elevated risk. Table III shows the distribution of the levels of nutritional risk at 12 months, according to the level of nutritional risk at baseline. Of the 317 subjects (40%) who experienced a change in their level of nutritional risk between baseline and 12 months, just over half increased in the level of risk (n=180) while the remainder (n=137) showed improvement (i.e., a decline in level of risk).

Cross-sectional analysis

Based on the bivariate analyses, 16 variables were selected for initial inclusion into

the cross-sectional, multivariable model. Table IV presents the results from the bivariate models and the final multivariable model.

In the final model, the self-rated health variables remained the correlates with the highest ORs. Reporting one's health to be poor compared to very good or excellent resulted in a more than threefold increase in the odds of being at elevated risk (OR=3.34). The OR for disability in ADLs was greater than that for IADLs. Self-reported digestive problems and psychological distress were also associated with elevated nutritional risk.

Longitudinal analysis

Bivariate logistic regressions generated ORs to quantify the magnitude of the association between variables measured at baseline and elevated nutritional risk at 12 months among those subjects at low risk at baseline who completed follow-up (n=319/335). Seven variables were selected for initial inclusion into the multivariable model. Table V presents the results from the bivariate models and the final multivariable model for the longitudinal analyses.

In contrast to the cross-sectional analysis, the only statistically significant predictors of elevated nutritional risk at 12 months found in the bivariate longitudinal analyses were current self-rated health and disability in one or more IADL. In the final multivariable model, only self-rated health variables were shown to be significant predictors. There was a threefold increase in the odds of elevated nutritional risk for someone who, at baseline, rated their health as poor as compared to very good/excellent (OR=3.30).

TABLE IV

Baseline Analyses: Associations Between Determinants and Elevated Nutritional Risk Measured at Baseline (n=839)

Determinant at Baseline	Bivariate Models* OR (95% CI)	Final Multivariable Model† OR (95% CI)
Demographic Characteristics		
Sex (ref=female)	0.61 (0.45,0.81)	0.83 (0.60,1.17)
Age (years)	1.06 (1.03,1.10)	1.05 (1.00,1.09)
Education		
None	1.00 (ref)	–
Some H.S.	0.80 (0.51,1.26)	–
H.S. complete	0.86 (0.54,1.37)	–
College, Tech, etc.	0.61 (0.38,1.00)	–
University	0.62 (0.39,0.98)	–
Income satisfaction (ref=no)	0.57 (0.39,0.83)	–
Medical Determinants		
Physical limitations	1.64 (1.41,1.82)	–
Disability		
ADL	3.25 (2.23,4.72)	1.59 (1.02,2.49)
IADL	2.40 (1.77,3.24)	1.45 (1.02,2.07)
Chronic Disease Score	1.03 (1.00,1.06)	0.99 (0.95,1.02)
Stomach aches (ref=no)	2.61 (1.92,3.55)	1.97 (1.38,2.79)
Dental problems (ref=no)	1.06 (0.79,1.41)	–
Current self-rated health		
Very good/excellent	1.00 (ref)	1.00 (ref)
Good	2.09 (1.52,2.88)	1.4 (0.97,2.02)
Poor	6.15 (4.00,9.47)	3.34 (2.01,5.54)
Self-rated health compared to one year ago		
Worse	3.39 (2.32,4.96)	1.78 (1.04,3.05)
Same	1.00 (ref)	1.00 (ref)
Better	1.08 (0.74,1.59)	0.96 (0.62,1.47)
Psychological Determinants		
Psychological distress (ref=low)	3.18 (1.86,5.41)	2.24 (1.22,4.09)
Environmental/Social Determinants		
Marital status (ref=not married)	0.79 (0.58,1.06)	–
Satisfaction with social support (ref=no)	0.73 (0.50,1.08)	–
Number of cohabitants		
0	1.00 (ref)	–
1	0.97 (0.72,1.30)	–
2+	0.47 (0.21,1.05)	–
Type of housing		
Apartment	1.00 (ref)	–
House	0.60 (0.42,0.84)	–
Senior's residence	1.36 (0.87,2.13)	–
Subsidized or non-profit housing	1.75 (0.86,3.57)	–
Other	0.42 (0.12,1.49)	–

* Unadjusted odds ratios
† Odds ratios adjusted for all other variables in the model

DISCUSSION

In this study, the prevalence of elevated nutritional risk at baseline (60.1%) was higher than anticipated. Although lower than some published estimates (Table I), the study sample was drawn at random from community-dwelling seniors, rendering it different from other studies in which institutionalized seniors and/or seniors receiving community services were included and/or targeted.

Assuming that elevated nutritional risk is a marker of the potential for a rapid decline in nutritional status, which can lead to numerous negative health outcomes, then observing such a high prevalence of nutritional risk establishes community-dwelling seniors as a meaningful target for early nutritional interventions.

The statistically significant associations found between elevated nutritional risk and most independent variables at baseline were confirmatory, given that theses variables were a subset of those known in the literature.

A novel feature of this research was prospective examination of the progression of nutritional risk. Among the subcohort of subjects at low nutritional risk at baseline, more than a third (38.2%) progressed to elevated risk during follow-up. With the goal of identifying factors that would be readily amenable to intervention, identification of only the two self-rated health variables in the final multivariable longitudinal model was unanticipated.

The inclusion of self-rated health variables as simple global assessments of health has been widespread in gerontological research since the 1950s.[47] Despite a growing body of literature – both medical and sociological – the determinants of self-rated health remain poorly understood.[48] It has been proposed that a self-report of poor health might be a proxy for the presence of medical or psychological conditions not yet clinically detectable.[49] The predictive ability of self-rated health might be as a marker for the development of diseases or conditions in the time between baseline and 12 months that negatively affect nutritional risk.

One possible reason why the correlates of nutritional risk identified in the cross-

TABLE V

Longitudinal Analyses: Associations Between Determinants Measured at Baseline and Elevated Nutritional Risk Measured at 12 Months in Subjects at Low Risk at Baseline (n=319)

Determinant at Baseline	Bivariate Models* OR (95% CI)	Final Multivariable Model† OR (95% CI)
Demographic Characteristics		
Sex (ref=female)	0.83 (0.52,1.32)	0.93 (0.58,1.51)
Age (years)	1.01 (0.95,1.07)	1.00 (0.94,1.07)
Education		–
None	1.00 (ref)	–
Some H.S.	1.00 (0.45,2.20)	–
H.S. complete	1.49 (0.67,3.32)	–
College, Tech, etc.	1.36 (0.60,3.09)	–
University	1.21 (0.56,2.62)	–
Income satisfaction (ref=no)	0.60 (0.31,1.14)	–
Medical Determinants		
Physical limitations	1.12 (0.87,1.44)	–
Disability		
ADL	1.26 (0.65,2.45)	–
IADL	1.61 (1.02,2.55)	–
Chronic Disease Score	1.02 (0.98,1.07)	–
Stomach aches (ref=no)	1.49 (0.89,2.49)	–
Dental problems (ref=no)	1.39 (0.87,2.22)	–
Current self-rated health		
Very good/excellent	1.00 (ref)	1.00 (ref)
Good	1.66 (1.01,2.75)	1.48 (0.87,2.50)
Poor	3.74 (1.65,8.51)	3.30 (1.42,7.67)
Self-rated health compared to one year ago		
Worse	1.38 (0.62,3.08)	1.09 (0.47,2.50)
Same	1.00 (ref)	1.00 (ref)
Better	0.55 (0.30,0.99)	0.55 (0.30,1.00)
Psychological Determinants		
Psychological distress (ref=low)	1.35 (0.51,3.60)	–
Environmental/Social Determinants		
Marital status (ref=not married)	0.77 (0.48,1.25)	–
Satisfaction with social support (ref=no)	0.56 (0.29,1.08)	–
Number of cohabitants		
0	1.00 (ref)	–
1	0.80 (0.49,1.29)	–
2+	1.61 (0.56,4.63)	–
Type of housing		
Apartment	1.00 (ref)	–
House	1.15 (0.69,1.93)	–
Senior's residence	1.45 (0.68,3.10)	–
Subsidized or non-profit housing	0.94 (0.27,3.33)	–
Other	3.29 (0.59,8.47)	–

* Unadjusted odds ratios
† Odds ratios adjusted for all other variables in the model

sectional analysis failed to emerge in the longitudinal analysis is that they are *consequences*, rather than predictors, of nutritional risk. Disentangling the temporality of this association will require further longitudinal research. Similarly, this research might fail to capture the effect of determinants whose impact on nutritional risk is longer or shorter than the 12-month timeframe evaluated.

The potential exists that this group of seniors – aged at least 75, no more than mildly cognitively impaired and community-dwelling – represents a group of resilient seniors, in whom the development of one or more of the studied determinants would not have a large effect.

This study database had several strengths. It was validated and subjects were contacted to clarify missing or nonsensical data. Apart from income, there was essentially no missing data. An assessment of losses to follow-up revealed little difference between those who completed the 12-month questionnaire and those who did not.

Use of the ENS© is another study strength. The ENS© was validated and shown to have a high sensitivity (78%) and specificity (77%) in distinguishing those at elevated nutritional risk from those at low risk in a population similar to that of this study.[50]

One limitation of this study is the small subcohort used in the longitudinal analysis (n=319), which resulted in insufficient statistical power to detect a statistically significant result in the longitudinal analysis. Disability in IADL (OR=1.38), self-reported digestive problems (OR=1.26), self-reported dental problems (OR=1.43), satisfaction with social support (OR=0.70) and income satisfaction (OR=0.71) all showed associations in the expected direction but with values lower than the smallest detectable ORs and failed to reach statistical significance.

The literature shows that the nutritional intake of seniors is affected by a variety of characteristics. Ascertaining which characteristics are most strongly associated with nutritional risk and understanding how these characteristics work in consort is essential to designing intervention strategies that can be implemented effectively to prevent the multitude of negative health outcomes associated with malnutrition in the elderly. Little prospective research has been done to monitor the progression of nutritional risk in community-dwelling seniors. The current study presents a preliminary examination of factors that could lead to an incident elevation in nutritional risk among community-dwelling seniors and highlights the need for more prospective research.

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RÉSUMÉ

Objectifs : À tout âge, une bonne nutrition est essentielle pour maintenir la santé. Le risque de détérioration de l'état nutritionnel augmente considérablement avec l'avance en âge dû aux changements physiologiques, psychologiques, économiques et sociaux qui accompagnent le vieillissement. Nous avons examiné la relation entre le risque nutritionnel et les caractéristiques physiologiques, psychologiques, sociales et environnementales de personnes âgées vivant dans la communauté.

Méthodologie : Les données ont été recueillies dans le cadre d'une étude prospective de 839 Montréalais âgés de ≥75 ans par entrevues face-à-face, à l'entrée dans l'étude et 12 mois plus tard. Le DNA© (Dépistage Nutritionnel des Aînés) a été utilisé pour déterminer le niveau de risque nutritionnel selon le risque de carences d'apports alimentaires. Utilisant les facteurs de risque déjà reconnus, des analyses bi- et multivariées ont été utilisées pour identifier les facteurs associés au risque nutritionnel à l'entrée dans l'étude et à l'incidence de ce risque 12 mois plus tard.

Résultats : À l'entrée dans l'étude, plus de la moitié (60 %) des participants étaient à risque nutritionnel élevé. Les résultats de nos analyses transversales appuient ceux d'autres études. Ceux des analyses longitudinales montrent que, parmi les sujets à faible risque nutritionnel, une mauvaise santé perçue prédit une augmentation de ce risque après 12 mois (RC=3,30, p<0,05).

Conclusion : Une bonne nutrition peut aider à vieillir en santé en prévenant la maladie et l'incapacité. L'amélioration de la santé et le maintien de l'autonomie fonctionnelle résulteront en une réduction de l'utilisation et des coûts des soins de santé. Nos résultats soulignent l'importance des études longitudinales pour améliorer notre compréhension du risque nutritionnel chez les personnes âgées afin de mieux adapter nos interventions.