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# Faculteit Revalidatiewetenschappen

## master in de revalidatiewetenschappen en de kinesitherapie

***Masterthesis***

***The gender differences in a pre-frail older population, determined by the Fried frailty criteria***

**Anne-Nina Rousseau**
**Lisa Spaas**

Scriptie ingediend tot het behalen van de graad van master in de revalidatiewetenschappen en de kinesitherapie, afstudeerrichting revalidatiewetenschappen en kinesitherapie bij kinderen

**PROMOTOR :**

Prof. dr. Joke SPILDOOREN

**2018**
**2019**

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Mol (Belgium), June 3th, 2019 A.R.

Rijkel (Belgium), June 3th, 2019 L.S.

**CONTEXT**

This Master's thesis fits in the geriatric research domain. The aging population is increasing substantially in populations worldwide with all its consequences for health, health systems and budgets (Beard et al., 2016). This Master's thesis focuses on pre-frailty, which can be identified as an intermediate stage between robust and frail. Although this group is less vulnerable than frail older adults, the risk of hospitalisation, disability, secondary complications, greater frailty, falls and mortality is higher than for robust adults (Fried et al., 2001). Approximately 42% of community-dwelling older adults have the transitional pre-frail state (Lang, Michel, & Zekry, 2009), which confirms the importance to understand this stage and to delay or reverse the transition to frailty.
More specifically, this thesis will examine how pre-frailty manifests itself in men compared to women. This will create the possibility for specific interventions to reverse, stabilize or delay the evolution to frail.

This Master's thesis is part of a multi-site, multi-national research unit i.e. The My Active and Healthy Ageing (My-AHA) Randomised Control Trial to detect pre-frailty in older adults and provide individually tailored interventions to reduce the risk for frailty. This My-AHA study determined screening and testing protocols for obtaining the population in ten countries (Austria, Australia, Belgium, Germany, Italy, Japan, South Korea, Spain, Sweden and the United Kingdom). For the Belgian research site, four Master's students; Anne-Nina Rousseau, Lisa Spaas, Hannelore Steyvers and Lore Vanmunster recruited and screened volunteers and eventually collected testing data from 29 pre-frail participants. For the data processing, this group of participants was complemented by 22 participants that were recruited and tested in both Austria and Germany. The further elaboration of this Master's thesis, such as data processing and academic writing, was done independently by the authors and under good cooperation.

A central format was applied and was written by two authors: Anne-Nina Rousseau and Lisa Spaas, under the guidance of Prof. Dr. Joke Spildooren as promotor.

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# 1 ABSTRACT

**Background**: Pre-frailty is an intermediate stage between robust and frail with a prevalence of approximately 42% in the community-dwelling population. The risk of hospitalisation, disability, greater frailty, falls and mortality is higher than for robust adults, which makes it important to understand this stage.

**Objectives**: To examine how pre-frailty manifests itself in men compared to women. This will create the possibility for specific interventions to reverse, stabilize or delay the evolution to frail.

**Participants**: 51 community-dwelling older adults, with a mean age of 74.62 for men and 77.24 for women, were pre-frail according to the Fried frailty criteria, and therefore included in this Master's thesis. The majority of the population (74.51%) was female.

**Measurements**: The Fried frailty criteria (unintentional weight loss, muscle weakness, exhaustion, slow gait speed and low physical activity level) were assessed as primary outcome measures. Furthermore, physical and cognitive tests were performed as secondary outcomes.

**Results**: The results show that low grip strength and exhaustion were the most common Fried criteria for being classified as pre-frail. Furthermore, data-analysis shows that there is a significant difference between the genders for presenting the criteria of low grip strength ($p = 0.0369$). Women are more often classified as pre-frail due to a low grip strength than men. Further, the average deviation from the cut-off value for muscle weakness is significantly different between the genders ($p = 0.0454$).
In the secondary outcomes, there was only a significant difference between men and women found for the four-meter walking test with dual task ($p = 0.0323$); men needed less time to perform this task.

**Conclusion**: These findings suggest that pre-frailty manifests itself differently in men compared to women, especially with regard to the Fried frailty criteria of muscle weakness. Further research with larger sample sizes is necessary to confirm these findings.

# 2 INTRODUCTION

The aging of the population worldwide has major consequences, particularly in socio-economic terms (Beard et al., 2016), which makes it an important research domain. Decreasing well-being and quality of life often accompany increasing age (Fried et al., 2001). Although biological and chronological age correlates, there is great heterogeneity between community-dwelling older adults with the same chronological age in functional status and health (Crimmins, Hayward, & Saito, 1996). The common geriatric syndrome of frailty attempts to explain this heterogeneity and is thus an important concept (Fried et al., 2001; Santos-Eggimann, Cuenoud, Spagnoli, & Junod, 2009). Older adults classified as frail are at greater risk for adverse health outcomes such as hospitalisation, falls and mortality (Fried et al., 2001; Rockwood et al., 1999).

This Master's thesis focuses on pre-frailty, which is an intermediate stage between robust and frail, that occurs in approximately 42% of the community-dwelling population (Lang et al., 2009). Older adults can be classified as pre-frail in several ways. One specific manner, used in this Master's thesis, is according to Fried and colleagues, where older adults are pre-frail if one or two of the five biological deficits are present. The five frailty criteria by Fried are: unintentional weight loss, muscle weakness, self-reported exhaustion, slow walking speed and low physical activity level (Fried et al., 2001).

The great proportion of pre-frail older adults and the proven negative consequences of frailty confirm the importance to understand the pre-frail state and to delay or reverse the transition to frail. Previous research among the frail population shows that women are more likely to be identified as frail, regardless of the criteria used, and tend to accumulate more physical deficits with age than men (Collard, Boter, Schoevers, & Oude Voshaar, 2012). Other research demonstrates that women live longer, but spent a greater proportion of their life expectancy pre-frail, frail and severely limited (Romero-Ortuno, Fouweather, & Jagger, 2014), but further research is recommended to understand pre-frailty and its different impact on men and women. This will create the possibility for specific interventions to reverse, stabilize or delay the evolution to frail.

Therefore, the first aim of this Master's thesis is to examine how pre-frailty manifests itself in men compared to women on the five frailty criteria of Fried.
Furthermore, the second aim is to assess what the possible gender differences are on physical and cognitive outcomes in a pre-frail population, defined with the Fried frailty criteria. Although the word 'gender' is often used to refer to gender identity, both 'gender' and 'sex' are used interchangeably in this Master's thesis and both refer to the biological characteristics.

Currently, little is known about the gender differences in cognition in a specific pre-frail population. Previous research on older adults shows that there is a higher prevalence of mild cognitive impairments in men aged 70 to 84 years (Petersen et al., 2010). Some studies on healthy older adults show differences in testing and in the rate of decline over time between the genders, but there is currently little consistency between studies (McCarrey, An, Kitner-Triolo, Ferrucci, & Resnick, 2016; Rabbitt, Lunn, & Wong, 2008; Reas et al., 2017).

Based on previous findings, the authors hypothesized that a greater proportion of the pre-frail population will be female based on the five biological markers of Fried. Complemented by the hypothesis that pre-frail men have possibly less physical, but more cognitive deficits than women.

# 3 METHODS

## 3.1 PARTICIPANTS

### 3.1.1 RECRUITMENT

Community residing older adults (60+) were recruited in Belgium by 4 Master's students (Anne-Nina Rousseau, Lisa Spaas, Hannelore Steyvers and Lore Vanmunster) through various methods: flyering, local advertisement, social environment, social media posts, contacting senior activity organisations and senior living facilities.

### 3.1.2 PARTICIPANT SCREENING

Participants who volunteered were screened to assess their eligibility.

The following inclusion criteria for participant screening were used:

- Aged over 60 years
- Meet Fried Frailty criteria for pre-frail status. A score of one or two on the Fried criteria: unintentional weight loss, muscle weakness, exhaustion, slow gait speed and low physical activity (Fried et al., 2001) (Table 1)
- Able to stand and walk unassisted
- Ability to participate in the protocol: e.g. ability to sign informed consent, understand directions,…

The following exclusion criteria for participant screening were used (Table 2):

- Significant cognitive impairment (MMSE < 24)
- Significant mood disturbance (HADS-Anxiety > 15 and HADS-Depression > 15)
- Mobility problems
- Acute, chronic or unstable medical conditions such as neurodegenerative central nervous system disorders, peripheral nervous system disorders, neuromuscular disorders, metastatic cancer, endocrine diseases and immunologic diseases
- Neurologic disorders or head trauma such as epilepsy and head injury with loss of consciousness

- Heart and vascular diseases known to impact independence, cognitive, psychological or physical functioning such as untreated hypertension, history of stroke, pacemaker, ischemic attack and signs of heart failure
- Current signs or symptoms of respiratory failure such as chronic obstructive pulmonary disease, bronchial asthma and lung fibrosis

The Belgium-site study was approved by the medical ethics committee University Hasselt and all subjects signed informed written consent (appendix).

## 3.2 OUTCOME MEASURES AND ASSESSMENTS

### 3.2.1 PRIMARY OUTCOMES: FRIED CRITERIA

**Self-reported unintentional weight loss**

The following question is asked: 'In the last year, have you lost more than four and a half kg unintentionally, not due to fasting or exercise?'.

**Muscle weakness (grip strength) with the Jamar® handheld dynamometer (Jamar Preston Jackson MT 19204) (Mathiowetz, Weber, Volland, & Kashman, 1984)**

Grip strength has a clinical and prognostic value because of its ability to characterize the current strength of an individual (Bohannon, 2015).
For the assessment, the participant is asked to sit without supporting the arm with the shoulder adducted and normally rotated, the elbow in 90° flexion and forearm and wrist in neutral position (Fess & Moran, 1981). There are three attempts with both the dominant and non-dominant hand and instruction is provided: 'Squeeze your hand with all your power". During the assessment, verbal encouragement is given by the examiner.

**Exhaustion with the Center for Epidemiological Studies Depression Scale (CES-D) (Radloff, 1977)**

The CES-D is a self-administered questionnaire about depressive symptoms, consisting out of 20 items. The answer possibilities are four items on a Likert scale: (1) rarely or none of the time (less than 1 day), (2) some or little of the time (1-2 days), (3) occasionally or a moderate amount of time (3-4 days) or (4) most or all the time (5-7 days).

For this research, two items were selected to assess exhaustion. Each participant responds to the items regarding the past week: item 7 'I felt that everything I did was an effort' and item 20: 'I could not get 'going''.

**Gait speed with the four-meter walking test (4MWT) (Guralnik et al., 1994)**

The participant is asked to walk normal, with the use of a cane or other walking aids if these are normally used. The examiner observes and times the seconds needed to walk a distance of four meters, marked by tape. The examiner gives verbal instructions, demonstrates the

task and walks behind the participant during the test. The gait speed test is executed a second time and the fastest time is taken into account.

**Activity level with the International Physical Activity Questionnaire-short version (IPAQ) (Craig et al., 2003)**

The IPAQ-short version is a self-administered questionnaire with 7 items that assess the level of physical activity regarding the last week. A distinction is made between vigorous-, moderate-intensity and walking.
Scores are converted to a standard energy consumption metric of MET-minutes per week. METs are multiples of the resting metabolic rate and a MET-minute is the multiplication of the MET-score of an activity and the minutes the activity is performed (Fan, Lyu, & He, 2014). These METs are then converted to kilocalories for the participant's weight using the formula: kcal = (total physical activity MET-min/week) x (weight in kg/60).

### 3.2.2 SECONDARY OUTCOMES

#### 3.2.2.1 BALANCE AND MOBILITY

**Balance and strength with the Short Physical Performance Battery (SPPB) (Guralnik et al., 1994)**

The following equipment is required for this assessment: a chair with arms, a stopwatch, a tape measure and tape to mark a distance of four meters. The SPPB consists of three parts, administered in the following order:

FOUR TEST BALANCE SCALE

Verbal instructions are provided, accompanied by a demonstration of the task. Safety is ensured by the examiner and the test environment and if the participant is unable to perform the test, a transfer is made to the next part of the test. For all test items in this part, the participant may use their arms to stay in balance and move their body (but not their feet).

- Side-by-side stand with the instruction to stand with both feet together for 10 seconds.

- Semi-tandem stand with the instruction to stand with one foot in front and side of the other foot, without the heel of one foot touching the toes of the other foot.
- Tandem stand with the instruction to stand with one foot in front of the other foot, with the heel of one foot touching the toes of the other foot.

FOUR-METER WALKING TEST WITH DUAL TASK (4MWT+DT)

The 4MWT is performed while counting backward out loud by seven, starting from 200 as a dual task.

FIVE TIMES SIT TO STAND TEST (5STS)

A single chair stand is performed to ensure safety during the actual 5STS. The instruction is to stand from sitting on a chair without using the arms, for five times as quick as possible.

**Mobility with the Timed up and go (TUG) (Podsiadlo & Richardson, 1991)**

For this assessment, a chair with armrest, a stopwatch, tape measure and tape to mark a distance of three meters is required.
The time is measured that is needed for the participant to perform the following instructions: stand up from a chair (with armrest), walk to the indicated point at three meters, turn around, walk back to the chair and sit back down.

#### 3.2.2.2 COGNITION

**Cognitive screening with the Mini-Mental State Examination (MMSE) (Folstein, Folstein, & McHugh, 1975)**

The MMSE is a mental status screening tool that is practical to use in a routinely setting because of the short administration time (eleven items on 5-10 minutes with a maximum score of 30) (Folstein et al., 1975). Six domains are assessed: (1) orientation time, (2) orientation place, (3) registration of three objects, (4) attention and calculation, (5) recall of three objects and (6) language and praxis.

**Mental flexibility with the Trail Making Test (TMT) (G. Armitage, 1945)**

The TMT has two parts, both paper-pencil tasks. Part A is a series of numbers, from one to 25, which need to be connected in the right numerical order, as fast as possible (measured

with a stopwatch) with registration of all errors made. Part B is a series of numbers ranging from one to 13 and a series of letters, from A to L. Participants need to make concurrently connections, starting with the first number, going to the first letter, to the second number, going to the second letter, and so on in the correct numerical and alphabetical order (G. Armitage, 1945).

**Verbal learning and memory with the Hopkins Verbal Learning Test (HVLT) (Brandt, 1991)**

Each form of the HVLT consists of a list of 12 words, composed of three semantic categories and examines memory function through immediate recall (part A), delayed recall and delayed recognition (part B).

For part A: the participant is instructed to listen carefully to the list and attempt to memorize the words. After the list of 12 words is clearly read out with two seconds per word, the participant's first immediate recall is noted. Hereafter, the same procedure is repeated two more times.

After these three trials are completed, there is a gap of 20 minutes in which other non-memory-based cognitive tests may be performed before starting part B of the assessment.

For part B: delayed recall is assessed by asking to recall the 12-words-list. Further, to examine delayed recognition, the examiner reads 24 words and instructs the participant to say 'yes' in case this word appeared in the 12-words-list and 'no' if not.

**Processing speed and memory with the Digit Symbol Coding Test from the WAIS-III (Wechsler, 1997)**

For this assessment, the numbers one to nine are linked to symbols. The participants need to copy the symbols that represent the numbers and try to complete as many items as possible within two minutes (measured with a stopwatch). Errors are registered.

**Cognitive flexibility and control with the Stroop Test (24 item Victoria Version) (Graf, Uttl, & Tuokko, 1995)**

The Stroop Test exists out of three parts, for all parts, the time needed to appoint is measured with a stopwatch and the errors are registered:

- Part A: the participant needs to name the colour of the ink of clusters of three dots.
- Part B: the participant needs to name the colour of the ink of simple words e.g. car.
- Part C: the participant needs to name the colour of the ink of colour words e.g. blue. The ink colour of the words does not match the word itself, which makes it very complicated. E.g. the word ‘red’ is written on the paper, but the colour of the ink is blue, the participant needs to say: ‘blue’.

The ratio of part C over A (C/A), the ratio index of interference, can be used as a general measurement of cognitive flexibility which is sensitive to age-related slowing.

## 3.3 DATA-ANALYSIS

The data-analysis was executed by the authors with the use of SAS JMP Pro 14 and is summarized in Figure 1, 2 and 3.
First, as regards the primary outcomes, the authors compared per Fried criteria the number of men versus the number of women who presented the criteria to assess the gender differences in reason for pre-frailty.
Due to the categorical nature of the data and low expected values, the Fisher's Exact test was used.

Secondly, the between-group differences for mean values of the five Fried criteria, 4MWT+DT, 5STS, TUG, MMSE, TMT part B, the recognition discrimination of the HVLT, WAIS-III digit symbol coding test and Stroop test were analysed. For all this continuous data, normal distribution was assessed using the Shapiro-Wilks W test and unequal variances with the Brown-Forsythe test. Due to the non-normal distribution of at least one of the groups and equal variances, the rank-sum test was appropriate for this data.
Further, the immediate recall and delayed recall of the HVLT had a normal distribution but considering the low sample size both the Wilcoxon rank-sum test and the t-test were used.
Due to the categorical nature of the four test balance scale, the Fisher's Exact test was used.

A significance level of 0.05 was applied for all the statistical tests.

# 4 RESULTS

## 4.1 MAIN CHARACTERISTICS

A group of 29 participants was included based on the inclusion- and exclusion criteria in Belgium, which was complemented by a group of 22 participants from Austria and Germany. The main characteristics of the eventually 51 participants of this Master's thesis are summarized in Table 3.

The majority were female (74.51%) and the age range went from 61 to 93 years old. The mean age was 74.62 ± 9.21 and 77.24 ± 6.42 years for men and women respectively. More than half of the men (53.84%) were married and lived with their partner, whereas only a third of the women (31.38%) were married. The majority of women who participated in this study were widowed (57.90%) compared to less than a quarter of the men (23.08%). Most of the participants lived in their own home (76.92% for men and 76.31% for women). These findings are not significantly different in demographic characteristics. History of falling is the only significant difference; men had a history of falls of 38.36% and women of 73.68% respectively ($p = 0.0411$).

## 4.2 PRIMARY OUTCOMES: FRIED CRITERIA

The five frailty criteria of Fried (unintentional weight loss, muscle weakness, self-reported exhaustion, slow walking speed and low physical activity level) were first analysed based on the frequencies for presenting the criteria. The results show that low grip strength and exhaustion were the most common criteria for being classified as pre-frail.

A significant difference between men and women was found ($p = 0.0369$); women are more often classified as pre-frail due to the low grip strength criteria (Table 4 and Figure 4).

The frequencies for displaying the other physical markers of frailty (unintentional weight loss, self-reported exhaustion, slow walking speed and low physical activity level) were not significantly different between the genders (Table 4).

Secondly, an analysis was done on the mean values to assess gender differences. For grip strength, women had an average deficit of 11.14% from the cut-off value, which is based on gender and BMI. The male participants scored on average 17.53% above their appropriate cut-off value, which is a significant difference ($p = 0.0454$) (Table 5).

For the 4MWT, both genders had a deficit from the cut-off value; on average men had a shortage of 24.69% and women of 17.62%, but this difference is not significant (p = 0.23) (Table 5).

Furthermore, for self-reported exhaustion and physical activity level no significant differences were found (Table 6).

TABLE 4 GENDER DISTRIBUTION OF FRAILTY CRITERIA

| | **Men n (%)** | **Women n (%)** | **P-value** |
|---|---|---|---|
| **Unintentional weight loss** (self-reported) | 2 (15,39%) | 2 (5,26%) | 0.26 |
| **Muscle weakness** (grip strength) | 6 (46,15%) | 30 (78,95%) | 0.0369 |
| **Exhaustion** (CES-D) | 4 (30,77) | 8 (21,05%) | 0.47 |
| **Slow walking speed** (4MWT) | 2 (15,39%) | 6 (15,79%) | 1 |
| **Low physical activity** (IPAQ) | 0 (0%) | 4 (10,53) | 0.56 |

CES-D = Center for Epidemiological Studies Depression Scale, 4MWT = four-meter walking test, IPAQ = International Physical Activity Questionnaire.

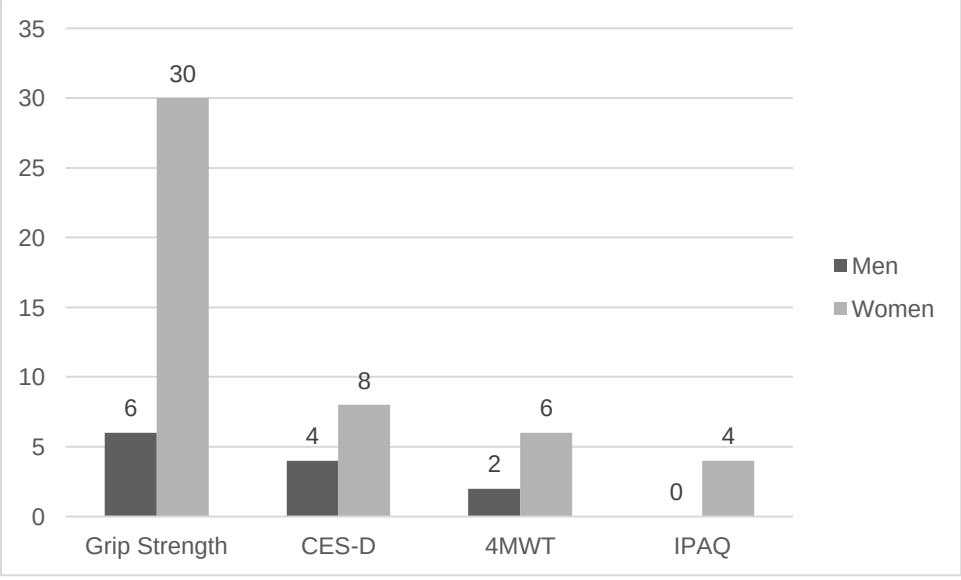


FIGURE 4 GENDER DISTRIBUTION PRESENTED FRAILTY CRITERIA

CES-D = Center for Epidemiological Studies Depression Scale, 4MWT = four-meter walking test, IPAQ = International Physical Activity Questionnaire.

TABLE 5 % DEVIATING FROM THE CUT-OFF VALUE

| | Men | Women | P-value |
|---|---|---|---|
| Grip strength | +17,53% ± 41,52 | -11,14% ±30,87 | 0.0454 |
| 4MWT | -24,69% ± 20,36 | -17,62% ± 23,12 | 0.23 |

4MWT = four-meter walking test

## 4.3 SECONDARY OUTCOMES

As secondary outcome measures, a few physical and cognitive tests were analysed.

The tests for balance and mobility (i.e. four test balance scale, 5STS and TUG) showed no significant differences between men and women (Table 6), except for the 4MWT+DT. The test with dual task displayed a significant difference (p = 0.0323); men needed less time to perform this task.

Furthermore, the tests on cognition (i.e. MMSE, TMT, HVLT, Digit symbol coding test and Stroop test) showed no significant differences between the genders (Table 7).

# 5 DISCUSSION

The current study provides insight into the gender differences in a pre-frail population on the Fried frailty criteria and other physical and cognitive outcomes. The main findings indicate that women are more often classified as pre-frail due to the low grip strength criteria. Furthermore, the authors found a significant difference in the time needed to perform the 4MWT+DT.

Most of the participants in the current study were female (74.51%). This is not representative of the average population aged 65 and above in Belgium, Germany and Austria according to a Chi-Square (Pearson) test ($p = 0.0093$). This result must be interpreted with caution because of the fact that the current population has a mean age of 76 years. Due to the higher life expectancy of women, it can be assumed that there is a higher proportion of women in the 70+ population. Furthermore, according to Romero-Ortuno et al. (2014) women have a higher prevalence of pre-frailty (in a 50+ population); 7.4% and 16.5% for men and women respectively. The same study concludes that women spent more absolute years and a greater proportion of their life expectancy in the pre-frail stadium, compared to men. These findings can explain the low percentage of men in the current study.

From the analysis of the demographic characteristics, the authors found that women experience falls more often than men. This is in agreement with the findings of Chang and Do (2015); in a population of 65 years or older, a significantly higher fall prevalence was found among women (22.4%) than men (17.3%). There is a further agreement with Gale, Cooper, and Aihie Sayer (2016), who found a similar result in a population of 60 years and over where the prevalence of falls was higher in women (29.1%) compared to men (23.5%).

The findings of the current study show that muscle weakness was the most common criteria for being classified as pre-frail for both sexes in this study ($n = 36$), followed by exhaustion ($n = 12$). This is in accordance with Lorenzo-Lopez et al. (2016); Sousa-Santos et al. (2018) with similar results in terms of the prevalence of physical markers for pre-frailty or frailty; both studies found that muscle weakness and exhaustion were the two most frequent markers. Lorenzo-Lopez et al. (2016) found that 71.8% of the participants were classified as pre-frail due to muscle weakness and Sousa-Santos et al. (2018) determined that low grip strength

was the most frequent indicator for pre-frailty or frailty (76.7%), followed by exhaustion (48.6%). This differs with the findings of Santos-Eggimann et al. (2009) where exhaustion shows to be the most common criteria for frailty and pre-frailty (36.7%) followed by muscle weakness (26.3%) among pre-frail and frail adults of 65 years and over.
The two latter studies were not solely based on a pre-frail population but a combination of pre-frail and frail older adults. As Santos-Eggimann et al. (2009) did not exclude participants based on selected diseases, it could mean that there was more frailty within the test group. Another possible reason for this discrepancy could be the method of testing the pre-frail criteria. Santos-Eggimann et al. (2009) made use of a different method than the other researchers by using a single multiple-choice question to determine which pre-frailty criteria were met.

Furthermore, the current study shows that women are more often classified as pre-frail due to a low grip strength than men. To the knowledge of the authors, this has not been studied in a pre-frail population before.
Grip strength data of Hogrel (2015) was used to make sure women were not disadvantaged by the Fried grip strength criteria; meaning to examine if women on average have a grip strength closer to the adjusted cut-off values and therefore be more easily classified as pre-frail. The data of 274 participants between the ages of 20 and 80 were used with a mean age of 49.73 years (Hogrel, 2015). The two genders were compared by calculating the average percentage scored above the mean cut-off value for men and women. According to the Fried frailty criteria, the mean cut-off score for women is 18.33 kg and 30.25 kg for men. The results for the mean percentage above the cut-off value showed similar scores for both genders; 64.24% for men and 74.26% for women ($p = 0.20$). Even when comparing the genders per age category of 10 years, the percentages of the women were close or slightly above those of men, although no statistical test could be performed on this data. Consequently, the differences in frequency of low grip strength are not due to biased cut-off values.

The rate of decline in grip strength is a point of discussion among many studies. Conflicting results are found. Some studies suggest that the rate of decline for grip strength is greater for men than for women (Dey, Bosaeus, Lissner, & Steen, 2009; Oksuzyan, Maier, McGue, Vaupel, & Christensen, 2010), while other studies found that the decline was greater for

women (Auyeung, Lee, Leung, Kwok, & Woo, 2014), or similar for men and women (Bassey, 1998; Daly et al., 2013). Considering the incongruent results, it is unlikely that a different rate of change in strength could be the cause of the difference in frequency for muscle weakness. More and larger studies in this pre-frail population are necessary to explain the differences found in this study.

There was a significant difference between men and women in the 4MWT+DT but not in the 4MWT. Women needed more time to complete the dual task walking test. This is in contrast with previous research. A study of Hollman, Youdas, and Lanzino (2011) found that the gait speed in adults over 65 years (mean age 77 years) did not differ between both genders, neither when performing a verbal dual task (backward spelling). Further, the results demonstrate that although stride-to-stride variability was equivalent between the genders during normal walking, men showed a greater stride-to-stride variability during dual task walking. This implies that older men may have more difficulties with performing a motor-cognitive dual task. Agmon, Armon, Denesh, and Doumas (2018) also found no difference in the distance walked during a one-minute walking test with a mathematical dual task (subtraction by 3, starting at a random number between 100 and 250) in community-dwelling older adults with a mean age of 75 years.
The participants in the recent study showed no difference in years of education between the genders. It is therefore unlikely that the level of education might be the reason for the difference in dual task performance.

The results of the current study showed no significant difference between men and women for cognitive tests e.g. MMSE, HVLT, Digit Symbol Coding and TMT part B. Reas et al. (2017) also found no differences in MMSE-scores between the genders. On the other hand, McCarrey et al. (2016) did found significant sex differences for the MMSE; men scored lower than women. This disagreement may be due to the small sample size of the current study.

The recent study found no gender differences in the HVLT, although other research found that female adults and female older adults score better on word memory tests compared to men (Hoogendam, Hofman, van der Geest, van der Lugt, & Ikram, 2014; McCarrey et al., 2016; Rabbitt et al., 2008; Reas et al., 2017).

Furthermore, no differences between men and women were found for the Digit Symbol Coding test, whereas McCarrey et al. (2016) found that men scored less than women. The same study also found differences for the TMT part A: women performed the test slower than men, but there was no distinction for part B. Reas et al. (2017) on the other hand, found that women were slower to perform part B. The authors did not perform part A of the test. In the current study, there was no gender difference found for TMT part B. TMT part A could not be statistically analysed, but the descriptive statistic shows that men needed on average 46.28 seconds (with a standard deviation of 20.84) to complete the part A, where women completed the trail within 42 seconds on average (with a standard deviation of 10.55).
The inconsistency between these studies might be due to the difference in mean age. Reas et al. (2017) and McCarrey et al. (2016) especially had lower mean ages (70.9 and 64.1-69.7 years respectively) compared to the mean age of the total population of the current study (76.6 years).

This study has several strengths. First, all data-analysis were performed by the authors. Secondly; the inclusion criteria were clearly described and implemented, leaving a population that is solely pre-frail with little to no impediment of diseases or conditions that may interfere with the results. All the testing was done in the home of the participant, which made the study more approachable. This also implies that testing was not as standardised as it could be in a clinical environment e.g. the height of the chair for the 5STS could not be standardised.
Furthermore, to the knowledge of the authors, this is the first study about gender differences in a solely pre-frail population.

The current study also has some weaknesses. There might have been a selection bias in the recruitment of the Belgian participants. Recruitment was mostly done in the social environment of the four researchers and all participants were volunteers. The small sample size of the male group is also a weakness. As this thesis is part of the multi-national, multi-site My Active and Healthy Ageing (My-AHA) Randomised Control Trial, that has trial sites in ten countries (Austria, Australia, Belgium, Germany, Japan, Italy, Spain, South Korea, Sweden and the United Kingdom). It may be interesting to redo the data analysis with the data of all

the participants. We recommend further research with larger sample sizes to confirm the results described above.

# 6 CONCLUSION

This study included 51 participants who were classified as pre-frail based on the Fried frailty criteria. The current study aimed to assess the gender differences in this specific population. The authors found that muscle weakness and self-reported exhaustion were the two most common criteria for being classified as pre-frail. Furthermore, three significant differences between men and women were found; in the frequencies for presenting the frailty criteria of muscle weakness, the average deviation from the cut-off value for low grip strength and in the time needed to perform the 4MWT+DT. No other differences between the genders were found. Further research with larger sample sizes is necessary for a pre-frail population to confirm these findings and to better understand the pre-frail state and why it impacts differently on men and women. This will create the possibility for specific interventions to reverse, stabilize or delay the evolution to frail.

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# 8 APPENDIX

TABLE 1 THE FIVE FRIED FRAILTY CRITERIA

<table>
<tr><th>Clinical sign</th><th>Assessment</th><th>Cut-off values</th></tr>
<tr><td>Unintentional weight loss</td><td>Self-reported weight loss by the question:<br>‘In the last year, have you lost more than 4.5 kg unintentionally, not due to fasting or exercise?’</td><td>≥ 4.5 kg in the last 12 months</td></tr>
<tr><td>Muscle weakness</td><td>Grip strength with Jamar® handheld dynamometer</td><td>In lowest 20%, adjusted for age and BMI<br><br>Men:<table><tr><th>BMI</th><th>CUT-OFF (KG)</th></tr><tr><td>≤ 24</td><td>≤ 29</td></tr><tr><td>24.1 – 26</td><td>≤ 30</td></tr><tr><td>26.1 – 28</td><td>≤ 30</td></tr><tr><td>> 28</td><td>≤ 32</td></tr></table><br>Women:<table><tr><th>BMI</th><th>CUT-OFF (KG)</th></tr><tr><td>≤ 23</td><td>≤ 17</td></tr><tr><td>23.1 – 26</td><td>≤ 17.3</td></tr><tr><td>26.1 – 29</td><td>≤ 18</td></tr><tr><td>> 29</td><td>≤ 21</td></tr></table></td></tr>
<tr><td>Exhaustion</td><td>Self-reported exhaustion by two CES-D scale questions:<br>‘I felt that everything I did was an effort’ and/or ‘I could not get going’</td><td>To either of the questions: a response of ‘2’ (a moderate amount of time, 3-4 days) or ‘3’ (most of the time)</td></tr>
<tr><td>Slow gait speed</td><td>Time to walk 4 meters</td><td>In lowest 20%, adjusted for gender and standing height<br><br>Men:<table><tr><th>HEIGHT (cm)</th><th>CUT-OFF (sec)</th></tr><tr><td>≤ 173</td><td>≥ 6.13</td></tr><tr><td>> 173</td><td>≥ 5.25</td></tr></table><br>Women:<table><tr><th>HEIGHT (cm)</th><th>CUT-OFF (sec)</th></tr><tr><td>≤ 159</td><td>≥ 6.13</td></tr><tr><td>> 159</td><td>≥ 5.25</td></tr></table></td></tr>
<tr><td>Low physical activity</td><td>IPAQ short version questionnaire</td><td>MET-minutes are converted to kcal<br>Men: < 383 kcal, women: < 270 kcal</td></tr>
</table>

TABLE 2 EXCLUSION CRITERIA

| | |
|---|---|
| **Cognitive, perceptual or sensory deficits that impair testing** | - Language deficits<br>- Significant visual impairment<br>- Significant hearing impairment<br>- Persistent cognitive impairment (two years) |
| **Psychological/mood disturbances (DSM-5 criteria)** | - Current major depressive disorder<br>- Schizophrenia or other psychotic disorders<br>- Bipolar disorder (within the past five years)<br>- Substance abuse (within the past two years) |
| **Mobility problems** | - Inability to stand and walk unassisted<br>- Limitation in balance and mobility caused by: amputation, painful arthritis, painful foot lesions or spinal stenosis |
| **Neurodegenerative central nervous system disorders** | - Alzheimer's disease<br>- Parkinson's disease<br>- Huntington's disease<br>- Lewy body dementia<br>- Frontotemporal Labor Degeneration, Frontotemporal Dementia<br>- Hydrocephalus<br>- Prion diseases<br>- Progressive supranuclear palsy<br>- Amyotrophic lateral sclerosis |
| **Peripheral nervous system and/or neuromuscular disorders** | - Multiple sclerosis (MS)<br>- Chronic Inflammatory Demyelinating Polyneuropathy (CIDP)<br>- Myasthenia gravis<br>- Polymyositis |
| **Neurological disorders or head trauma** | - Epilepsy<br>- Head injury with loss of consciousness<br>- Skull fracture |
| **Heart and vascular diseases** | - Untreated hypertension<br>- Clinical evidence or history of stroke (within the past two years)<br>- Clinical evidence or history of transient ischemic attack (within the past six months)<br>- A cardiac pacemaker<br>- Acute coronary syndrome (acute myocardial infarction or unstable, angina)<br>- Angina pectoris (within the past year)<br>- Evidence of uncontrolled atrial fibrillation<br>- Postural hypotension at screening (only screened if there is a known history of postural hypotension, nor underlying medical condition related to hypotension) |
| **Respiratory failure** | - Chronic obstructive pulmonary disease<br>- Bronchial asthma<br>- Lung fibrosis<br>- Other respiratory disease |

TABLE 2 CONTINUED

| | |
|---|---|
| **Concurrent acute or chronic immunologic, hepatic or endocrine diseases** | - E.g. encephalopathy, ascites…<br>- Metastatic cancer or immunosuppressive therapy |

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**Definitief gunstig advies**

**Faculteit Geneeskunde en Levenswetenschappen**
**Comité voor Medische Ethiek**
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|---|---|---|
| **CME2018/034** | | 15/06/2018 |

| | |
|---|---|
| Titel protocol | **My Active and Healthy Aging (My-AHA) Randomized control trial study** |
| Nummer protocol | |
| Opdrachtgever | Universiteit Hasselt |
| Eudractnummer | NVT |
| Belgisch nummer | **B9115201836735** |
| Onderzoeker | *Prof. dr. Raf Meesen, dr. Joke Spildooren* |

Geachte collega,

Het hierboven vermeld dossier werd besproken en goedgekeurd.

Na inzage van de informatie en documenten met betrekking tot dit dossier is het Comité voor Medische Ethiek UHasselt van oordeel dat de voorgestelde studie, zoals beschreven in het protocol, wetenschappelijk relevant en ethisch verantwoord is.

Het definitief gunstig advies betreft de volgende documenten:
- Protocol versie 2, 15/06/2018
- Informatie en toestemmingsformulier versie 3, 15/06/2018
- Bewijs van 'No-fault' verzekering, 14/05/2018
- Vragenlijsten
- Flyer
- CV's

Het Comité voor Medische Ethiek van UHasselt handelt volgens de geldende richtlijnen van de 'International Conference of Harmonization (ICH) Good Clinical Practice (GCP)' en volgens alle geldende en van toepassing zijnde wetten en reglementen.

Dit gunstig advies houdt niet in dat het Comité de verantwoordelijkheid voor de geplande studie op zich neemt. De onderzoeker blijft zelf verantwoordelijk hiervoor. Bovendien dient u er over te waken dat uw mening als betrokken onderzoeker wordt weergegeven in publicaties, rapporten voor de overheid enz., die het resultaat zijn van dit onderzoek.

Het comité vraagt aan de onderzoeker op de hoogte te worden gehouden wanneer de studie wordt gestart of wanneer ze wordt afgesloten of vroegtijdig onderbroken (met opgave van reden)

Indien de studie niet binnen het jaar beëindigd is dient de onderzoeker een jaarlijks rapport met het verloop van de studie te bezorgen aan het CME UHasselt.

Bij Serious Adverse events (SAE's) dient de onderzoeker het comité hiervan op de hoogte te brengen.

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UHASSELT
KNOWLEDGE IN ACTION

Wijzigingen in het studieprotocol, informatie en toestemmingsformulier, onderzoeksteam) dienen te worden goedgekeurd door het Comité via een amendement.

Wanneer een studie beëindigd wordt dient de onderzoeker een studierapport op te maken met het verloop van de studie (startdatum, einddatum, aantal geïncludeerde patiënten, aantal drop-outs, aantal patiënten die de studie volledig doorlopen hebben, eventuele adverse events, ...

Met oprechte hoogachting,

Prof. dr. Ivo Lambrichts
Voorzitter Comité voor Medische Ethiek

Cc:

FAGG – Research & Development department, Victor Hortaplein 40, bus 40, 1060 Brussel

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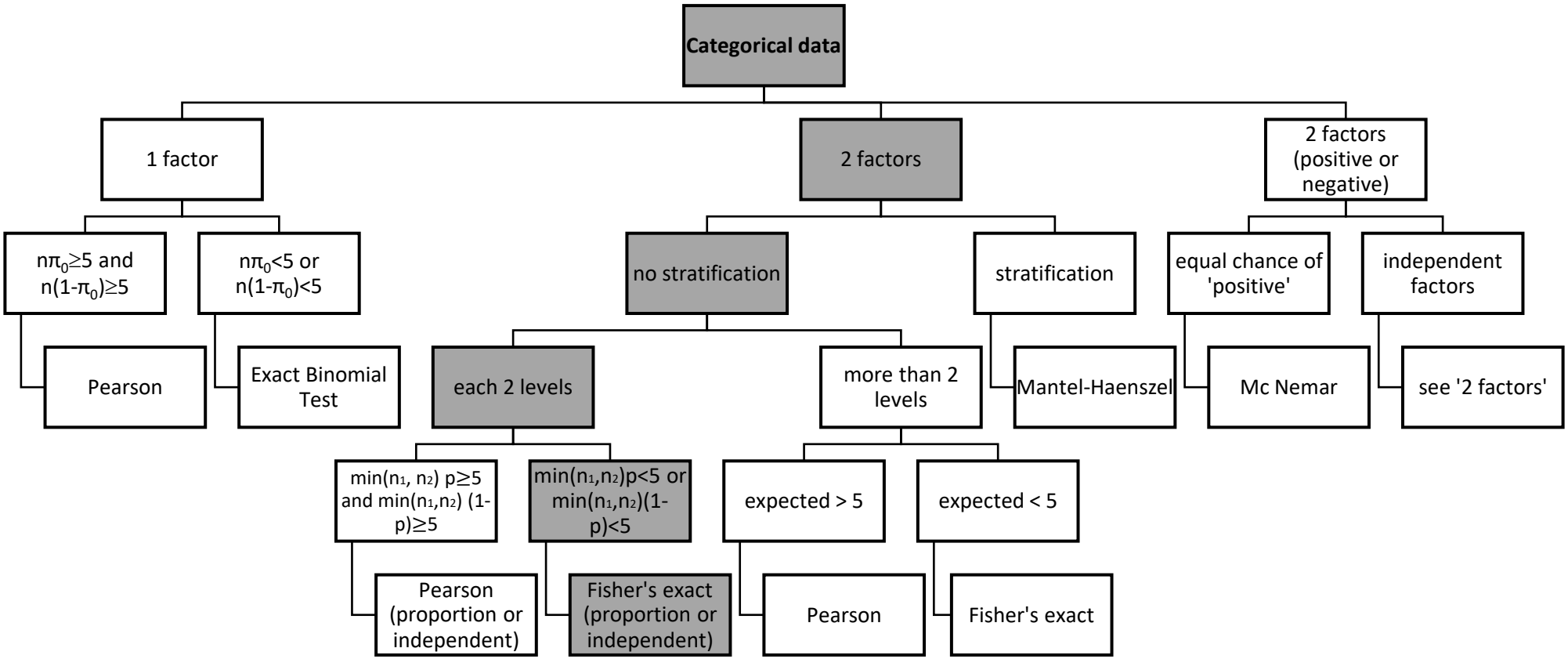


FIGURE 1 STATISTICAL PATHWAY FOLLOWED FOR THE PRIMARY OUTCOME MEASURES (FREQUENCIES FRIED FRAILTY CRITERIA) AND THE FOUR TEST BALANCE SCALE

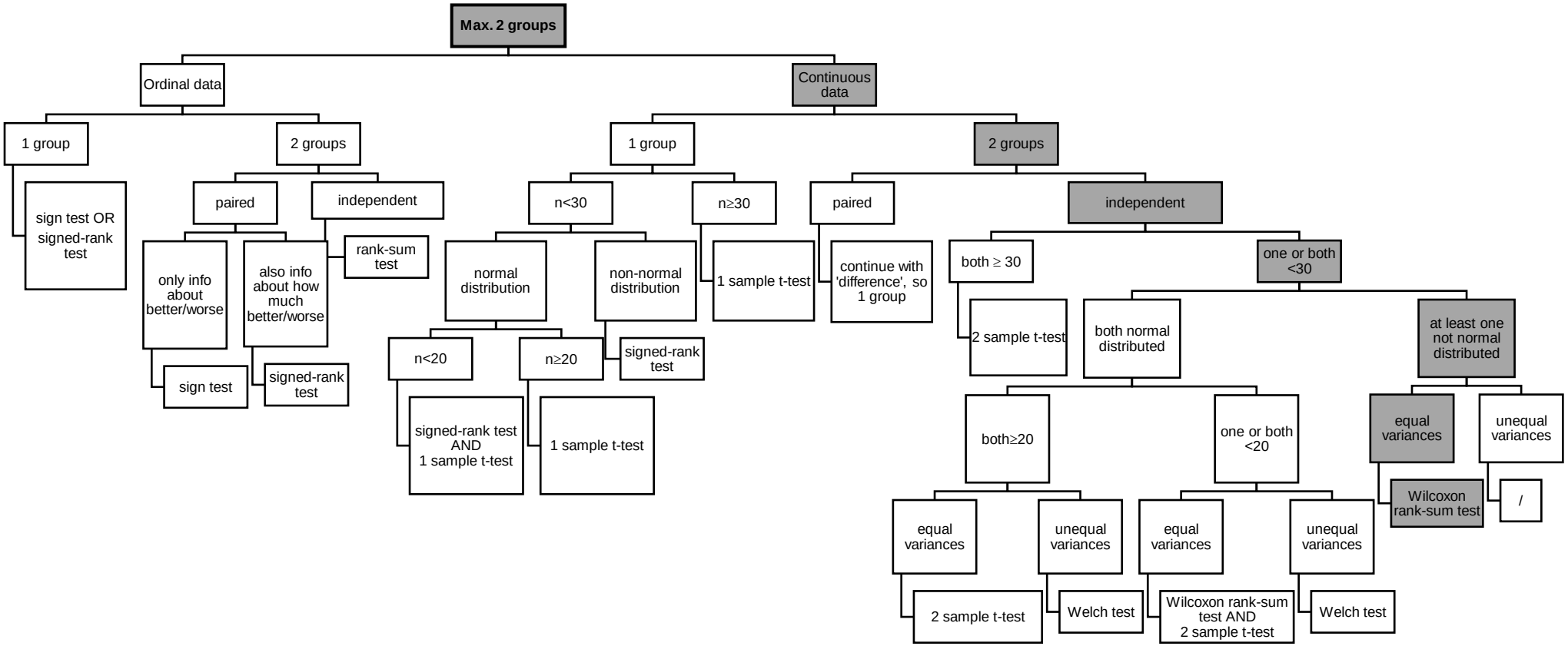


FIGURE 2 STATISTICAL PATHWAY FOLLOWED FOR THE BETWEEN-GROUP DIFFERENCES FOR THE FIVE FRIED CRITERIA, 4MWT+DT, 5STS, TUG, MMSE, TMT PART B, THE RECOGNITION DISCRIMINATION OF THE HVLT, WAIS-III DIGIT SYMBOL CODING TEST AND STROOP TEST.

MMSE = Mini-Mental State Examination, HVLT = Hopkins Verbal Learning Test, 5STS = 5-times sit-to-stand, TUG = Timed-Up and Go, 4MWT+DT = four-meter walking test with dual task, TMT = Trail Making Test

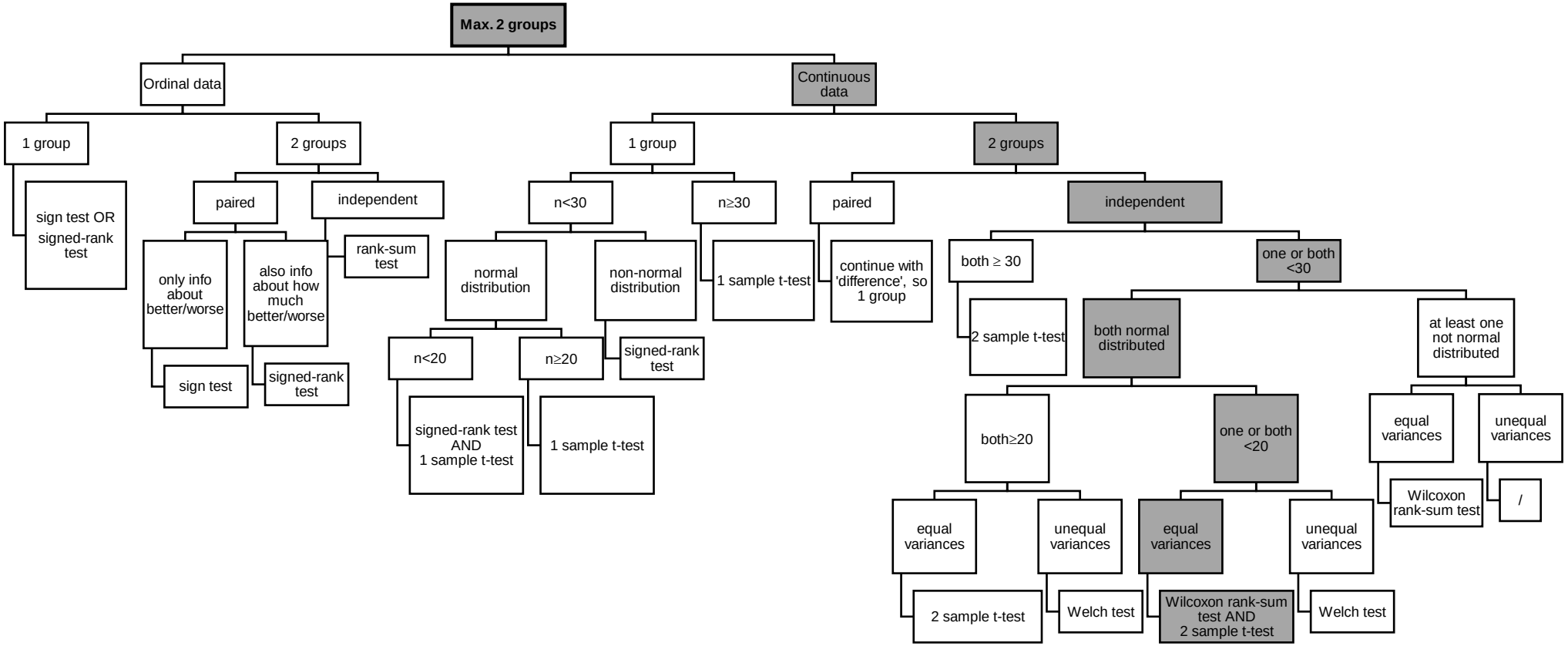


FIGURE 3 STATISTICAL PATHWAY FOR THE IMMEDIATE RECALL AND DELAYED RECALL OF THE HVLT.

HVLT = Hopkins Verbal Learning Test

TABLE 3 DEMOGRAPHICAL CHARACTERISTICS

| | **Men** | **Women** | **P-value** |
|---|---|---|---|
| Number of participants | 13 | 38 | |
| Mean age (years) | 74.62 ± 9.21 | 77.24 ± 6.42 | 0.26 |
| Age range | 61-93 | 62-89 | |
| Body weight (kg) | 81.65 ± 13.26 | 73.07 ± 14.51 | 0.07 |
| Body height (m) | 1.74 ± 0.06 | 1.59 ± 0.07 | < 0.001 |
| Marital status n (%) | | | 0.14 |
| Single/unmarried | 1 (7.69%) | 1 (2.63%) | |
| Married | 7 (53.84%) | 12 (31.58%) | |
| Divorced | 2 (15.39%) | 3 (7.90%) | |
| Widow/widower | 3 (23.08%) | 22 (57.90%) | |
| Residential status n (%) | | | 0.16 |
| Alone | 5 (38.46%) | 25 (65.79%) | |
| With partner | 8 (61.54%) | 12 (31.58%) | |
| With children/grand-children | 0 (0%) | 1 (2.63%) | |
| Living n (%) | | | 1 |
| In own home | 10 (76.92%) | 29 (76.31%) | |
| Residential village | 1 (7.69%) | 2 (5.26%) | |
| Assisted living | 2 (15.39%) | 7 (18.42%) | |
| Nursing facility | 0 (0%) | 0 (0%) | |
| Independent living n (%) | | | 0.89 |
| Independent | 6 (46.15%) | 20 (52.63%) | |
| Partly independent | 6 (46.15%) | 16 (42.11%) | |
| Dependent | 1 (7.69%) | 2 (5.26%) | |
| Total years of education | 13.92 ± 3.07 | 12.17 ± 3.18 | 0.09 |
| History of falls | 5 (38.46%) | 28 (73.68%) | 0.0411 |
| Fear of falls: | | | 0.4627 |
| Never | 5 (38.46%) | 9 (23.68%) | |
| Rarely | 4 (30.77%) | 5 (13.16%) | |
| A little | 3 (23.08%) | 12 (31.58%) | |
| Moderately | 0 (0%) | 5 (13.16%) | |
| Often | 1 (7.69%) | 4 (10.53%) | |
| Always | 0 (0%) | 3 (7.90%) | |

TABLE 6 GROUP DIFFERENCES PRIMARY OUTCOMES: CES-D AND IPAQ

| | Men | Women | P-value |
|---|---|---|---|
| **CES-D 1 n (%)** | | | 0.59 |
| Score 0 | 5 (38.46%) | 18 (47.37%) | |
| Score 1 | 4 (30.77%) | 14 (36.84%) | |
| Score 2 | 4 (30.77%) | 6 (15.79%) | |
| Score 3 | 0 (0%) | 0 (0%) | |
| **CES-D 2 n (%)** | | | 0.53 |
| Score 0 | 10 (76.92%) | 21 (55.26%) | |
| Score 1 | 2 (15.39%) | 13 (34.21%) | |
| Score 2 | 1 (7.69%) | 3 (7.90%) | |
| Score 3 | 0 (0%) | 1 (2.63%) | |
| **IPAQ** | | | |
| MET-min/week | 4113.54 ± 4528.39 | 2615.71 ±2292.19 | 0.29 |
| kcal | 6031.92 ± 7515.04 | 3216.03 ± 3168.06 | 0.16 |

CES-D = Center for Epidemiological Studies Depression Scale, IPAQ = International Physical Activity Questionnaire.

TABLE 7 GROUP DIFFERENCES SECONDARY OUTCOMES

| | Men | Women | P-value |
|---|---|---|---|
| **Four test balance scale n (%)** | | | |
| Side-by-side | 13 (100%) | 38 (100%) | 1 |
| Semi-tandem | 12 (92%) | 38 (100%) | 0.25 |
| Tandem | 8 (62%) | 33 (87%) | 0.10 |
| **5STS (s)** | 16.68 ± 12.42 | 14.68 ± 4.13 | 0.39 |
| **TUG (s)** | 10.23 ± 4.26 | 10.22 ± 2.63 | 0.52 |
| **4MWT + DT (s)** | 6.80 ± 4.96 | 7.63 ± 3.40 | 0.0323* |
| Ratio dual task/no dual task | 1.61 ± 0.88 | 1.66 ± 0.55 | 0.13 |
| **TMT** | | | |
| Part A time (s) | 46.29 ± 20.84 | 41.99 ± 10.55 | / |
| Errors | 0.23 ± 0.83 | 0.47 ± 0.86 | 0.16 |
| Part B time (s) | 98.98 ± 55.32 | 110.03 ± 47.12 | 0.58 |
| Errors | 0.62 ± 1.39 | 1.53 ± 1.91 | 0.06 |
| **Digit symbol coding test** | 48.69 ± 13.19 | 49.71 ± 13.65 | 0.88 |
| **Stroop test C/A ratio** | 2.23 ± 0.44 | 2.45 ± 0.80 | 0.43 |
| **MMSE** | 28.54 ± 1.51 | 27.71 ±1.45 | 0.08 |
| **HVLT** | | | |
| Immediate recall | 9.23 ± 2.09 | 8.66 ± 2.25 | 0.41 (t-test)<br>0.44 (Wilcoxon) |
| Delayed recall | 6 ± 3.21 | 7.42 ± 3.09 | 0.18 (t-test)<br>0.16 (Wilcoxon) |
| Recognition discrimination | 9.77 ± 2.05 | 10.37 ± 2.16 | 0.18 |

5STS = 5-times sit-to-stand, TUG = Timed-Up and Go, 4MWT+DT = four-meter walking test with dual task, TMT = Trail Making Test, MMSE = Mini-Mental State Examination, HVLT = Hopkins Verbal Learning Test.

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# INVENTARISATIEFORMULIER WETENSCHAPPELIJKE STAGE DEEL 2

| DATUM | INHOUD OVERLEG | HANDTEKENINGEN |
|---|---|---|
| 31/08/18 | uitleg My-AHA project , recrutering, screenings-procedure en testing | Promotor:<br>Copromotor/Begeleider:<br>Student(e): L.S.<br>Student(e): A.R. |
| 09/10/18 | bespreking testings en onderwerp van thesis | Promotor:<br>Copromotor/Begeleider:<br>Student(e): L.S.<br>Student(e): AR. |
| 03/01/2019 | feedback via email over methode | Promotor:<br>Copromotor/Begeleider:<br>Student(e): L.S.<br>Student(e): AR. |
| 15/02/2019 | bespreking tweede testmoment | Promotor:<br>Copromotor/Begeleider:<br>Student(e): L.S<br>Student(e): AR. |
| 08/04/2019 | bespreking statistiek en resultaten | Promotor:<br>Copromotor/Begeleider:<br>Student(e): L.S<br>Student(e): A.R. |
| 24/04/2019 | bespreking data-analyse en resultaten | Promotor:<br>Copromotor/Begeleider:<br>Student(e): L.S<br>Student(e): A.R. |
| 15/05/2019 | bespreking resultaten en opbouw discussie | Promotor:<br>Copromotor/Begeleider:<br>Student(e): L.S.<br>Student(e): A.R. |
| 24/05/2019 | bespreking context, inlaiding en discussie inschrijving presenteren eerste zit | Promotor:<br>Copromotor/Begeleider:<br>Student(e): L.S.<br>Student(e): A.R. |
| | | Promotor:<br>Copromotor/Begeleider:<br>Student(e):<br>Student(e): |
| | | Promotor:<br>Copromotor/Begeleider:<br>Student(e):<br>Student(e): |

**In te vullen door de promotor(en) en eventuele copromotor aan het einde van MP2:**

**Naam Student(e):** Anne-Nina Rousseau **Datum:** 28/05/2019

**Titel Masterproef:** The gender differences in a pre-frail older population, determined by the Fried frailty criteria.

1) Geef aan in hoeverre de student(e) onderstaande competenties zelfstandig uitvoerde:
   - NVT: De student(e) leverde hierin geen bijdrage, aangezien hij/zij in een reeds lopende studie meewerkte.
   - 1: De student(e) was niet zelfstandig en sterk afhankelijk van medestudent(e) of promotor en teamleden bij de uitwerking en uitvoering.
   - 2: De student(e) had veel hulp en ondersteuning nodig bij de uitwerking en uitvoering.
   - 3: De student(e) was redelijk zelfstandig bij de uitwerking en uitvoering
   - 4: De student(e) had weinig tot geringe hulp nodig bij de uitwerking en uitvoering.
   - 5: De student(e) werkte zeer zelfstandig en had slechts zeer sporadisch hulp en bijsturing nodig van de promotor of zijn team bij de uitwerking en uitvoering.

| Competenties | NVT | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Opstelling onderzoeksvraag | ⊗ | O | O | O | O | O |
| Methodologische uitwerking | ⊗ | O | O | O | O | O |
| Data acquisitie | O | O | O | O | ⊗ | O |
| Data management | O | O | O | O | ⊗ | O |
| Dataverwerking/Statistiek | O | O | O | O | O | ⊗ |
| Rapportage | O | O | O | ⊗ | O | O |

2) Niet-bindend advies: Student(e) krijgt (toelating)/~~geen toelating~~ (schrappen wat niet past) om bovenvermelde Wetenschappelijke stage/masterproef deel 2 te verdedigen in bovenvermelde periode. Deze eventuele toelating houdt geen garantie in dat de student geslaagd is voor dit opleidingsonderdeel.

3) Deze wetenschappelijke stage/masterproef deel 2 mag (wel)/~~niet~~ (schrappen wat niet past) openbaar verdedigd worden.

4) Deze wetenschappelijke stage/masterproef deel 2 mag ~~wel~~/(niet) (schrappen wat niet past) opgenomen worden in de bibliotheek en docserver van de UHasselt.
   → dit pas wel na publicatie My-AHA studie

| Datum en handtekening Student(e) | Datum en handtekening promotor(en) | Datum en handtekening Co-promotor(en) |
|---|---|---|
| 28/05/2019 | 28/5/2019 | |

**In te vullen door de promotor(en) en eventuele copromotor aan het einde van MP2:**

**Naam Student(e):** Lisa Spaas **Datum:** 28/05/2019

**Titel Masterproef:** The gender differences in a pre-frail older population, determined by the Fried frailty criteria.

1) Geef aan in hoeverre de student(e) onderstaande competenties zelfstandig uitvoerde:
   - NVT: De student(e) leverde hierin geen bijdrage, aangezien hij/zij in een reeds lopende studie meewerkte.
   - 1: De student(e) was niet zelfstandig en sterk afhankelijk van medestudent(e) of promotor en teamleden bij de uitwerking en uitvoering.
   - 2: De student(e) had veel hulp en ondersteuning nodig bij de uitwerking en uitvoering.
   - 3: De student(e) was redelijk zelfstandig bij de uitwerking en uitvoering
   - 4: De student(e) had weinig tot geringe hulp nodig bij de uitwerking en uitvoering.
   - 5: De student(e) werkte zeer zelfstandig en had slechts zeer sporadisch hulp en bijsturing nodig van de promotor of zijn team bij de uitwerking en uitvoering.

| Competenties | NVT | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Opstelling onderzoeksvraag | X | O | O | O | O | O |
| Methodologische uitwerking | X | O | O | O | O | O |
| Data acquisitie | O | O | O | O | X | O |
| Data management | O | O | O | O | X | O |
| Dataverwerking/Statistiek | O | O | O | O | O | X |
| Rapportage | O | O | O | X | O | O |

2) Niet-bindend advies: Student(e) krijgt toelating/~~geen toelating~~ (schrappen wat niet past) om bovenvermelde Wetenschappelijke stage/masterproef deel 2 te verdedigen in bovenvermelde periode. Deze eventuele toelating houdt geen garantie in dat de student geslaagd is voor dit opleidingsonderdeel.

3) Deze wetenschappelijke stage/masterproef deel 2 mag wel/~~niet~~ (schrappen wat niet past) openbaar verdedigd worden.

4) Deze wetenschappelijke stage/masterproef deel 2 mag wel/niet (schrappen wat niet past) opgenomen worden in de bibliotheek en docserver van de UHasselt.
→ dit pas na publicatie My-AHA Studie

| Datum en handtekening Student(e) | Datum en handtekening promotor(en) | Datum en handtekening Co-promotor(en) |
|---|---|---|
| 28/05/2019 | 28/5/2019 | |