Chapter 1

General introduction
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**Ageing population**

Globally, the population is rapidly ageing. The percentage of adults aged 60 years and older is expected to double, from 901 million in 2015 to 2.1 billion in 2050; for adults aged 80 years and older this percentage is expected to increase more than threefold; from 125 million in 2015 to 434 million in 2050 [1]. Ageing is associated with physiological changes including shifts in body composition [2, 3]. After the age of 50 years, muscle mass declines with 1% to 2% per year [4, 5]. Next to the decline in muscle mass, muscle strength also declines with increasing age. Muscle strength starts declining after the age of 30 years and this decline is steeper after the age of 50 years with approximately 0.4 kg handgrip strength loss per year [6]. There is an association between the decline of muscle mass and muscle strength, however, the decline in muscle strength is much more rapid compared to the decline in muscle mass [7]. Furthermore, it is has been shown that the age-related decline in muscle strength cannot be prevented by maintaining or gaining muscle mass only [7].

**Clinical relevance of the ageing muscle**

Muscle is a modifiable organ and important for the glucose metabolism and protein storage [8]. If muscle mass and muscle strength are below a clinically relevant threshold, it is called sarcopenia [9]. The clinical relevance of sarcopenia is increasingly being recognized and an emerging challenge in the ageing population. The term sarcopenia was first introduced by Rosenberg in 1989 and literally means the ‘deficiency’ (penia) of ‘flesh’ (sarx) [9]. According to the definition of the European Working Group on Sarcopenia in Older People [10], sarcopenia is prevalent in approximately a third of the older population [11].

The pathophysiology of sarcopenia is complex because several mechanisms contribute to the age-related decline in muscle mass and muscle strength such as genetics, chronic diseases, hormones and lifestyle factors [4, 12]. Lifestyle factors include physical activity and nutrition which are modifiable factors [13]. A combined physical and nutritional intervention has been shown to significantly improve muscle mass and muscle strength [14]. However, there is a lack of knowledge on the nutritional needs and the interrelation between physical activity and nutritional status in older adults. This knowledge is mandatory for the optimization of
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Definition of sarcopenia

There is no consensus on the definition of sarcopenia and therefore prevalence rates vary dependent on the used definition [26]. Recently, several diagnostic criteria for sarcopenia are proposed encompassing different diagnostic measures and cut-off values. The use of diagnostic measures within the diagnostic criteria are based on only muscle mass [18, 19, 27-29], only muscle strength [30] or algorithms using a combination of muscle mass, muscle strength and physical performance [10, 31-33]. Cut-off values for these diagnostic measures also vary widely [26]. Due to the use of these different diagnostic criteria, studies are difficult to compare. In addition, the agreement between different diagnostic criteria in different older populations is yet unknown and especially in clinically relevant populations. It is important to show the impact of using different diagnostic criteria for sarcopenia and to eventually work towards one consensus definition. Another highly prevalent condition in older adults is frailty [34, 35]. Frailty is often intermingled with sarcopenia [36], however, both conditions are based on different constructs and therefore require a different treatment [37].

Diagnostic measures of sarcopenia

Relating candidate diagnostic measures of sarcopenia to muscle-related clinical parameters in different populations is necessary for the establishment of the most clinically valid definition of sarcopenia. Previous studies have shown that diagnostic measures relate differently to muscle-related clinical parameters such as physical performance, insulin resistance, bone mineral density and standing balance [17, 38-40]. Relative muscle mass was found to be most strongly associated with physical performance [38] and glucose regulation [39], absolute
muscle mass with bone mineral density [40] and muscle strength with standing balance [17]. Nutrition and physical activity both contribute to the age-related decline in muscle mass and muscle strength [4] and therefore it is important to assess how diagnostic measures of sarcopenia relate to these muscle-related clinical parameters.

**Awareness among healthcare professionals**
Healthcare professionals play a key role in diagnosing and managing sarcopenia which require knowledge and awareness. However, the current awareness on sarcopenia among healthcare professionals is unknown. Thereafter, knowledge dissemination is an important step to create awareness among healthcare professionals working in the aged care setting. Identifying factors are needed to ensure an effective implementation of diagnosis and management.

**Aim of this thesis**
The aim of this thesis was to 1) to compare prevalence rates of sarcopenia using different sets of diagnostic criteria in diverse relevant populations of older adults; 2) to assess associations between candidate diagnostic measures of sarcopenia and muscle-related clinical parameters in diverse relevant populations of older adults and 3) to provide insight into the current awareness on sarcopenia in a cohort of healthcare professionals.

**Study populations**

**Geriatric outpatients**
This cross-sectional study consisted of 299 geriatric outpatients (mean age 82 years, standard deviation 7 years) who were consecutively referred to a middle-sized teaching hospital (Bronovo Hospital, The Hague, the Netherlands) for a comprehensive geriatric assessment (CGA). This CGA included questionnaires and measurements of physical and cognitive performance. Muscle measures included in the CGA were muscle mass measured by bioelectrical impedance analysis, handgrip strength and gait speed measured with the four-meter walking test. Being a clinically relevant population of older adults, this population was used to address several research questions.
**MyoAge cohort**
This cross-sectional European multicentre study included healthy young (n=182, aged between 18 and 30 years) and old participants (n=322, aged between 69 and 81 years). Participants were recruited in the Netherlands (Leiden), Finland (Jyvaskyla), France (Paris), Estonia (Tartu) and the United Kingdom (Manchester). The MyoAge study aimed to include healthy participants only, to minimize the confounding effects of disease on sarcopenia [41]. Muscle measures included muscle mass measured by dual-energy X-ray absorptiometry, handgrip strength and gait speed measured with the six-minute walking test.

**Grey Power cohort**
This cross-sectional study included 256 community-dwelling participants (aged between 20 and 91 years) recruited from the Grey Power debate events, taking place at the VU University Medical Center, Amsterdam, the Netherlands. The Grey Power debates were freely accessible lectures for the general population to promote healthy aging. Visitors were offered to participate in the Grey Power study. Muscle measures included muscle mass measured by bioelectrical impedance analysis, handgrip strength and gait speed measured with the four-meter walking test.

**Healthcare professionals**
This population was used to assess the awareness on sarcopenia among healthcare professionals. This longitudinal study included 223 medical and allied healthcare professionals attending the ‘Sarcopenia Road Show’, a postgraduate, multidisciplinary lecture cycle for healthcare professionals with different backgrounds. The Sarcopenia Road Show visited four locations spread over the Netherlands and comprised lectures and workshops in one single session focused on the pathophysiology of sarcopenia and the influence of exercise and nutrition and its interventions. Attending healthcare professionals were asked to complete three questionnaires; before attendance, directly after attendance and five months after attendance. Questionnaire included topics on the current state of knowledge about the concept of sarcopenia, diagnostic strategy and management of sarcopenia.
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Outline of this thesis

Chapter two and three focus on the comparison of prevalence rates of sarcopenia using different sets of diagnostic criteria and the concordance with diagnostic criteria for frailty. In chapter four, the influence of the number of attempts on maximal handgrip strength was assessed. Chapter five, six and seven compare the association between diagnostic measures of sarcopenia and muscle-related clinic parameters i.e. parameters of malnutrition (chapter five), serum albumin (chapter six) and physical activity (chapter seven).

Chapter eight describes the current awareness on sarcopenia among healthcare professionals. Chapter nine reflects on the main findings and gives clinical implications and suggestions for future research.
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References


