Aim
The general aims of this thesis were; 1) to study the criterion validity of an Attention-Deficit/Hyperactivity Disorder (ADHD) screener, that was developed for younger adults, in older adults, 2) to determine the prevalence of ADHD in older adults, 3) to examine the stability of ADHD symptoms during the life course, and 4) to study physical and mental health of older adults with ADHD.

Before we started our study little was known about ADHD in older adults. Only very recently the first scientific papers have been published. Therefore, the diagnostics and treatment of ADHD in older adults are mainly based on what is known from younger adults and children, whereas it might be expected that due to aging and increasing somatic comorbidity the diagnostics and treatment of ADHD in older adults may need its own clinical guidelines.

To study ADHD in a representative sample of older adults we used a large population-based cohort in the Netherlands (The Longitudinal Aging Study Amsterdam (LASA)) in which we first screened for ADHD, and subsequently performed a diagnostic interview. The findings of our studies will be summarized and evaluated in this chapter. In addition methodological considerations, implications for the clinical practice, and ideas for future research will be presented.

Summary of main findings
To identify ADHD in older adults a validated screener may be helpful. A screener is an efficient way to determine whether a more expensive diagnostic interview is desirable or not. However, no such screener is available for older adults. Chapter 2 reports about the reliability and criterion validity of an ADHD screener that was originally designed for younger adults. The screener was tested against a semi-structured diagnostic interview (Diagnostic Interview for ADHD in Adults, second edition (DIVA 2.0)). In the first phase 1494 respondents (60 – 94 years) from LASA were assessed with the ADHD screener. Scores on the screener were stratified into three levels: a high scoring group, most likely to have ADHD (score 3 – 9); a moderate scoring group (score 1 – 2) and randomly selected low scoring group (score 0). This way 231 respondents were selected and participated in the diagnostic interview.

The results showed that the screener had an acceptable internal consistency (Cronbach’s α: 0.71) and validity (area under the curve: 0.82) and had a moderate reliability (intraclass correlation coefficient (ICC): 0.56). The optimal cut-off for older adults was found at 2 (sensitivity: 0.80; specificity: 0.77; positive predictive value (PPV): 0.13; negative
predictive value: 0.99). Despite its only moderate ICC, the ADHD screener has proven to show good sensitivity and predictive value in our population-based sample of older adults. Therefore we concluded that it is valid and useful instrument for screening ADHD in older adults.

Since little is known about the prevalence of ADHD among older adults the prevalence of ADHD diagnosis in The Netherlands was estimated (Chapter 3). Our prevalence rates were weighted according to sex and age to be able to generalize our findings to the general older population in The Netherlands. The prevalence of ADHD was calculated using DSM-IV criteria. According to those criteria a syndromatic diagnosis of adult ADHD required six symptoms of either inattention and/or hyperactivity-impulsivity during the six months prior to the interview (DSM-IV criterion A) and during childhood. Because these criteria were probably too strict for older adults, we also computed a symptomatic ADHD-diagnosis, which required four symptoms of either inattention and/or hyperactivity-impulsivity during the 6 months prior to the interview and six symptoms of either inattention and/or hyperactivity-impulsivity during childhood.

The estimated prevalence rate of syndromatic ADHD in older adults was 2.8%; for symptomatic ADHD the rate was 4.2%. This correlates roughly with 95000 older adults aged 60 – 94 years in The Netherlands who have syndromatic ADHD, and 145000 older adults who have symptomatic ADHD. Although both age groups were diagnosed with ADHD, younger older adults (60 – 70 years) reported significantly more ADHD symptoms than older adults (71 – 94 years). Results from this study demonstrate that ADHD does not fade or disappear in adulthood. It also shows that it is an important topic to investigate further.

Chapter 4 describes the lifetime stability of ADHD symptoms into old age. A recent study showed the persistence of self-reported childhood ADHD symptoms over the lifespan in older adults. However, in this study no ADHD diagnostic information was available and high attrition rates may have confounded the results.

The results of our study however, also suggest continuity of the number of ADHD symptoms present in childhood into old age. The balance of inattentive/hyperactive-impulsive symptoms in older adulthood and in childhood is the same in persons with and without ADHD. This suggests that aging does not influence the presentation of ADHD.

Studies in children and younger adults have shown that ADHD is associated with smoking, alcohol and drug use, unstable eating patterns, sleep disorders, migraine, and high healthcare use and costs. These unhealthy life styles may lead to poor physical
health at a younger age, or early death in persons with ADHD. **Chapter 5** describes the results of the study in which we examined the association between ADHD, physical health and lifestyle in older adults. Information on physical health, medication use, and lifestyle characteristics was collected during home visits in Phase 1 of the study. The results showed that the number of ADHD symptoms was positively associated with the presence of chronic nonspecific lung diseases ($B = 2.58, p = .02$), cardiovascular diseases ($B = 2.18, p = .02$), and number of chronic diseases ($B = 0.69, p = .04$) and was negatively associated with self-perceived health ($B = −2.83, p = .002$). These associations were not mediated by lifestyle variables. Contrary to expectations, there were no associations between symptoms of ADHD and lifestyle variables in our older adults. The association between ADHD and cardiovascular disease has not been reported before in younger adults with ADHD. Therefore this association may be specific for older adults. A closer inspection of this association showed that those with ADHD more often had a heart disease, cerebrovascular accident, or used more often medication for one of these conditions than those without ADHD.

Extensive research illustrated cognitive deficits in children and younger adults with ADHD.$^{41,42}$ Few studies have focused on the cognitive functioning in older adults, however. In **Chapter 6** we investigated the association between ADHD and cognitive functioning in older adults. Cognitive functioning was assessed with the Mini Mental State Examination (MMSE), Raven’s Coloured Progressive Matrices, Auditory Verbal Learning Test, Alphabet Coding Task-15, Stroop Color-word Test, Trail Making Task, Word Fluency Test, and Digit Span, covering the cognitive domains of executive functioning, information processing speed, memory and attention/working memory. The results showed that ADHD diagnosis and ADHD severity were only negatively associated with cognitive functioning in the attention/working memory domain, but the effect sizes were small. When adjusting for depression, these associations were no longer significant. It was concluded that the association between ADHD and cognitive performance was mainly explained by depressive symptoms.

Comorbidity between ADHD and depression is high,$^{140–142}$ also in older adults as is shown in a paper from our group.$^{121}$ Thus far it is not well understood why ADHD and depression are so strongly interrelated. A factor that may play a role is an increased risk of experiencing adverse life events in persons with ADHD. In **Chapter 7** the role of adverse life events in the association between ADHD and depression was studied. Therefore, six-year follow-up data from LASA were used including the life events ‘relocations’, ‘serious conflicts with others’, ‘financial problems’, and ‘total number of life events’. The results showed that compared to older adults without ADHD, those with ADHD reported having more serious conflicts. The increased risk of depression in older adults with ADHD was partly explained by these serious conflicts. Furthermore, the association between the severity of ADHD-symptoms
and depression was stronger in those who experienced serious conflicts, and those who experienced a larger number of adverse life events. The results suggest that better and earlier treatment of ADHD might prevent the development of depression in the presence of life events associated with ADHD.

In conclusion, the findings of our studies have shown that ADHD is a lifelong disorder, which is associated with physical and mental health problems in older adults.

Methodological considerations
Our study was the first that studied ADHD in a large population-based sample, and only few clinical studies among older adults are available. Because so little was known about ADHD in older adults, we had to deal with several limitations, which will be discussed below.

DSM
Diagnosing ADHD in older adults comes with several limitations. It is unclear whether the DSM criteria for ADHD, which were developed for children and younger adults, are appropriate for older adults. Neither the DSM-IV-TR criteria, nor the DSM-5 criteria have been validated in older adults yet. It may be that the expression of symptoms of ADHD changes with age, which might have led to missing ADHD symptoms that are specific for older adults, leading to an underestimation of the prevalence of ADHD in this group. In addition, some ADHD-symptoms that are important in childhood may no longer be relevant in adulthood, since life demands of older adults are significantly different compared to the life demands of children. For this reason, in the DSM-5 the diagnostic criteria for ADHD in adults have been slightly changed compared to the DSM-IV-TR and the cut-off is set at six or more symptoms present in childhood and five or more symptoms present in adulthood. In our studies the cut-off for ADHD was set at four or more symptoms present six month prior to the interview and 6 or more symptoms present in childhood. At the time of our studies the DSM-5 criteria were not yet published, therefore the cut-off used in our studies is based on Kooij et al. They found a clinical relevant rise in impairments in persons with 4 or more current symptoms of ADHD. Whether the DSM-5 criteria are adequate for older adults or that a lower cut-off may be more adequate remains to be determined.

DIVA
The semi-structured diagnostic interview DIVA 2.0 has been developed to operationalize the DSM-IV-TR criteria for ADHD in adults. For our study, the DIVA 2.0 was modified into a fully structured interview. This was necessary because lay interviewers performed the diagnostic interview. However, it is unknown what the effect of this may have been on the results.