Chapter 10

General discussion
RATIONALE OF RESEARCH

The topic of this research project is dizziness in older people in general practice. Dizziness is a common health problem in older people and strongly affects daily functioning. Physicians are often unable to identify a specific cause for dizziness in older people, even after an extensive diagnostic work-up. As a result, general practitioner’s management for dizziness often includes a wait-and-see strategy. A prognosis-oriented approach might add to the current approach by estimating the prognosis in a specific patient, and subsequently targeting potentially modifiable risk factors for an unfavourable outcome.

In our project we aimed to get more insight into current management of dizziness. Furthermore, we aimed to investigate whether treatment with a prognosis-oriented approach is effective in reducing dizziness-related impairment. To be able to answer the latter, we wanted to be able to identify patients at high risk of an unfavourable course of dizziness. Furthermore, we carried out a cluster randomised controlled trial with a risk factor guided multifactorial intervention among patients with dizziness and a high-risk of an unfavourable prognosis.

This final chapter first summarises the findings of our research. I will then reflect on the main findings and discuss the methodological strengths and weaknesses of this thesis. Finally, implications for future research and clinical practice are discussed.

SUMMARY OF FINDINGS

Prevalence, diagnosis and current management of dizziness
In chapter 2 we describe a qualitative study with 13 significantly impaired older dizzy patients. We investigated the older patients’ dizziness related experiences and their wishes and expectations regarding general practitioner care. Patients described many dizziness related restrictions in daily life. However, despite the many reported dizziness-related restrictions, patients seldom presented dizziness as main reason for encounter with their general practitioner. Most patients presented dizziness as a secondary complaint when they visited the general practitioner for another complaint. They felt that their dizziness was not serious enough to be the main reason for encounter with their general practitioner or they expected the general practitioner would not be able to relieve their symptoms. After having visited the general practitioner, the vast
majority of the patients reported they were very satisfied with the way the general practitioner handled their dizziness. They were satisfied even when, according to the patients, the general practitioner was not able to reduce the dizziness symptoms or did not start any therapy at all.

In chapter 3 we investigate the prevalence, diagnosis and current management of dizziness in general practice in a sample of 2812 older dizzy patients in primary care. The prevalence of dizziness in this sample was 11.8%. Cardiovascular conditions and peripheral vestibular disease were most often recorded as cause of dizziness. The general practitioner recorded a symptom diagnosis or did not record a diagnosis at all in 35.9% of the sample. The study revealed a variety of management strategies. Frequent treatments included a wait-and-see strategy (28.4%) and providing education and advice (28.0%). Additional tests were carried out in 26.8% of the sample and general practitioners referred 19.0% of the older dizzy patients to specialised care. Of the patients, 87.2% had at least one Fall Risk Increasing Drug (FRID) prescription. General practitioners adjusted the use of one or more FRIDs for 11.7% of the patients.

Predictors of dizziness

In our project we developed two prediction models for dizziness in older patients, one to predict a 6-month unfavourable course of dizziness in a primary care population and one to identify long-term predictors (7 and 10 years) for dizziness in a population-based sample.

With the first model, presented in chapter 4, we wanted to predict which older patients suffering from significant dizziness-related impairment, would have a 6-month unfavourable course of dizziness. Based on the developed prediction model, we also constructed a risk score for identification of patients at high risk of an unfavourable course of dizziness. The developed prediction model and accompanying risk score consisted of four predictors: score of the screening version of the Dizziness Handicap Inventory (DHI-s, assessing dizziness-related impairment), age, history of arrhythmia and looking up as provoking factor. The prediction model showed good calibration and fair discrimination (Area Under the Receiver Operating Characteristic curve (AUC) 0.77). On external validation, discriminative ability remained stable (AUC 0.78). The constructed risk score was strongly correlated to the prediction model (r=0.96, p<0.001).

With the second prediction model, as presented in chapter 5, we identified long-term predictors of regular dizziness among community-dwelling older
adults. Living alone, history of dizziness, history of osteoarthritis or rheumatoid arthritis, history of cancer, use of nitrates, presence of anxiety or depression, impaired vision, and impaired function of lower extremities predicted regular dizziness at 7-year follow-up. Furthermore, living alone, history of dizziness, history of cancer, use of anxiolytics, and impaired function of lower extremities predicted regular dizziness at 10-year follow-up. Both models showed good calibration and acceptable discrimination (AUC 0.77 and 0.71, respectively).

**A prognosis-oriented approach for treatment of dizziness (the RODEO study)**

As mentioned before, physicians are often unable to identify a specific cause for dizziness in older people, even after an extensive diagnostic work-up. As a result, general practitioner’s management for dizziness often includes a wait-and-see strategy. A prognosis-oriented approach might add to the current approach by estimating the prognosis in a specific patient, where after potentially modifiable risk factors for an unfavourable outcome are targeted.

We carried out a cluster randomised controlled trial with a risk factor guided multifactorial intervention among older patients with dizziness to evaluate the effectiveness of a prognosis-oriented approach. In chapter 8 we describe the study design of our cluster randomised clinical trial (the RODEO study). In chapter 9 we present the results of the RODEO study. The prognosis-oriented approach with a multifactorial risk factor guided intervention for dizziness proved ineffective; we did not find any significant effects of the intervention on the primary outcome, dizziness-related impairment, and on most of the secondary outcomes including quality of life, dizziness frequency, fall frequency, and anxiety disorder and depression. The intervention significantly reduced the number of prescribed FRIDs. Uptake of and adherence to the interventions were significantly lower in patients eligible for two or three interventions compared to patients eligible for only one intervention. Furthermore, refusal and withdrawal were significantly higher for the interventions ‘stepped mental health care’ and ‘exercise therapy’, as compared to the intervention ‘FRID adjustment’. 
DISCUSSION OF MAIN FINDINGS

Prevalence, diagnosis and current management of dizziness
To our knowledge, we were the first to perform a qualitative study on significantly impaired older patients’ wishes and expectations regarding general practitioner care (chapter 2). It is remarkable that most participants of this study stated their dizziness was not severe, even though they reported many restrictions in daily life. Furthermore, despite the restrictions in daily life, most patients did not visit their general practitioner to discuss their dizziness. The fact that many participants described that the dizziness complaints were not as disabling as other chronic diseases or health issues among acquaintances, might have contributed to not seeking help. If patients mentioned dizziness to their general practitioner at all, they mostly presented it as a secondary complaint when visiting the general practitioner for another complaint. This may give general practitioners the wrong impression that the dizziness-related impairment of their patients is only mild. General practitioners need to be aware of this and should actively ask the dizzy patient about experienced restrictions to properly assess the impact of dizziness on everyday life.

As compared to previous studies, our results (chapter 3) confirm the relatively high prevalence of dizziness in older patients in general practice (11.8%) [1,2]. Our results also confirm the high rate of unknown cause of dizziness (35.9%) [2], which reflects once more the difficulty for general practitioners to establish the origin of dizziness in older people. Over all, we provided important additional knowledge since only few studies previously investigated the usual care of dizziness in general practice [1,3-5]. Moreover, we were the first to investigate the usual care management of dizziness in patients aged 65 years and over in general practice. A remarkable finding of our study was the high rate of referrals to specialised care (19%). Two other Dutch studies reported referral rates of 3.2%-4.5% for dizziness in the general population [6,7]. Yet, these studies differed from our study in several aspects: they used study populations of all ages and only included patients with International Classification of Primary Care (ICPC) codes N17 ‘vertigo/dizziness’ and H82 ‘vertiginous syndrome’. Our study comprised of patients aged ≥65 years and besides identification of patients via ICPC codes N17 and H82 we also identified patients by searching for ‘dizziness’ in the full text electronic records of the general practitioners. As a result, 57.5% of the identified dizzy patients in our study were recorded with other ICPC codes than N17 or H82 (see table 1 of chapter 3 for reported diagnoses). However, the differences in study populations can probably not fully explain the difference
in referral rates between those previous studies and our study. Several studies demonstrate that general practitioner's referral decisions are influenced by a complex mix of patient, physician, and health care system structural characteristics [8-10]. Since the Dutch health care system did not change, changes in patient's expectations, doctor's perceptions of patients expectations reassurance for the patient might have influenced the referral rate.

Regarding the usual care of dizziness, we had a special focus on adjustment of FRIDs in chapter 3 because it is assumed that medication is a contributory factor to dizziness in as much as 25% of older patients [11]. Drugs that contribute to dizziness demonstrate a striking similarity with the list of FRIDs [12-14], and FRIDS might therefore be a useful proxy for potential dizziness inducing medication. General practitioners adjusted one or more FRIDs in 11.7% of the patients. This is important information. First, knowing that general practitioners adjusted a FRID in only 11.7% of the total of 87.2% of patients having at least one FRID prescription, showed us there was ample room for more FRID adjustment and potentially more reduction of dizziness with a simple management strategy. Second, as FRID adjustment was one of the interventions of the RODEO study we established that our intervention could actually make a difference as compared to usual care.

**Predictors of dizziness**

In chapter 4 of this thesis we present a prediction model for identification of patients at high risk of an unfavourable course of dizziness. Dizziness-related impairment, was previously identified as strong predictor of dizziness in a study by Dros et al [15]. Yet, it is remarkable that none of the other predictors of our newly developed prediction model (age, history of arrhythmia and looking up as provoking factor) has been previously identified as predictor [15-18], nor has been associated with dizziness in previous research [19-24]. We believe there are three possible explanations for the fact that we identified three 'new' predictors of dizziness. First, the outcome measure of our prediction model was the presence of significant dizziness-related impairment as dichotomised item (yes/no). Apart from the study of Dros et al. [15], all comparable studies used presence of dizziness (yes/no) as the outcome [15-18]. Potentially we might have measured a different construct by measuring dizziness-related impairment (yes/no), as compared to presence of dizziness (yes/no) in the other studies [15-18]. Second, one of the predictors we identified in our prediction model was dizziness-related impairment, which was such a strong predictor of the outcome that there was less room for other predictors with smaller predictive ability.
This hypothesis is affirmed by the results of Dros et al.; they chose to exclude dizziness-related impairment from their final model because it did not provide guidance for clinical interventions [15]. By ignoring the strongest predictor, there was room in Dros’ model for other predictors with a smaller predictive ability for identifying patients with an unfavourable course of dizziness. Third, we chose to dichotomise our outcome because we wanted our prediction model to be able to differentiate between patients at low risk and at high risk of an unfavourable course of dizziness. Yet, converting a continuous outcome measure into a dichotomous outcome measure might result in information loss [25]. To further investigate this issue, we developed an additional prediction model introducing the DHI as a continuous outcome (see appendix 2 of chapter 4). The new prediction model with DHI as continuous outcome consisted of nine predictors, including three predictors that have been previously associated with dizziness: standing still as provoking factor, a history of cerebrovascular disease and falling [15,17-19]. In both the model with DHI as dichotomous outcome and DHI as continuous outcome, the variables DHI-s, age, and looking up as provoking factor were the strongest predictors, confirming the robustness of the original prediction model with DHI as dichotomous outcome. We believe that a prediction model with DHI as dichotomous outcome is the most useful for daily clinical practice because with this model it is much easier for a general practitioner to interpret the outcome; a patient is at high risk or at low risk of an unfavorable course of dizziness.

We also investigated long-term (7 and 10 years) predictors for regular dizziness in older community-dwelling adults (chapter 5). Only two studies have previously investigated risk factors for dizziness in older patients in a prospective cohort study with 6 months follow-up [17], and 6 years follow-up [18], respectively. Concluding, we therefore believe that our study has provided important new information on long term prognosis of dizziness, potential contributing factors to dizziness and potential pointers for the management of dizziness in older people. In chapter 5 we stated that the identified predictors for dizziness are potential contributing factors to dizziness, i.e. risk factors for development of dizziness. However, our study was not designed to investigate causality and one could question whether this statement is justified. The best study design to identify risk factors for developing a disease is a clinical experiment but this is not possible in most situations because of moral or practical issues [26]. Second best is a prospective cohort study, ideally with a long follow-up period. Even with results from a prospective cohort study, the causal relation between risk factors and subsequent development of a disease is never 100% sure [26]. Yet, there
are several aspects that make a causal association more plausible: validity and generalisability of the study, biological plausibility, a time relation (i.e. the factor is present before the development of dizziness), magnitude of the association and consistency between results of different studies [26]. Our study on long-term predictors of regular dizziness does not fully meet the requirement of a time relation; at 7-years follow-up 47 of 129 patients were suffering from ongoing (≥ 7 years) dizziness and at 10-years follow-up 28 of 73 patients were suffering from ongoing (≥ 10 years) dizziness. When we take a look into the consistency aspect, comparing the identified predictors for dizziness in our study and the two previous studies [17,18], there are three factors that were identified in at least two of the three studies: living alone, history of dizziness and depression. Therefore, based on the current evidence, living alone and depression seem to be the most important risk factors for long-lasting dizziness.

**A prognosis-oriented approach for dizziness (the RODEO study)**

*Ineffectiveness of a prognosis-oriented approach for dizziness*

In the RODEO study we established that a prognosis-oriented approach with a multifactorial risk factor guided intervention was not effective in reducing dizziness-related impairment. In this paragraph we will elaborate on potential explanations for the absence of effect of the RODEO study.

The aim of the multifactorial intervention was to reduce dizziness, by targeting risk factors for an unfavourable course of dizziness. Yet, for two out of the three RODEO interventions, the impact on the targeted risk factor proved to be ineffective. FRID medication adjustment significantly reduced the number of prescribed FRIDs but stepped mental health care and exercise therapy failed to influence the presence of anxiety disorder and depression and impaired functional mobility, respectively. Although FRID medication adjustment significantly reduced the number of prescribed FRIDs, the magnitude of the effect might have been too small to reduce dizziness: on average the intervention achieved to reduce the number of prescribed FRIDs with 0.5 FRID only. An intervention able to realize a bigger reduction of number of prescribed FRIDs might positively influence dizziness. The RODEO study thus showed that reducing number of prescribed FRIDs proved ineffective in improving dizziness-related impairment but it remains unclear whether a multifactorial intervention, with effective impact on all its risk factors, would affect dizziness symptoms.
The ineffectiveness of the multifactorial intervention might also be due to the fact that the targeted risk factors of an unfavourable course of dizziness, i.e. significant dizziness-related impairment at 6-months follow-up, were based on only one study [15]. Although two other studies identified polypharmacy [17], and problems in walking and history falling as predictors of dizziness as predictors of dizziness [17,18], the body of evidence for the targeted risk factors in the RODEO study is small. Ideally, the risk factors for dizziness should have been identified in more studies because this would give more certainty. In chapter 5 we present a prediction model for long-term regular dizziness, confirming presence of anxiety/depression and impaired function of the lower extremities as predictors of dizziness. We also performed a prediction study on risk factors for an unfavourable course of dizziness with data from the RODEO study (chapter 4). This study did not conform previous identified predictors for an unfavourable course of dizziness or regular dizziness [15,17,18].

Finally, inadequate power might be an explanation for the ineffectiveness of the multifactorial intervention. The RODEO study aimed to include 200 patients, 100 patients in the intervention group and 100 patients in the control group. However, we were unable to include 200 patients in our intervention study and included 168 patients instead: 83 patients in the intervention group and 85 patients in the control group. However, the study had sufficient power to rule out a clinically relevant difference on the primary outcome (11 DHI points) between intervention group and control group.

Other notes regarding a prognosis-oriented approach for dizziness

As mentioned before, we observed a low uptake of and adherence to the stepped mental health care intervention and the exercise therapy intervention in the RODEO study. Looking back at designing the study, we may not have given enough attention to the vulnerability of our target population. Before the start of the study, patient information and questionnaires were checked on length and intelligibility by two former participants of the Dizziness In Elderly Patients (DIEP) study. Yet, we did not ask them about the feasibility of the separate components of our multifactorial intervention. We may have been too naïve to think that dizzy older patients would be able to visit the mental health nurse practitioner and/or the physiotherapist frequently in a short period of time.

During baseline assessment of the RODEO study a lot of patients have asked us whether there was a pill available that would stop their dizziness. The fact that many patients asked about a ‘magic pill’, together with the low uptake of and
adherence to stepped mental health care and exercise therapy, brought us to the idea that investing a lot of time and effort to get rid of their dizziness was too much of a burden for a substantial number of dizzy patients. It is important that researchers are aware of the fact that their ideas of a new promising intervention might not match the preferences of the target population. Furthermore, because of the fact that a lot of patients asked for a ‘magic pill’ in our study, in daily practice general practitioners should manage the expectations of older dizzy patients regarding diagnosis and successful treatment by informing them about the uncertainty and unpredictability of dizziness.

As mentioned above, we were able to include only 168 participants in the RODEO study, instead of the 200 participants we planned to include according to our sample size calculation. The phenomenon that recruitment of patients takes much more time than estimated by the investigators is known as ‘Lasagna’s law’, named after the American clinical pharmacologist Louis Lasagna who first described this problem. Lasagna observed that when trial recruitment starts, the supply of suitable patients becomes a fraction of what it was assumed to be before the trial began [27]. In 2007, Dutch researchers established that Lasagna’s law also holds for recruitment of patients in Dutch general practice and presented a number of recommendations to increase the chances of successful recruitment [28]. While designing our study we tried to implement most of these recommendations, including (1) recruitment of general practitioners for our study via primary care research networks and general practitioner alliances, (2) simple inclusion and exclusion criteria, (3) identification of eligible patients both by general practitioners during consultation and through searches in the general practitioners’ electronic medical records, and (4) minimising the recruitment work for the general practitioners and assistants. Initially we intended to recruit all our study patients in one year. However, we achieved to include only 122 patients after one year. Therefore, we decided to prolong our recruitment period with seven extra months and planned to recruit extra general practitioners to participate in our study. Yet, it turned out to be very difficult to find new general practitioners willing to participate in our study: of 250 approached general practices, only nine decided to participate. Most of the general practitioners who responded to our request recognised the importance of our study but felt they were too busy to participate or told us they had no affinity with scientific research. Trouble with finding general practitioners willing to participate in scientific research seems to be a growing problem in the Netherlands. Recently, Opstelten et al. stated that it is getting harder to motivate general practitioners to participate in scientific research [29].
can probably be explained by the increasing workload of general practitioners caused by an ageing population, a shifting of responsibilities from secondary care to primary care and more paperwork [29]. As clinicians, we understand that patient care is core business and always comes first. However, we believe that scientific research in general practice is essential and deserves more attention to improve and support evidence-based general practice. Already in 2012, one of the stated ambitions of The Future Vision for General Practice Care 2022 was that each general practice structurally contributes to education, research or innovation [30]. We believe it is important to motivate general practitioners to participate in scientific research. This might be achieved by actively involving general practitioners in initiation of new research, including the decision on which topics new research should focus on. Furthermore, the work load for participation in research should be minimised for the general practitioners, for example with the help of research nurses in the practices. Also, general practitioners might be rewarded with accreditation points when participating in scientific research.

METHODOLOGICAL CONSIDERATIONS

In the interpretation of the results described in this thesis, several methodological considerations should be taken into account. The most important issues are described in this section.

Study designs
In chapter 2 we describe a qualitative study with semi-structured interviews. As compared to quantitative research, the aim of qualitative research is generally to seek answers to questions about the ‘what’, ‘how’ or ‘why’ of a topic; there is a need to understand more about a phenomenon, rather than ‘measure’ it [31]. By purposely applying their observations, communication and interpretation, the researcher is able to gather new insights [32]. Consequently, the advantage of qualitative design is that it helps to provide depth and detail of the topic of interest at an individual level instead of at group level and it can reveal new topics not initially considered. Analysis of the results is subjective which might be seen as a limitation of the study design by critics. In our study, all interview analyses were carried out by two researchers independently to achieve intersubjective agreement and improve reliability of our findings [31]. Furthermore, we endeavoured to maximise the trustworthiness of our qualitative study by the following procedures: a topic list was used to guide the interviews; interviews
continued until saturation was reached; categories were created in discussion sessions with four authors; all participants were asked for a member check.

We performed a retrospective database study to establish prevalence, diagnosis and current management of dizziness in general practice (chapter 3). We used anonymized data from the database of the Academic Network of General Practice of VU University Medical Center (ANH-VUmc). The ANH-VUmc database contains anonymized routine health care data, derived from the electronic medical records of the participating general practitioners. An important strength of using a longitudinal routine care database is that it allowed us to examine health care utilization over a period of time as it occurs in routine general practice. The database we used provided us with a large study population and an adequate observation period. In addition, using a routine care database provided a relatively inexpensive and efficient opportunity for answering our research question regarding general practitioner care for older dizzy patients. It is important to note that the quality of data depends on the accuracy of registration by the participating general practitioners. General practitioners who participate in ANH-VUmc are annually trained on registering and coding of medical data.

For both of our prediction studies we used longitudinal study designs. The longitudinal design allowed us to investigate changes over time, with the certainty that the exposure preceded the outcome. The prospective cohort used for chapter 4 was part of the RODEO study (RODEO prediction study). The cohort study included RODEO participants of the observation group and control group (see figure 1 chapter 8). Thus, none of the participants of the prospective cohort of chapter 4 received the RODEO intervention. By creating our own cohort, we were able to select a specific patient cohort and it enabled us to collect all the information we expected to be important to answer our research questions. Yet, due to a limited amount of time and resources, the cohort is quite small and the follow-up only 6 months.

For chapter 5 we used population-based LASA data. LASA is an ongoing cohort study in older people in The Netherlands. Major advantages of the LASA cohort are the long-term follow-up and the high number of participants in the cohort. An obvious disadvantage of using an existing cohort is that analysis of data is restricted to the variables that have been measured in the cohort study.
For the RODEO intervention study, as described in chapter 9, we chose a cluster randomised controlled design. Randomised controlled trials are generally considered to provide the most reliable evidence for the effectiveness of an intervention because randomisation minimizes selection bias and allocation bias, thus balancing both known and unknown prognostic factors. We applied cluster randomisation at practice level to avoid contamination. Stratified randomisation by list size of older patients in practices was applied to ensure good balance of number of participants in the intervention group and control group.

**Populations**

Sampling procedures of the different populations investigated in this thesis may have influenced the results.

As with all qualitative research, the population of our qualitative study was small. Yet, as prescribed in qualitative research, the number of interviewed participants was prospectively decided upon, based on the moment where saturation of information was reached [31]. Furthermore, we purposely selected a diverse group of participants based on gender, age, participants’ general practitioner, marital status and duration and intensity of symptoms.

The ANH-VUmc cohort contains data derived from electronic medical records of the participating general practitioners of the ANH-VUmc. In the Netherlands, the general practitioner is the gatekeeper in the Dutch health-care system and all non-institutionalised Dutch citizens are registered in a general practice. As a consequence, the investigated ANH-VUmc cohort represents a proper reflection of routine health care in general practice. Yet, the participating general practitioners of the ANH-VUmc are all located in an urbanized area, i.e. greater Amsterdam. With regard to the generalisability of the findings of our study, one might question whether the health care use in an urban population is the same as for inhabitants of more rural areas in the Netherlands.

The LASA cohort consists of a randomly selected population-based sample. As a result, external validity of findings is high. Selective non-response and loss to follow-up is an inevitable problem in more frail and ill older adults. Attrition of respondents may have led to a relatively healthy sample over time. However, attrition in the LASA cohort can be attributed for the largest part to mortality and attrition to refusal, frailty, or no contact is limited [33].
Participants of the RODEO prediction study and RODEO intervention study were purposely selected and all dizzy older participants suffered from significant dizziness-related impairment at baseline. As a result, the RODEO sample might be a subgroup of dizzy older patients suffering more from their dizziness and are potentially more ill than the ‘average’ dizzy older patient consulting the general practitioner. This should be kept in mind when interpreting the findings of the RODEO study. Furthermore, we tried to minimize selection bias by the general practitioner by searching the electronic medical records of all participating general practices. However, before inviting dizzy patients identified in the electronic medical record, the general practitioner always checked the identified patients on the exclusion criteria of the RODEO study with potential (unintended) selection bias by the general practitioner as a result. The large number of patients that did not respond (47%) or declined to participate (55%) might also have resulted in a selected population. Yet, regarding age and gender, patients who declined to participate were comparable to the RODEO prediction study population and the RODEO intervention study population (mean age 77.6, 77.5 and 78.8 years old respectively; female gender 68.5%, 62.6% and 68.5% respectively).

**Measurements**

In the RODEO study dizziness-related impairment was the primary outcome, as measured with the DHI. The DHI is a widely used self-report questionnaire, designed to quantify the impact of dizziness on everyday life. Previous studies showed good construct validity, high internal consistency and satisfactory test-retest reliability [34,35]. For the inclusion of patients suffering from significant dizziness-related impairment and for the outcome of the prediction study we dichotomised the score of the DHI, with a DHI score of ≥30 correlating with significant dizziness-related impairment [15,34-36]. Although dichotomisation at a cut-off of ≥30 DHI points is often used in research on dizziness, only two studies investigated the discriminative ability of this cut-point in two relatively small samples (n=85 and n=119) [35,37]. Yet, both studies presented excellent discriminative ability between participants with and without dizziness-related impairment at a cut-off of ≥30 DHI points [35,37].

For the measurement of dizziness frequency and fall frequency, patients were asked to fill out a calendar weekly for one year. The calendar was similar to a fall calendar used in a previous study [38]. Filled-out calendars provided us with rich data with 52 measures of dizziness and fall frequencies for every participant. However, although we reminded all patients every three months on filling out the calendar, 67 of 150 patients (45%) did not return the calendar at the end of follow-
up of the study. Quality of life (QoL), depression, and anxiety were all measured with validated and widely used questionnaires [39-42]. Measuring depression and anxiety with a diagnostic interview would have been even more accurate. Yet, conducting a diagnostic interview with all participants at all four time points of the RODEO study was not possible because of restricted time and financial resources. Fall Risk Increasing Drug (FRID) use was assessed by the number of prescribed FRIDs at the participants’ pharmacist, but we did not measure the patients’ adherence to the prescribed FRIDs.

As described in our design paper (chapter 8) we also planned to assess the 1-year health care utilisation of all RODEO participants by extracting the general practitioners’ electronic medical records. Unfortunately, we did not succeed in assessing health care utilisation, because extracting the data from the electronic medical records turned out to be much more complicated and time consuming than initially expected.

**IMPLICATIONS FOR PRACTICE**

Based on findings of our qualitative study (chapter 3) we believe it is important for general practitioners to be aware of the fact that many dizzy patients present their dizziness only as a secondary complaint during consultation with the general practitioner. This may give general practitioners the wrong impression that the dizziness-related impairment is only mild. General practitioners need to be aware of this and should actively ask the dizzy patient about experienced restrictions to enable assessing of dizziness-related impact on everyday life. Furthermore, establishing the cause of dizziness seemed to be important for older patients suffering from dizziness. General practitioners should manage the expectations of dizzy patients regarding diagnosis by informing them about the uncertainty and unpredictability of dizziness. Regarding treatment, patients should be informed about the absence of effective dizziness reducing medication and that most therapies are time consuming.

With the risk score presented in this thesis (chapter 4), the general practitioner is able to easily detect older dizzy patients with a high risk of an unfavourable course of dizziness. These patients could be offered impairment reduction strategies. Furthermore, we would like to recommend the 10 item screening version of the DHI (DHI-s) for daily clinical practice because the score of the DHI-s is multifunctional: it helps in predicting the risk of an unfavourable course
of dizziness, informs the general practitioner about current dizziness-related impairment and can be used to monitor treatment effect.

The guideline ‘Dizziness’ of the Dutch College of General Practitioners has recently been revised (2017) [43]. The revised version has an extra focus on dizziness in older patients. As compared to the first version of the guideline (2002) [44], there is more background information on dizziness in older adults and there is more information on potential dizziness inducing medication in older patients in the revised guideline. Furthermore, there are special sections on disequilibrium (postural instability, often described as dizziness by older patients) and non-specific dizziness (dizziness of unknown cause, often the case in dizzy older patients). The guideline advises to apply a ‘systemic approach’ in case of non-specific dizziness, which implies targeting potential contributing factors to dizziness. The results of several of our studies have been included as evidence in the guideline (chapter 3, 6, 7). Given the disappointing outcome of the RODEO study, one might wonder whether this should lead to the conclusion that multifactorial treatment targeting potential contributing factors to dizziness should not be recommended. Possible causes of the ineffectiveness of the RODEO multifactorial intervention are discussed previously in this chapter (page 178). We would not recommend a multifactorial intervention designed as in the RODEO study. However, it is possible that targeting anxiety and depression and impaired mobility with other types of interventions can result in better adherence rates, resulting in reduced dizziness. Also, group physiotherapy instead of individual physiotherapy might have more effect on mobility [45,46], and potentially on reducing dizziness through improvement of mobility.

In the end, we still believe that focusing on impairment reduction as part of a combined diagnostic and prognostic approach is the right strategy in older dizzy patients. This impairment reduction strategy could include multifactorial treatment targeting potential contributing factors, however not necessarily simultaneously. Multifactorial treatment could also be offered in a step-wise approach, potentially gradually increasing to more intensive therapies so that less burdensome therapies are applied first and more intensive therapies are only offered when the preceding therapies would not decrease dizziness symptoms. At the moment, the best evidence for impairment reduction strategies, including which potential contributing factors to target, is probably an impairment reduction strategy as recommended in the guideline for dizziness of the Dutch College of General Practitioners [43]. It is self-evident that the impairment reduction strategy should be tailored to the preferences of the dizzy patient.
IMPLICATIONS FOR FUTURE RESEARCH

Our research contributed to the body of evidence on dizziness in older patients in primary care by providing answers to relevant questions. The findings of our research also raised new research questions. Suggestions for further research are described in the following paragraphs.

Based on the findings of the RODEO study, we have several recommendations for future research with regard to targeting potential contributing factors to dizziness.

First, the baseline interviews with RODEO participants gave us the impression that investing a lot of time and effort to get rid of their dizziness was too much of a burden for a substantial number of dizzy older patients. This might have influenced the uptake and adherence rates of the multifactorial intervention. There is no point of investigating the effectiveness of a new treatment strategy when the offered therapy is too intense for the target population. Future qualitative research could explore the motivation of older patients regarding treatment for their dizziness, including how much time and effort they are willing and able to invest. Furthermore, we recommend to pitch new research ideas to representatives of the target population and also to engage patients in designing new studies.

Second, there is a lack of prognostic studies on dizziness in older patients. As a result, it is unclear which risk factors are the most relevant to target in a prognosis-oriented approach. More studies on predictors of dizziness are needed to confirm the findings of previous studies and to assess which predictors are consistent in most of the studies, and thereby probably the most relevant to target.

Third, the low uptake of and adherence to the multifactorial intervention might also have been a result of the multifactorial intervention being too demanding for our study population. Instead of multifactorial treatment, future research could focus on effectiveness of sequential treatment, e.g. measuring effectiveness of various patient-tailored evidence-based therapies for dizziness in a stepwise approach.
Future research could also focus on other treatment strategies to target dizziness in older people. In the field of fall prevention in older people, a multicomponent cognitive behavioural group intervention resulted in significantly reduced fear of falling, reduced activity avoidance, reduced concerns about falling and increased daily activity [47]. As dizziness in older people is associated with frustration, decreased self-esteem, decreased self-rated health, less social activities, loneliness and isolation [48,49], a cognitive behavioural (group) intervention might also be beneficial for this population. This intervention would not primarily aim to reduce dizziness but could positively influence dizziness beliefs and associated consequences and thereby improving quality of life.

Finally, virtual reality has been a new focus in many research fields the past years. Concerning fall prevention in older people, a number of small studies showed that interactive cognitive-motor interventions improved physical and cognitive factors associated with falls [50]. A lot of the interventions in these studies focused on improving balance and although inconsistent, there have been positive intervention effects on one leg stance, functional reach and timed up and go performance [50]. It would be interesting to investigate whether virtual reality interventions, combining training of cognitive and physical functioning, can positively influence dizziness and dizziness-related impairment in older people.

**CONCLUSION**

With our research, we contributed to the body of evidence on dizziness in older patients in primary care, including prevalence, diagnosis and current management of dizziness, predictors of dizziness, and a prognosis-oriented approach for dizziness. We also gained insight into the effectiveness of a multifactorial risk factor guided intervention for dizziness. We did not find any significant effects of the multifactorial intervention on the primary outcome, dizziness-related impairment, and most of the secondary outcomes. Future research should assess whether our findings can be replicated or may focus on alternative strategies to target potential contributing factors to dizziness. Furthermore, future research may focus on cognitive behavioural interventions and virtual reality interventions to impact dizziness in older people.
REFERENCES


