General discussion

Chapter 7
7.1 Introduction

Two studies were conducted during the nationwide implementation of GALM. First a study on the development and initial validation of the behavioral change model underlying GALM was conducted, which resulted in the thesis of Martin Stevens (2001). The second study, into the effects of participation in GALM on physical activity, health and fitness outcomes, is the present thesis. In this concluding chapter, findings and points of discussion from the preceding chapters concerning theoretical and methodological considerations will be discussed. Finally, implications for public health and future research are described. However, first an overview is provided of the main findings of the preceding chapters.

7.2 Summary of main findings

Chapter 2 addressed the effectiveness of the GALM recruitment strategy with sedentary and underactive older adults as starting point of the study on the effects of participation in GALM on physical activity, health and fitness. The results showed that of the 12.3% of older adults who were included, 79.4% could be indeed considered sedentary or underactive. This implies that the GALM recruitment was successful in selecting and recruiting sedentary and underactive older adults.

Chapter 3 described the background and intensity of the GALM physical activity program. The results revealed that the GALM program, which was versatile and multi-dimensional in nature and contained all sorts of recreational sports activities (e.g. softball, dance, self-defense, swimming and athletics), was able to meet the intensity guidelines to enhance cardiorespiratory fitness as recommended by the ACSM (1998).

Chapters 4 and 5 report on the six- and twelve-month effects of participation in GALM on physical activity, fitness and health, respectively. In general, the effects after six months showed that there was an increase in EE_{RECSPORT} and EE_{LTPA} in the intervention as well as in the control group. These latter results may indicate that the control group participants were primed by the attention that accompanies the recruitment and the fitness measurements. Furthermore, only few significant between-group differences were found favoring the intervention group (sleep, fitness score, diastolic blood pressure and grip strength). However, both study groups demonstrated many significant improvements in the performance-based fitness outcomes and several health indicators over time.
The results after twelve months illustrated a continuous increase in $E_{RECSPORT}$ which was reflected by significant time effects in performance-based fitness outcomes. A decline for $E_{LTPA}$ in the intervention group from 6 to 12 months was found that could not be explained by seasonal influences. This may reflect a compensatory mechanism also found in other studies — that doing more intensive physical activities (i.e. sports) is compensated by a decrease in the level of other physical activities among older adults. No noteworthy effects in health indicators were found. In summary, GALM demonstrated to have only a short-term effect on leisure-time physical activities and health outcomes. Positive long-term effects were found for recreational sports activities and performance-based fitness outcomes.

Chapter 6 addressed the changes in heart rate during fixed submaximal exercise after 18 months of participation in the GALM recreational sports program as a marker of aerobic endurance. The results showed that there was a significant main effect for time, implying that heart rate during fixed submaximal walking performance at 4, 5, 6 and 7 km/h decreased. This significant decrease in heart rate reflected an increase in cardiovascular function after 12 to 18 months of participation in GALM.

When combining the results from Chapters 2 to 6, it can be concluded that participation in GALM increased $E_{LTPA}$ in the short term (6 months) and $E_{RECSPORT}$ in the long term (12 months). This was reflected in short-term effects of the health measures that diminished later on. In line with the increase in $E_{RECSPORT}$ in the long term, positive changes in performance-based fitness occurred over a longer period of time (i.e. cardiovascular function).

7.3 Theoretical considerations
This thesis contributes to a clearer understanding of the effects of a multi-modal recreational sports program on physical activity, health and fitness in sedentary and underactive older adults. Theoretical considerations regarding the effects on physical activity, health and fitness will be discussed in the remainder of this section.

Effects on recreational sports and leisure-time physical activities
From Chapters 4 and 5 regarding the 6- and 12-month effects of GALM, respectively, it can be concluded that the GALM program was able to increase energy expenditure for leisure-time physical activities probably only from baseline to 6 months, and for
for recreational sports activities from baseline to 12 months.

The increase in energy expenditure for recreational sports activities could be partly explained by participation in the GALM recreational sports program, so the remaining amount of energy increase was caused by recreational sports activities conducted in addition to GALM. This indicates that GALM was able to stimulate recreational sports activities over a 12-month period.

With respect to energy expenditure for leisure-time physical activities, Chapter 5 shows that some sort of compensatory mechanism took place. The intervention group demonstrated an increase in leisure-time physical activities from baseline to 6 months, however from 6 to 12 months a compensatory decline was found which could not be explained by seasonal influences. Whether these changes in leisure-time physical activities also occurred in the control group, which after a 6-month waiting list period was no longer a real control group, remains unclear.

In his review entitled "Physical activity as determinant of daily energy expenditure", Westerterp (2008) found similar results to GALM regarding the fact that an increase in more intense forms of physical activity (e.g. sports, exercise-training) go along with a compensatory decline in other daily physical activities. In the review of Westerterp (2008), the study by Goran and Poehlman (1992) demonstrated no change in total energy expenditure among healthy older adults (ages 56-78) in response to endurance training. One of their explanations was that the level of exercise, increasing to 85% of VO\textsubscript{2}max, was too vigorous and thus fatigued them for the rest of the day. Meijer et al. (1999 & 2000) also found that a training program (50% of heart rate reserve) in older adults (ages 55-68) did not increase the total daily physical activity level. On training days, persons showed a significant decrease in non-training activity. Although this program decreased non-training activity, a significant increase in maximal oxygen uptake of approximately 8% was observed together with a significantly reduced heart rate during exercise at submaximal intensity. This last finding reveals a paramount parallel with GALM in that a compensatory decline in leisure-time physical activity was found together with a significant decrease in heart rate at submaximal exercise from baseline to 18 months. Some differences between the studies mentioned by Westerterp (2008) and GALM must be taken into account though. The interventions described by Westerterp were conducted over a shorter period of time (12 weeks) and were exercise training programs in nature, while the GALM program contained recreational sports activities. Furthermore, the
energy expenditures values in the GALM study were derived from physical activity questionnaires vs. accelerometers in the studies described in the Westerterp review.\(^3\)

In conclusion, the aforementioned assumption as stated in Chapter 1 that GALM may cause a transfer towards physical activity besides the GALM program is true regarding recreational sports activities, but must probably be rejected for leisure-time physical activities.

**Effects on health-related and performance-based fitness outcomes**

As described in Chapter 3, the GALM recreational sports program can be characterized as follows: a) frequency of once a week; b) duration of 60 minutes per week; c) is versatile and contains recreational sports activities; d) moderate to high intensity. From the results of Chapters 4, 5 and 6 it can be concluded that participation in the GALM program led to several favorable changes in performance-based fitness outcomes but no clear effect in health-related fitness outcomes.

The increases in performance-based fitness outcomes go along with the continuing increase in energy expenditure for recreational sports activities that were observed from baseline to 12 months. The significant decrease in heart rate at submaximal intensity as an indicator for cardiovascular function reported in Chapter 6 is also very promising and relevant. Despite the fact that the study participants grew older, they demonstrated on average a clear and significant decline in heart rate during submaximal exercise, indicating that the activity became lighter for them. The studies of Meijer et al. (1999 & 2000) demonstrate comparable results with respect to aerobic endurance in that, apart from the aforementioned compensatory decline in leisure-time physical activity energy expenditure, the observed older adults reported a favorable decline in heart rate during submaximal exercise.\(^{5,6}\)

Toraman (2004) described the effects of a multi-component training program on functional fitness in older adults aged 60-86 and found increases in upper and lower body strength, aerobic endurance and agility/dynamic balance but no effects on body composition.\(^7\) Although a different definition of fitness was used in the Toraman study, his findings confirm the results found in the GALM study, as significant results were found in what is described in the GALM study as performance-based outcomes. A plausible explanation for only finding significant increases in performance-based fitness outcomes and no significant favorable changes in health-related fitness outcomes could be as follows. The ACSM 1998 position stand states
that potential health benefits can occur as a consequence of regular exercise performed more frequently and for a longer duration but at a lower intensity level than recommended to increase fitness. From the results of other studies and this thesis it seems that participation in multi-component physical activity programs like GALM may not sufficiently increase the total amount or volume of physical activity necessary to cause favorable health-related changes. However, the intensity and specificity of physical activities conducted in multi-component programs which have been reported as important training variables for increasing performance-based fitness outcomes (e.g. strength, aerobic endurance, flexibility) were sufficient.

GALM was based on the 1995 ACSM/CDC and 1998 ACSM recommendations. In 2007 the ACSM and the American Heart Association (AHA) published an updated recommendation on physical activity and public health for adults in general, and a companion recommendation for older adults. The 2007 ACSM/AHA recommendation for adults provided an update of the 1995 ACSM/CDC recommendation. Although fundamentally unchanged from the 1995 recommendation, key issues (such as frequency and incorporation of vigorous-intensity physical activity) were more clarified and therefore improved the recommendation. This 2007 ACSM/AHA recommendation for older adults was also extended by the following: a) combinations of moderate- and vigorous-intensity activity can be performed to meet the total amount of physical activity recommended to improve and maintain health; b) additional muscle strengthening activities should be performed; c) additional flexibility activities should be performed; d) activities that improve balance should be performed. Despite the fact that GALM was developed earlier than the publication of the 2007 ACSM/AHA recommendations for older adults, it can be concluded that the GALM recreational sports activity program, with respect to a multi-modal nature, meets these updated recommendations that promote such an approach. The GALM recreational sport program combines moderate- and more vigorous-intensity physical activities, and because of its multi-modal nature pays attention to strength, balance and flexibility. From that perspective, GALM and other multi-modal physical activity programs can be considered as interesting, effective and attractive alternatives for future interventions aimed at stimulating physical activity in sedentary and underactive older adults.

To also improve health-related fitness outcomes, additional actions should be promoted that lay more emphasis on increasing overall daily physical activity (individualized goal-setting for other physical activities, regular
self-monitoring of targeted activities, reinforcement for reaching goals, behavioral skill building, etc).

7.4 Methodological considerations

Internal validity
In longitudinal observational and intervention studies it is almost inevitable that some outcomes will be unobserved or subjects will drop out of the study.  

In the GALM effect study, a relatively high attrition rate occurred (Chapters 4 and 5) even though all sorts of preventive and reparative actions were undertaken to counter this (e.g. newsletter, phone calls). A major reason for the high attrition rate was that at each wave, measurements consisted of a questionnaire and test session. In practice, participants often missed one or more questionnaire and/or fitness test sessions due primarily to factors such as lack of time or inability to appear at the test session. Another aspect was the dropouts. If the dropout of subjects were to be selective, the results found would not be representative of all participants eligible for GALM. Still, comparison between dropouts and the GALM participants who stayed verified that no significant differences regarding main characteristics and outcome measures appeared at baseline. Reasons for the dropping out were many practical issues like illness and change of accommodation, time schedule for the sessions, and trainer.

Inappropriate handling of the missing data like deleting cases with missing data or ad hoc imputation techniques (e.g. last observation carried forward) may result in misleading conclusions. Therefore multiple imputation procedures and multilevel analyses were conducted. Both methods are well-accepted and used in cases where missing data in longitudinal datasets occur under the restriction of certain statistical assumptions. Since this was true for the GALM effect study, the internal validity of this study can be considered sufficient.

External validity
A strong point of the GALM study is that the results and conclusions are highly representative and generalizable to the Dutch population of sedentary and underactive older adults, since it was conducted in a real community-based setting. The study participants were recruited in three municipalities representing three of five degrees of urbanization that are applied in the Netherlands: (1) highly urbanized municipality category 1;
(2) middle-level urbanized municipality category 3; (3) rural municipality category 5. Furthermore, the recruitment strategy and recreational sports program in this study was an exact copy of how they are conducted in regular GALM projects. The feasibility of the recruitment strategy and the GALM recreational sports activity program together with the scale on which GALM has been implemented make this study unique. To our knowledge, no comparable study on the effects of such a broadly implemented strategy with the aforementioned characteristics has been described in the literature so far.

**Waiting list control group**

For ethical reasons, control group participants were placed on a waiting list for only a short period of 6 months. Results after 6 months of GALM (Chapter 4) revealed that control group participants also increased their energy expenditure level for recreational sport and other leisure-time physical activities. These results seem to indicate that the waiting list control group participants were motivated and prepared to participate in GALM. This priming was probably caused by the intensive door-to-door recruitment and other forms of attention like the interview and fitness test which also have been reported in others studies.  

One plausible theory for the increase in physical activity, health and fitness outcomes favoring the intervention group not reaching level of significance may be this priming effect. The priming and the fact that the control group participants also started being physically active in GALM after their waiting list period resulted in no real control group being available after the 6-month study period, which is a limitation of this study.

**Measurement of energy expenditure for physical activity**

The self-reported estimated energy expenditure data that was collected by means of the Voorrips physical activity questionnaire for the elderly showed that very large standard deviations appeared, indicating a broad range in energy scores at the group level. The small differences in energy expenditure scores for physical activity combined with the large standard deviations may be a reason for not finding significant between-group differences and relations with health and fitness outcomes. This is especially relevant with respect to the measurement of other leisure-time physical activities. From that perspective, the pattern from our study results — GALM not having a clear effect on health — may be a consequence of this.
However, the data cannot provide us with more information on this relation. On the other hand, validation studies show that physical activity questionnaires compiling information on high-intensity activities like sports are more reliable than questionnaires on other types of physical activities, since older adults can recall these activities much better. \(^{21}\) Therefore, the significant increase in EE\(_{\text{RECSPORT}}\) and the consequent increase in fitness outcomes could be considered an important and reliable finding. For future studies comparable with GALM, more objective and sensitive measures for assessing (small) changes in physical activity levels that could be already relevant in this target group are promoted (e.g. accelerometers). \(^{22}\)

**Measurement of health and performance-based outcomes**

In this study a compromise was made between measures necessary to detect in a valid and reliable way (small) changes caused by participation in GALM and feasibility for large-scale use and authenticity of GALM. This resulted in measurements of health and fitness-related outcomes that were originally part of the fitness test (GFE, Groningen Fitness Test for the Elderly) as conducted in GALM, extended with bio-impedance, timed chair-stand and functional reach.

The study was designed to include 144/192 participants in the intervention and the control group, respectively, taking into account an expected dropout percentage of 20% and 40% with an alpha of 5% and a power of 80%. From the actual dropout rates it becomes clear we did not manage to realize the expected numbers of inclusion and dropouts.

The lower numbers of participants (*Chapters 4 and 5*) combined with the restricted sensitivity of especially the health measurements may have resulted in (small) changes remaining undetected or not reaching level of significance. For instance, in the GALM study body fat was predicted by means of bioelectrical impedance (BIA) measurement. BIA is widely used to estimate body composition because it is simple, quick and cheap, and has potential epidemiological value. \(^{23}\) Regarding the restricted numbers of participants included in our study, it is questionable whether BIA was still a reliable measure to predict percentage of body fat and detect possible (small) changes in body fat. The same parallel can be drawn for electronically measured blood pressures. Since the chosen health-related measures suffered from the sensitivity and study-size issue, this may also be a reason for not finding significant changes in health outcomes.
7.5 Implications for public health and future research

The present thesis revealed that participating in the GALM recreational sports program leads to longitudinal increases in energy expenditure for recreational sports activities and performance-based fitness in sedentary and underactive older adults. No clear increases in leisure-time physical activity or health-related outcomes were found over a longer period of time.

To our knowledge, this study is the first to investigate the effects of a strategy containing a recruitment strategy that was feasible for community-based purposes on a large scale and a multi-modal recreational sports activity program for physical activity, health and fitness outcomes in sedentary and underactive older adults. Knowing that this group forms a growing cohort in Western societies that can profit highly from becoming physically active and feel attracted to a program like GALM makes it a very relevant objective for future studies.

From our experience, the following recommendations for future initiatives and research can be made. An important finding from this study was the effectiveness and feasibility of the door-to-door GALM recruitment strategy. This type of recruitment is a very useful and effective tool for future community-based strategies and other target groups.

Another recommendation would be to develop a more differentiated program after the GALM recruitment, since not all older adults have the same needs, wishes or functional capacities. Already successful examples are individual programs like COACH for older adults who do not want to participate in group-based programs. There is also an opportunity for older adults with chronic diseases or limitations to join a group-based program entitled SCALA. The multi-modal GALM recreational sports program could also be integrated into national initiatives like ‘Beweegkuur’. This project promotes primary and secondary prevention of diabetes mellitus type 2, a growing problem among older adults over 60 years of age in the Netherlands. Older adults are screened by physicians and subsequently advised to engage in a more active lifestyle. For the segment of older adults that feels attracted to a versatile group-based recreational sports program, GALM could be an attractive alternative.

From this thesis and other aforementioned studies, multi-modal physical activity programs appear to be appealing, feasible and effective toward increasing performance-based fitness outcomes which are relevant for older adults to perform activities of daily living and remain functioning independently. Future studies should further investigate the impact of this type of programs.
Such studies should use more reliable and objective measures to detect changes in amount and nature of physical activity. This could be done by using accelerometers or sensor technology that can not only measure (small) changes in physical activity but also type and intensity of activities.\textsuperscript{27}

The fact that a compensatory decline in leisure-time physical activity appears during GALM does not mean that promoting recreational sports activities among older adults should be restricted, since they have a favorable influence in performance-based fitness outcomes. However, a major challenge remains to also increase other leisure-time physical activities, hence efforts such as integrating individualized goal-setting for other physical activities, regular self-monitoring of targeted activities, reinforcement for reaching goals and behavioral skill-building are recommended to this end.
Chapter 7

References
