1 Introduction

Taking a fall is something that happens in everyone's life more than once. Whether as a child, a teen, an adult or a senior, falling is a constant. But what changes as we mature are the consequences of a fall. For young people, falls are usually harmless while for older people they can often have more serious consequences (Balzer et al. 2012).

Looking at the demographic development in Germany, the senior age group clearly has increased in significance. The birth rate for women in their in child-bearing years has been 1.38 children per female since 2008. Projected into the future, this would mean a shrinking of the German population from 81.752 million people at the end of 2010 to approximately 65-70 million people in 2060 (shown in Appendix 13; Federal Statistical Office Germany, 2009; 2011a; 2012b). This birth rate 'minus' will thus rise from 162 thousand in 2008 to approximately 553 thousand in 2060 (shown in Appendix 14; Birg, 2001; Federal Statistical Office Germany, 2009; 2011a). The current life expectancy at birth is 82.59 years for women and 77.51 years for men, and this will continue to rise until 2060 (89.2 years for women, 85 years for men) (Federal Statistical Office Germany, 2009). By the year 2060 there will be a significant aging of our population. Almost every third person will be older than 65 years and the number of people over 80 will triple (shown in Appendix 15; Birg, 2001; Federal Statistical Office Germany, 2009). The proportion of older people will thus almost double if conditions remain the same until the year 2060 (Birg, 2001; Federal Statistical Office Germany, 2009). In terms of emigration, a long-term average of between 100,000 and 200,000 persons are assumed until 2060 (Federal Statistical Office Germany, 2009). This national development can be observed internationally at similar levels as well. The 80 years and older age group (the oldest old) will be the fastest growing age group worldwide until the year 2050.

Today, there are approximately 109 million people worldwide who are in this age group, which corresponds to 1.6% of the world's population. By 2050, it will have grown to 402 million people (4.3% of the world's population) (United Nations, Department of Economic and Social Affairs, Population Division, 2011; United Nations Population Fund (UNFPA), 2012; Birg, 2001; Schirrmacher, 2004).

Our society is facing great challenges as a result of these demographic changes, particularly in the context of health, prevention and rehabilitation for those in the senior age. Expenditures for health in Germany for 2009 reached 278.3 billion euros. These health expenditures include services and goods employed with the goal of prevention, treatment, rehabilitation and care as well as investments in health facilities. It also includes medical preventative exams and medical care services for those needing them in nursing home facilities (Federal Statistical Office Germany, 2011b). The costs which resulted from illness for the year 2008 reached a total of 254.3 billion euros. When the costs are distributed across age groups, it can be seen that 48.4% of health care costs stem from 20.3% of the total population, which is primarily the group of people 65 years old and older. Morbidity plays a significant role in this context; above all, the steadily increasing multi-morbidity with increasing age plays a role (Federal Statistical Office Germany, 2010). This is particularly obvious when looking at the 85-years-and-older age group. In 2008, 10.3% of the total costs were attributed to 2.2% of the general population. In general, more of the health care costs are attributed to women than to men across all age groups except the under-15-years-old group (Federal Statistical Office Germany, 2010). With this current situation as background, it can be seen that simply extending the life expectancy of people in Germany will no

longer be the focus of attention in the future. Instead, it will be necessary to provide this additional lifespan with the best possible health-related quality of life. The goal for the existing social and health system is of exceptional relevance for reasons which are both individually specific and economic.

The question of increased health-related quality of life for seniors is faced with the problem of the very limited research which has been done on the topic and accompanying data. If one considers life conditions and quality of life for those of advanced age, it can be seen that the determinants of its quality are the basic physical, psychic and social states of being, i.e., the general state of physical health, the available mental capacities and the changes in social conditions which are typical for this age group (loss of partner, relatives and friends, moving to a retirement center or assisted living facility) (Federal Ministry for Family, Senior Citizens, Women and Youth (BMFSFJ) 2002;

2005; 2010). The problem of morbidity and multi-morbidity plays a large role in aging when evaluating and determining the quality of life. Old people suffer from one or more, usually chronic and ofter painful, diseases with a high rate of probability. Dementia-related diseases which entail a loss of perception, memory and logical thinking skills are a particular risk for quality of life (Baltes, 1993). Studies indicate that satisfaction with life and quality of life remain highly individual up into an advanced age (Staudinger et al., 1996). Integrative approaches towards evaluating life conditions have guided current research; in other words, both subjective and objective aspects are taken into account when determining the life conditions of a subject (Noll &Schöb, 2001; Erikson, 1974; Filipp, 2001). This approach integrates both objective and subjective features into one concept instead of viewing them as congruent. Both material and immaterial, objective and subjective, and individual and collective aspects flow thereby into such a multi-dimensional approach (BMFSFJ (Federal Ministry for Family, Senior Citizens, Women and Youth), 2002; 2005; 2010).

In contrast to other countries, the senior group in Germany, however, has not held any particular significance in science and research when measured in terms of public health-related relevance up until now. In the USA, for instance, there is an institute specifically dedicated to this target group. The National Council on Aging in Bethesda, Maryland is one of 27 institutes and centers run by the U.S. National Institute of Health (NIH). The NIA has become the leading institute for research on Alzheimer's (NIA, 2005). In Germany, such a dedicated institute for research on aging does not yet exist. The concerns of seniors fall under the competencies of the Federal Ministry for Family, Senior Citizens, Women and Youth. In addition to national research centers on aging, such as the clinic for geriatric rehabilitation at the Robert Bosch Hospital in Stuttgart as well as the geriatric center Ulm/Alb-Donau (which is part of the University Clinic Ulm), there are also international research projects and cooperations between researchers such as the PROFANE group (Preventions of Falls Network Europe). In 2009, a national bundling of institutions, measures and engagements, which came about through the research on falls, resulted in the Federal Campaign for the Prevention of Falls (*Bundesinitiative Sturzprävention*). The campaign brings together researchers and experts in the area of fall prevention, on the one side, and the health insurers on the other, along with sports associations and other non-profit groups. The existing scientific knowledge and the practical experience from these various perspectives can be effectively utilized for implementing preventative fall measures. The Federal Campaign for the Prevention of Falls pursues the common objective of implementing support for groups active in ambulant fall prevention

(Federal Campaign for the Prevention of Falls, 2009).

1.1 Subject of Study

Currently there is a variety of intervention measures to prevent falls among seniors at both the national and international level. These measures exhibit a large variety and range from individual measures in the physical, mental and social area to the improvement of motor functioning and modifying a subject's living environment, both interior and exterior, to multifactor and multi-modal intervention measures. However, measuring the efficacy of these various measures remains limited so far and, in fact, many of them have not even been evaluated. Furthermore, the specific development of the target programs and an exact target-group orientation has just begun. For the most part, an adaptation of already existing programs is attempted which, however, does not do the existing problem justice. The more specifically tailored the goals, contents and methods of a program are to the specific target group, its individual living context and its particular conditions, the better the chance for an intervention to be successful.

The subject of study for the present dissertation project is the analysis of a therapeutic movement program called *Drums Alive / Golden Beats* which is specifically for the senior age group. In particular, the potential for having an influence on the fall behavior of older people who are living independently are evaluated. *Drums Alive / Golden Beats* is a preventative program that combines rhythmic training with movement forms for overall strength and cardiovascular training. It is assumed that, at the same time, it has a very strong influence on the cognitive functional area since the coordination part of the abilities trained are very large. The new approach in *Drums Alive / Golden Beats*—which is the musical-rhythmic stimulation of physical, psychic and social aspects of well-being—has not yet been applied in research on fall prevention. Drumming as a form of rhythmic articulation, communication in social groups and style of emotive expression for seniors should be researched as a new form of physical activity and its possible effects on preventing falls examined. Since *Drums Alive / Golden Beats* is a fairly new form of physical athletic movement, very little scientific research and findings exist for it. When combined with research on fall prevention, there is an enormously limited amount of data and findings. Intervention measures with *Drums Alive / Golden Beats* for older people thus has a pilot character in the context of fall prevention research. Within the context of the present work, the question is the extent to which participating in a Drums Alive program can influence the fall and stumbling frequency among the corresponding target group. Of interest here is how the relevant physical, mental and social parameters related to falls are changed by participating in a prevention program developed specifically for seniors. Of particular interest here are the effects on the motor and cognitive parameters, the physical activity, the evaluation of certain sensory functions and social parameters for the target group. Furthermore, whether and when, and to which extent, the effects of participating in the intervention are sustainable should also be investigated.

2.5.1 Drumming / Dance / Gymnastics / Music

The research and studies situation in the area of drumming is not very extensive or straightforward, especially in regards to athletic drumming or the use of it in the area of prevention or rehabilitation. The following provides an overview of the existing studies and a short inventory of research in the area of music/dance/gymnastics.

Remedios et al (2009) researched the verbal and nonverbal communicative behavior of Macaque monkeys and found that they used the conspicuous sounds created by drumming as a nonverbal means of communication to supplement their verbal

communication.

The researchers could also show that both the verbal and nonverbal communication was controlled by two temporally overlapping brain networks. The non-verbal drumming is used by the Macaque monkeys in very differentiated and graded nuances ranging from strong crescendos to softer tones and very often in connection with verbal expression as a sign of social dominance and emotional expression towards their peers which can be seen in the interconnectedness of the areas of the brain. Remedios et al. (2009) was able to show the origins of the drumming and the purposes for which it was used based on the primate's behavior. Drumming has been one of simplest forms of communication since the Stone Age and still retains a broad and significant spot in ceremonies and rituals today as well as its medicinal or healing purposes, which is an indication of the value that has been attributed to it for health (Hamel, 1976).

Drumming has an important position within the context of music therapy, something Boso et al. (2007) has been able to verify with studies. It showed the positive psychological aspects of music therapy (52 weeks) using integrated drumming in addition to singing and piano for autistic patients whose symptoms significantly improved after the intervention.

The effect of the drumming on the synchronization of both brain hemispheres and an increased delta wave production as well as better recuperation through relaxation could be shown among persons with drug addiction by Winkelman (2003).

Smith and colleagues (2008a; 2008b) studied the physiological effects of playing drums within the context of the Clem Burke Drumming Project and found that the stresses (energy consumed, heart rate, oxygen intake, subjective perception of stress) during rock music drumming were comparable in areas to those of high-performance sport.

Clark et al. (2011) researched the physical stress of piano music students while playing in order to research the relevance of the musicians' physical fitness level in addition to the already well-researched mental stress. The heart rate and oxygen intake were measured during playing. Based on the varying intensity within the different music pieces, the researchers found that the player's energy consumption while playing was intermittent and not a straight-forward progression. Clark et al. (2011) compared the energy stress level while playing the piano with that of a brisk walk but, during the peak stress periods, with that of rock music drumming (Smith & Draper, 2008a; 2008b).

Ho et al. (2011) researched the social-psychological effects of drumming on a group of children (10-12 years old) who came from low income groups and who were up to 90% of Latino origin. The group was taught and trained rhythm, listening, emotional processing and group-building skills as part of a weekly drumming group that met over a period of 12 weeks. At the end of the intervention, comparison with the control group showed that the intervention group had significant improvement when dealing with general problem solving, when internalizing problem solutions, during depression, anxiety and withdrawal, attention deficit and hyperactivity problems, post-trauma stress problems as well as lowered and slower comprehension. Ho et al. (2011) could show that drumming promotes positive development among youths, contributes to improved student-mentor relationships and thus can also be used as a therapeutic technique in this area.

In their study, Kokal et al. (2011) investigated the question of why people who sing, drum or dance together feel connected to one another. Their research results showed that the brain section responsible for the reward process is activated when people perceive synchronicity while drumming with other people and that the reward signals increase with increasing pro-social behavior with the drumming partner. This provides evidence for the social character of joint drumming and the associated positive emotional effects.

Dancing, in its various forms, has been shown to be one of the most popular forms of physical activity to improve mental and psycho-social functioning particularly among older people. Dancing improves aerobic endurance, strengthens lower extremities, flexibility, balance, postural control, bone mineralization, cardiovascular issues and lowers the frequency of falling (Keogh et al., 2009). A review by Keogh et al. (2009) summarizes the current state of research in the area of the positive effects of dance for older people. Dance, as a form of physical activity, was shown in particular to improve balance and reduce the risk of falling (Judge, 2003). This seems to be based on the fact that many types of dance can be compared with Tai Chi, many turns are practiced and relatively high heart rates, high metabolism and subjective stresses are reached (Keogh et al., 2009). The studies analyzed in the review covered a broad range of dance forms, such as, for example, gymnastics and folk dancing, Turkish line dancing, traditional Korean dancing, Viennese waltzes, aerobic dance, Argentinian Tango, Caribbean dance and traditional Greek dancing. The following improvements for older people could be identified among the various dance programs considered in the review:

- aerobic performance (Hopkins et al., 1990; Eyigor et al., 2009),
- muscle endurance for the lower extremities (Eyigor et al., 2009; McKinley et al., 2008; Young et al., 2007),
- muscle strength for the lower extremities, Eyigor et al., 2009),
- flexibility of the lower extremities (Hopkins et al., 1990),
- static balance (Hopkins et al., 1990; Eyigor et al., 2009; Federici et al., 2005; Hackney et al., 2007; Young et al., 2007; Sofianidis et al., 2009),
- dynamic balance (Hopkins et al., 1990; Federici et al., 2005; McKinley et al., 2008; Young et al., 2007; Sofianidis et al., 2009),
- gait speed (Hackney et al., 2007; McKinley et al., 2008; Eyigor et al., 2009),
- bone mineralization in the lower extremities (Uusi-Rasi et al., 1999),
- frequency of falling (Jeon et al., 2005),
- cardiovascular risks (Kim et al., 2003; Zhang et al., 2008).

The review is the first of its kind in the area of dance for older people and shows the varied positive effects of such a program.
Trombetti et al. (2011) investigated the effect that a multi-tasking training based on music had on posture, balance and frequency of falling among older people in an RCT. Since falls primarily occur during walking or conditions of dual/multi-tasking, the effects of a six-month training program for 134 independently living people over the age of 65 with an increased risk of falling was investigated. Trombetti et al. (2011), in their RCT, were the first to show that a music-based multi-tasking intervention program, conducted over a period of six months, led to a significant reduction in step length variability under both simple and motor and cognitive dual-tasking conditions among the intervention

group when compared to the control group. An improvement of balance, fewer falls and a lowered risk of falling could also be determined in the intervention group at the end of the intervention. The positive effects also had a sustainable component which could be shown six months after the intervention ended. The intervention comprised a weekly lesson in the Jaques Dalcroze eurhythmics program in which various body movements and exercises were performed under the most varied motor and cognitive dual and multi-tasking conditions, such as, for example, playing percussion instruments or dealing with different types of balls, and which increased in complexity over the period of the intervention, while listening to improvised piano music. At the same time, gait variations were performed to the varying music rhythms and patterns. In addition to the intervention program, all of the participants kept a journal of their falls during the entire 12 month period of the intervention, which is considered a variant of what is currently the largest research evidence in the area (Trombetti et al. 2011).

Kressig et al. had already undertaken research on gait variability under dual-tasking conditions among a group of long-time practitioners (40 years) of the Jaques Dalcroze eurhythmics program in 2005. They were able to show that there was no significant increase in age-related variability of step speed among the Jaques Dalcroze eurhythmics group but, in contrast, that the control group showed a significant increase in their gait variability under dual-tasking conditions.

Granacher et al. (2012) investigated the extent to which an eight-week salsa dance course led to improvement of the static and dynamic balance and strength of leg muscles among older people. According to their study, salsa dancing is a safe and executable exercise program for older people that can reduce the age-related decrease in static and dynamic balance. However, it led to no significant improvement of the gait variability and strength of leg musculature. This could be attributable to the general good level of fitness and mobility among the intervention group.

Shigematsu et al. (2002) investigated the influence of increasing the frequency (three times per week compared to many other studies) of an aerobic-based dance program on balance, strength, motor control and risk of falling among older women. In contrast to the control group, the intervention group showed significant improvement in the target figures after the 12-week intervention program. With this study, improvements of various risk factors for falling could be aimed for without employing any special strength, endurance or balance program but, instead, an aerobic dance program using folk music which had comparable results and was also more fun for the older people. Such a program, when offered at this level of frequency, thus provides fall prevention measures for older people.

Hui et al (2009) came to similar results in their research on the physical and mental effects of a dance intervention on the state of health of older people which could be improved among the participants of the intervention group. They recommend including a dance program in the community course offerings for seniors.

Hamburg & Clair (2003) showed the value of music in neurological music and dance therapy in their research. Based on gait speed and balance among healthy older adults, they tested the extent to which motivating music—adapted and composed specifically for individual segments with the purpose of promoting healthy movement among the target group—had an influence on the target figures. It could be shown that music plays an auditory key role in movement, and that movement is synchronized with rhythm and thus presents a basis for movement control of the lower as well as the upper extremities. The positive effects of the intervention could be determined for the small intervention group. However, to make a more generalized statement, it would need more research with larger intervention groups.

2.6 Intervention Approach of Drums Alive

The research reviewed demonstrates the multifaceted, positive influences that drumming, dance, music, aerobics or movement exercise can have on the physical, mental and social well-being of people. The objective of Drums Alive is to form a unity of these separate components; to create a new kind of rhythmic movement program in which the positive effects of the separate components can be bundled to combine physical activity and music therapy. The results of a study by Wright et al. (2010) allow the conclusion that Drums Alive can be classified as a movement alternative in fitness and recreational sport. Other scientific investigations and research results are currently not available.
The American, Carrie Ekins, is considered the founder of whole-body experience Drums Alive. It arose from Ekins' own pressing health needs. After a hip operation in which she received an artificial hip, she developed drumming on completely different objects first while sitting, then standing, and later while moving into a personal rehabilitation program consisting of strength training, endurance, and a rhythm and movement program (Ekins, 2012a).

2.6.1 Objectives – Target groups

The primary objective of Drums Alive is always a whole-body experience for every individual course participant. The unity of the physical, mental and social components is an essential key within the Drums Alive philosophy. Another objective is to gather experience in moving to rhythm and music while at the same time having fun and pleasure in the movement (Ekins, 2012b).
The physical, mental and spiritually motivating effects of the drumming lead to different medical and physiological effects which are the goals of Drums Alive. This should be achieved through (Ekins, 2008):

- changes in the central nervous system, stimulation of sensory and motor regions of the brain
- drumming in the lower frequency range which leads to brain activation
- synchronization of the brain hemispheres
- stimulation of the alpha brain waves for increased feelings of euphoria and well-being
- increased heart rate and improved circulation in the body
- stress reduction
- release of endorphins
- positive mood, lessening of negative feelings

The goals and effects which are described make drumming an important element of therapy in various fields of application.
Drums Alive appeals to varying target groups through programs developed specifically for them. The special target groups are (Ekins, 2012c):

- mentally and physically challenged children
- gifted and talented children

- fit and healthy children and adults
- children and adults with aggression problems
- older adults
- patients with Parkinson's, Alzheimer's, stroke and other life-changing conditions

The programs are developed in orientation to the target group with a corresponding adaption of the teaching and training methods. Based on this target group orientation, the following programs have been developed, for example (Ekins, 2012b):

Within the *THE DRUM BEAT* project, additional target groups and fields of application which would be appropriate for drumming and Drums Alive in schools, therapy, sports, cultural contexts and various social areas were investigated (Ekins, 2012d).

2.6.2 Contents

Drums Alive uses drum sticks to drum on gymnastic balls which are held in special ball holders. Supplemental exercises and step sequences from strength, endurance and coordination training result in individual, creative sequences all the way to complex choreographies for large or small groups which are very challenging at the physical, mental and social level. The music and rhythms used function as a source of inspiration and thus lead to an integrated workout (Ekins, 2008).
Content elements of a Drums Alive program according to Ekins (2008) can be:

- body posture, alignment and natural form
- neuromuscular rhythm
- motion sequences for stimulating and synchronizing both brain hemispheres
- focusing and concentrating energy
- rhythm and movement for stimulating the alpha and beta waves in the brain
- time for individual creative expression and stress reduction
- relaxation, concentration, well-being

The basis for the contents of Drums Alive is movement to rhythm and music as well as drumming in great variation. This interaction has a motivating and inspiring effect and leads to increased feelings of euphoria and physical and mental well-being. The drumming, which primarily takes place in the lower-frequency range, leads to synchronization of the brain hemispheres and stimulation of the alpha brain waves which are responsible for mild relaxation, relaxed alertness, increased mental attentiveness, self-awareness and well-being (Ekins, 2008).

2.6.3 Drums Alive/ Golden Beats

Drums Alive/ Golden Beats was specially developed for the older generation and targets adults older than 50 and less than 100 years old. It combines the effects of fitness programs with the positive effect of music and rhythm to create an experience of group fitness for the participants. The leading idea behind the Golden Beats philosophy is to promote a healthy physical, mental, emotional and social equilibrium from fun and creative expression. The aim is to improve the physical, mental and social quality of life among the older adult participants through the sensomotoric drumming program leading to an integrated physical-mental feeling (Ekins, 2012b).

Various principles are applied to implement the philosophy and extended goals for the older generation (Ekins, 2012b):

- the principle of movement, training, music and listening therapy as well as rhythm training
- individual or group courses adjusted for special needs and requirements
- development of a platform for social contact and interaction among the older adults, development of a group feeling to promote the motivation and participation of the participants
- room for individual and creative expression using verbal and non-verbal communication
- stress and aggression reduction in a *controlled* framework and environment
- development and promotion of neural and cognitive associations
- development of acceptance, respect and understanding for different cultural movements, rhythms and music

The Golden Beats program should have a supportive effect for maintaining independence in increasing age, which is one of the most important goals for most older adults, and enable them to perform all necessary everyday activities such as washing or dressing themselves, combing their hair, cooking meals, etc. as long as possible (Ekins, 2012b; Freiberger & Schöne, 2010; Jansenberger, 2011).
The following principles should be taken into consideration when executing a Drums Alive / Golden Beats program (Ekins, 2012b; Freiberger & Schöne, 2010):

- creating a group fitness experience for increasing feelings of well-being among older adults
- creative and fun movement tasks offer the freedom for individual ideas, and solution possibilities provide increased motivation and learning capacity without the course leader having excessive influence
- creation of a safe, comfortable, motivating and stimulating learning environment to which participants like to return
- provides an integrated program for improving the overall state of health for every individual participant
- reduces age-related breakdown processes in the physical, mental and social area
- knowledge transference to increase compliance, to build a connection to physical activity, to improve the health-related fitness, to promote quality of life and to maintain independence

Ekins (2012b) indicates that there is not a single, true way to transmit Drums Alive / Golden Beats but that it is much more important to create an integrated rhythm and movement program specially targeted to older participants, which helps to build cognition, socialization and team work and to activate both brain hemispheres and which applies elements from physical fitness and health programs.

2.6.4 Scientific Foundation of the New Approach of Drums Alive in the Prevention of Falls

These core areas, which are addressed by the Drums Alive / Golden Beats, have a direct effect on the essential risk indicators for falling among older adults.

2.6.5 Summary

Applying the new intervention approach of Drums Alive in the area of fall prevention shows great promise from a scientific point of view. The theoretical framework, with its objectives, target groups and contents, is supported by the current research findings and needs practical execution and evaluation.
The new kind of comprehensive approach using musical-rhythmic drum movements combined with various motor fitness elements and cognitive and social interactions goes in a new direction compared to the fall prevention measures employed up until this point.
The basis for a successful fall prevention intervention with Drums Alive / Golden Beats appears to be:

- Leading and attaching to a physically active lifestyle corresponding to current recommendations for physical activities with health-promoting benefits
- Implementation of motor requirements to maintain or improve performance capability
- Using the positive effects of physical activity and motor performance on the mental-cognitive area for the reduction of fear of falling and improving the ability to notice, remember and pay attention
- Using group interaction effects for building or improving social contact, activities and supports
- Implementing strategies for training physical perception and for maintaining sensory functioning or for compensating restricted sensory functioning

2.7 Key Research Questions and Hypotheses

An investigation into whether drumming has positive effects on the physical, mental and social well-being of older adults has not taken place up until this point. The central question to be answered by this research and the accompanying explorative study which was conducted is regarding the extent to which a Drums Alive /Golden Beats intervention can influence the falling behavior of older adults. The information on falling, tumbling and tripping reported in the falling journals should clarify the question of differences between intervention groups and control groups.

Based on these global, central issues, further, more detailed sub-questions result. The main risk factors associated with falls such as leg strength, balance, mobility and habitual gait speed are investigated based on the changes caused by the intervention. The effects of the explorative study on the fear of falling as a cognitive indicator is as much of a focus of consideration as the effects on social interactions, attachment to a physically active lifestyle and addressing the various sensory functions are.

The Drums Alive / Golden Beats intervention program which was conducted meets the requirements of a multi-factorial intervention approach for preventing falls. The program tackles the origins of fall risk factors at various points. Positive effects on the reduction of these risk factors are compared with a waiting control group. Furthermore, it is investigated whether differences between the sexes can be observed.
The sustainability of the potentially targeted positive effects through the program conducted is another point of interest in the research.

The following questions thus can be posed for investigation within the framework of this research:

1 Can the beneficial changes which occur through the intervention affect the frequency of stumbling/tripping incidents among the subjects on a daily basis?

2 Can the intervention minimize the associated risk factor of fear of falling and thus contribute to a reduction in the fall risk?

3 Can the beneficial changes or motor indicators of strength, balance, mobility and habitual gait speed be brought about by the intervention?

4 Can the intervention cause beneficial effects on social parameters (social contacts and support, social activities)?

5 Can an increase in physical activity in every day life be achieved with the intervention?

6 To what extent can the significant sensory functions involved in falling (touch, vision and hearing) be improved through the intervention?

A beneficial change in the features implies lowering the risk of falling.
The study recorded the effects on various primary risk factors during a ten-week, 20-unit comprehensive Drums Alive / Golden Beats intervention. Consequently, the following *hypotheses* can be derived from the formulated questions as a guide:

H 1 The intervention participants showed a significantly lower number of falls and stumbles in every day, both in the post-test as well as in the follow-up, than before the intervention took place.

H 2 The occurrence of the feature of 'fear of falling' was significantly better after the intervention, both in the post-test and in the follow-up, than before.

H 3 The intervention participants showed a significantly improved occurrence of the features for motor factors, namely, strength, balance, mobility and habitual gait speed and risk of falling after the intervention (post-test) as well as in the follow-up.

H 4 The intervention led to both short-term (post-test) and long-term (follow-up) of significantly improved occurrences of the parameters for fall prevention, namely, effective social support and contact as well as social activity.

H 5 Immediately at the end of the intervention (post-test) as well as at the third measuring point (follow-up), the intervention group showed significantly increased physical activity in every day activity compared to before the intervention (pre-test).

H 6 The sensory functions (touch, vision and hearing) significant for falls in every day were clearly better evaluated by the intervention participants in the post-testing as well as in the follow-up.

In order to be able to answer the central questions and hypotheses, a randomized trial and control group study with a ten-week intervention was conducted. The analysis of the empirical data targets the representation of the direct intervention effects (post-test) as well as the sustainability three months after the intervention ended (follow-up). The waiting control group serves as a safeguard for the effects (Table 3).

Tab. 3.

The intervention results show that, in addition, improvements in the primary fall risk factors of balance control and motor mobility (with and without added tasks) could be produced and assessment of fall-relevant sensory functions tended to be improved through the Drums Alive / Golden Beats program. No effects from the intervention were achieved in the area of cognitive mobility and fear of falling. Strength ability, social activity and overall physical activity in every day life also showed no statistically significant effect. In particular, intervention contents need to be modified in terms of the potential for changing the parameters of cognitive abilities and fear of falling in the author's opinion. In line with the conclusions of the pilot study, *A Matter of Balance*, from Tennstedt et al. (1998), the focus should be on rethinking and changing behavioral habits to reduce the fear of falling and bring about improvements in the cognitive performance area. These focuses were clearly given too little weight in the context of the intervention that was conducted.

Further reasons for a lack of improvement in the specified areas can presumably be attributed to the very good beginning level of the participants in the study, the limitations of individual measuring instruments and the seasonal and environmental influences. Additional possible explanations should be looked for in the intervention itself. Since it deals with a pilot study which applied the intervention contents of Drums Alive / Golden Beats for the first time in relation to fall prevention, there was no point of orientation or comparison values from the literature or research up until that point. An explicit comparison with other intervention studies of the same contents is not possible since the contents applied in this study were being used for the first time and large differences in the study design of fall-related interventions can be confirmed. The necessary stress criteria were probably not sufficiently adequately selected for the relevant changes in the parameters included.

The subjective feedback from the intervention participants can be consistently evaluated as very positive. This shows that, above all, none of the participants quit the intervention prematurely and compliance was very large. Beyond that, a majority of the participants expressed a positive impression of the intervention program as well as having had fun and pleasure in participating during a personal interview. After the study was over, many participants expressed the wish to continue a group Drums Alive

/ Golden Beats program. This wish was met: a corresponding program was offered by a preventative sports club at the end of the program. After the waiting control group had also gone through the intervention program, there were more participants interested in participating in a continuation program.

3 Summary and prospects

The goal of the present work is to answer the central question of the extent to which a Drums Alive / Golden Beats intervention can influence the fall behavior of older adults. There are already numerous interventions, studies and reviews on the topic of falls. The research has recognized the relevance of the topic of falls and fall prevention on their own and has been able to generate important findings. New, particularly multi-modal intervention programs need to be evaluated in terms of their efficacy in the context of fall prevention. Drums Alive / Golden Beats is just such a new approach. In the pilot study that was conducted, it was analyzed for its preventative character in relation to the fall behavior of older adults with low to moderate fall risk. Effects in regards to changes in fall and stumbling incidents, fear of falling, social parameters, physical activity, the evaluation of fall relevant sensory functions and the motor indicators of mobility, balance, strength and the habitual gait speed were analyzed. The intervention program Drums Alive / Golden Beats was evaluated within the framework of a ten-week, 20 unit comprehensive RCT study. Time and interaction effects were evaluated using a waiting control group. After pre-testing before the beginning of the intervention, a post-test conducted directly after ending the intervention (10 weeks) served to record the short-term effects. A follow-up test three months after the end of the intervention provided data for analyzing the longer term maintenance of the intervention effects.

The results of the Drums Alive / Golden Beats intervention show direct beneficial effects (t2) on the parameters of stumbling frequency, balance ability, motor mobility (with and without additional tasks), intensive physical activity as well as improved assessment of sensory functions relevant to falling. On the motor mobility indicators with additional tasks, female participants benefited more from the intervention than the male participants in terms of balance ability, assessment of sensory functions, and intensive, moderate and overall physical activity. The intervention effects listed above could be verified more long-term (t3). It is to be expected that the intervention causes behavioral changes—taking all limitations into account—which have a sustainable effect on the level of the parameters. For the parameters of fall frequency, cognition and fear of falling, for the social indicators which were considered, for the dimensions of mild, moderate and overall physical activity as well as for the parameters of strength and habitual gait speed, neither short-term (t2) nor long-term (t3) positive changes could be verified. However, by including a comparison with the control group, it could be determined that the intervention had at least a maintenance effect for the parameters of strength and social contact and support at the pre-test level (t1) and prevented a backwards development which was shown to be the case for the control group.

In addition to the data recorded by the measuring instruments, the observations and conversations of the participants among themselves or with the study and the course leaders provided insight into the effects of the intervention, even if those insights need to be interpreted with caution. Participants repeatedly reported an overall improved feeling of well-being and general condition, an increase in attentiveness

during the day, more consciously executed activities, alertness in risk situations, meeting with other participants before and after the intervention unit or also meeting privately. These generally positive effects led to the desire among more than half of all participants at the end of the study to be able to participate in a continuation of the Drums Alive / Golden Beats course offering. To this end, a recreational sport club designed a weekly course. This also makes it possible to be able to research long-term effects within the framework of a supplementary research project.

The results of the intervention study are generalizable, as already discussed, only to older adults with low to moderate fall risk. And this is only under observation of the limits described for the study. In view of further research efforts, it would be interesting to look at (1) whether an optimized selection, combination, and integration of stress criteria in regards to the intervention program could deliver more beneficial effects within the framework of fall prevention. Absent effects should be attributed partially to the weaknesses of the measuring instruments in this study. Thus, it would be meaningful for a follow-up study to (2) use measuring instruments which are more sensitive or can differentiate more or to modify the existing instruments accordingly. (3) Further findings could also be found by another testing of the intervention with a random sample of subjects with high or very high risk of falling. Then, explicit statements about the effect of the intervention for this target group in relation to fall prevention could be made. (4) The same applies to the target group of older adults who are no longer living independently. Considering the limited personnel, financial and time resources of these facilities, it should be of extraordinary importance to maintain the mobility of these older adults as long as possible. For self-motivated physical activity among this target group, improving the parameters related to fall risk should be of enormous relevance.

The results of the randomized intervention study highlights the findings present in the literature and the general calls of many authors to employ multi-dimensional or multifactoral intervention approaches for fall prevention (Gillespie et al., 2009; Sherrington et al., 2008; Chang et al., 2004; Gardner et al., 2000; Lord et al., 1995; Campbell et al., 1999). These should target above all a reduction in the risk of falling and frequency of falling at the same time. Interventions which are structured differently, according to the literature, lead to a reduction in fall frequency but they don't cover the causes for falling and do not lead to a reduction in fall risk. Findings from various review studies (Cameron et al., 2010; Gillespie et al., 2009; Sherrington et al., 2008) show that the largest effect related to the fall rate is targeted through interventions that have a long duration (more than 50 intervention hours) and include challenging balance exercises. A minimal amount for achieving effects is listed in the reviews as an intervention frequency of at least two times per week (60 minutes each) over a period of 25 weeks. The reviews confirm that the minimum interventions should be for a time period of 10 weeks. Future research approaches should thus be more strongly directed towards conducting longer term intervention measures. In the present study, an intervention frequency of twice a week could be assured. However, because of financial, temporal and personnel reasons, it could only be carried out for a period of 10 weeks. The expansion and extension most likely would have had further positive effects through the intervention contents. For those parameters for which no effects could be reported in the study, perhaps effects could only be confirmed after a longer intervention period which would then have to be clarified through additional research approaches.

Sherrington and colleagues (2008) showed that groups with a high risk of falling (nursing home residents, assisted living, persons with a history of falling) would benefit more from fall prevention programs than groups with a moderate or low risk factor (independently living, no history of falling). Subsequent to having conducted

the Drums Alive / Golden Beats in this study with a moderate to low fall risk group which led to varying results, it remains for future researchers to test this new approach in fall prevention research for its efficacy on high risk groups.

The cognitive-behavioral approach, followed in the intervention, could not achieve any significant changes among the target group. In particular, the intervention approach applied by Tennstedt and colleagues (1998) for the first time in the area of 'fear of falling' pursued the goals of higher physical, social and functional activity through a reduction in the fear of falling. The investigation conducted by Tennstedt et al. (2001) on the efficacy of *A Matter of Balance* showed that the people who benefit the most from such an intervention are those with few physical and social limitations but a higher level of fear of falling and greater self-efficacy in mastering these anxieties. Additional studies confirm this approach (Zijlstra et al., 2005; 2006; Hill et al., 1996; Ware, 1993; Myers et al., 1998) and postulate an apparent success in multifactoral interventions with both physical training and also the creation of self-efficacy and the theoretical training and transfer of knowledge. It remains a task for additional research with selective target groups to determine the extent to which Drums Alive / Golden Beats can also achieve positive effects in this area. For the target groups in the present study, no significant effect could be achieved which could also be due to a lack of theoretical training and knowledge transference as well as the explicit environmental evaluation and risk assessment in the current intervention program.

An additional focus on the Drums Alive / Golden Beats group intervention approach was linking musical-rhythmic elements with drumming, dance, music and aerobics combined in such a way as to make a whole body experience following Ekins's philosophy (2008; 2012a; 2012b; 2012c). The program, which has not yet been scientifically evaluated, was investigated for the extent to which these goals could be implemented through the program contents and which effects were brought about in the area of fall preventions. A method already known in the research, Rhythmic Acoustic Stimulation (RAS), was used to achieve an improvement of movement control through the physiological effects of rhythm on the motor system. This sensomotoric training is used in gait training therapy for patients with gait disturbances as well as for participants without objective limitations for general gait and posture training and in fall prevention (Wulf, 2004). Comprehensive research results in the area of the synchronized effect of rhythm on human movement exist from Thaut and colleagues (1992; 1993; 1996a; 1996b; 1997; 1999) and McIntosh et al. (1994). The work of Kokal et al. (2011), which primarily deals with the social aspects of group drumming, dancing and singing, confirms the promotive character of such interventions. The review from Keogh et al. (2009) comes to the conclusion that, as a form of physical activity, dance particularly improves balance and reduces risk of falling. Implementation of the positive effects of rhythm, dance, music and drumming through the Drums Alive / Golden Beats program can be viewed as partially successful. The positive effects on balance ability verified by the research could also be achieved in the present study. The essential advantage of Drums Alive / Golden Beats is its combination of dance, rhythm, music, aerobics and the newly supportive element of drumming. This strong sensomotoric-rhythmic-acoustic stimulation is a driving force and the foundation of all intervention contents. That also confirms and reinforces the approach by Shigematsu et al. (2002) in its research work which achieved comparable results as with special strength, endurance or balance training through a dance aerobic program based on folk music. Hui et al. (2009) also came to similar findings. The large advantage of such interventions is justified in that these play-like, rhythmic-dance contents provide the mostly older intervention participants with more pleasure and fun than special training programs. This is indicated by a higher compliance in the

program and lower drop-out rates, which was also observed in the present study.

In summary, the following recommendations for research and practice can be drawn:

- Use of a randomized controlled study design (RCT);
- Application of multi-dimensional or multifactoral programs;
- Use of simple, clear, understandable, practical, clearly distinguishable and easy to use measuring instruments and test procedures in a battery of tests;
- Planning and organization of interventions or course offerings targeted to different settings, specific acquisition and initiation in participation for high risk groups (nursing home, assisted living) corresponding to the Federal Campaign for the Prevention of Falls (2009);
- Generating findings regarding the stress structure and application of special stress criteria for different target and risk groups;
- Using musical-rhythmic-dance elements in connection with drumming combinations;
- Establishing a link to every day living for the intervention contents;
- Creating a pleasant, trust-forming learning environment;
- Implementing regular fall prevention groups or Drums Alive / Golden Beats groups which meet multiple times per week and occur long-term; at the same time, further scientific assistance for analyzing the maintenance of the effects of the intervention;
- Conducting booster sessions (Tennstedt et al., 1998; 200) to refresh or update intervention content, maintain contact to the target groups;
- Group leadership through trained (methodological/didactic, social, technical) personnel/course leaders competent for the target group, preferably with certification as a fall prevention trainer corresponding to the Federal Campaign for the Prevention of Falls (2009);
- Offering fall prevention programs for target groups with low risk and no history of falling as well;
- For the achievement of sustainable and long-lasting effects in the physical, mental and social area, the different perspectives of the participants need to be taken into consideration; goals, wishes, interests, needs as well as already existing competences or existing deficits of participants need to be taken account in the planning and implementation.