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Faculteit Revalidatiewetenschappen

master in de revalidatiewetenschappen en de kinesitherapie

Masterthesis

The physical effects of a music and video-based group exercise program in nursing home residents with moderate dementia

Margot Cochez

Scriptie ingediend tot het behalen van de graad van master in de revalidatiewetenschappen en de kinesitherapie, afstudeerrichting revalidatiewetenschappen en kinesitherapie bij neurologische aandoeningen

PROMOTOR :

Prof. dr. Joke SPILDOOREN

BEGELEIDER :

Mevrouw Tine PLATTIAU

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Situering

Deze masterproef maakt deel uit van de PhD-studie ‘AMUSED’, wat staat voor 'Adherence by Music to Exercise in Dementia'. Dit onderzoek is een initiatief binnen de onderzoeksgroep onder leiding van Professor Dr. Spildooren, die zich voornamelijk richt op de geriatrische populatie. De AMUSED-studie onderzoekt de cognitieve en fysieke achteruitgang bij personen met dementie. Volgens de lijst van knelpuntberoepen van de VDAB voor 2024 is kinesitherapeut in een woonzorgcentrum een knelpuntberoep (*Knelpuntberoepen | VDAB*, z.d.). Omwille van deze tekorten, wordt het voor kinesitherapeuten in woonzorgcentra steeds moeilijker om intensieve, individuele therapie te bieden. Deze studie maakt gebruik van groepstherapie en hoopt hiermee een manier te vinden om de druk op de verzorgers te verminderen.

Binnen de grote PhD-studie worden parameters zoals therapietrouw, cognitie en participatie onderzocht. Door het volledige functioneren van de deelnemers te analyseren, kan een volledig beeld van de effecten van de interventie worden verkregen. Dit zorgt voor een uitgebreide analyse van de relevantie van deze interventie.

In overleg met de promotor Professor Dr. Joke Spildooren en begeleider Tine Plattieau is de onderzoeksvraag opgesteld. Er is besloten om in deze studie enkel naar de fysieke parameters te kijken. De studie is uitgeschreven door de student en is gebaseerd op het protocol en de testresultaten die door de onderzoeksgroep zijn verstrekt. Het onderzoek werd uitgevoerd in twee woonzorgcentra: Sint-Elisabeth in Hasselt en Aquamarijn in Kasterlee. Beide woonzorgcentra hebben hun ruimtes voor dit onderzoek ter beschikking gesteld.

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Abstract

Background

As the aging population grows, dementia cases are expected to rise. Dementia causes, besides cognitive decline, motor symptoms like rigidity, bradykinesia, and gait problems. To maintain muscle strength and reduce fall risk, exercise is beneficial for frail individuals with dementia who often exhibit sedentary behavior in nursing homes. Adherence to these exercise programs in this population is typically low.

Objectives

This study aims to investigate the effects of a music and video-based exercise program on physical decline in individuals with moderate dementia in nursing homes. Given the limited research on multicomponent training in dementia and the positive impact of music-based exercise interventions, we expect that music will motivate participants and indirectly slow their physical decline.

Methods

A single-blinded randomized controlled trial was conducted at two nursing homes. Participants were randomly assigned to an intervention group, receiving the music and video-based exercise program, or a control group, receiving usual care. Physical outcomes were measured by the Micfrofet 2, modified Timed Chair Stand Test (mTCST), and the Performance Oriented Mobility Assessment (POMA). Data was analyzed using a linear mixed model.

Results

24 participants were enrolled in this study, with 20 remaining by the study's end (4 drop-outs). The exercise program did not significantly improve lower limb strength (Microfet and mTCST) or balance and gait (POMA) parameters over time compared to the control group. Additionally, both groups did not experience significant changes in these outcomes before and after the intervention ($p>0.05$).

Conclusion

While previous studies have indicated that music-based exercise programs can enhance physical and cognitive outcomes in individuals with dementia, this study did not find significant effects on the measured physical parameters. Potential reasons include the small

sample size, short intervention duration, and varying adherence rates. Future research should also consider the impact of cognitive status and adherence on physical outcomes.

Keywords
Dementia; multicomponent training; music; video; strength; balance and gait.

Introduction

Globally, the World Health Organization records a prevalence of approximately 55 million people with dementia and an incidence of 10 million per year (World Health Organization: WHO & World Health Organization: WHO, 2023b). Despite a stable age-specific prevalence, the aging population's growth will amplify dementia cases due to longer life expectancy (Prince et al., 2016). Given that individuals with dementia live an average of 7.3 years after diagnosis, finding effective rehabilitation modalities to mitigate disease progression is crucial (Liang et al., 2021).

Besides the known cognitive decline, dementia also causes motor symptoms such as rigidity, gait problems, and bradykinesia (Scarmeas et al., 2004). The decline in cognitive functions is associated with malnutrition, decreased physical activity, and a reduction in gait speed (Soni et al., 2019; Taylor et al., 2017; Tchalla et al., 2018). Individuals with dementia are more likely to be frail, and exercising positively affects muscle mass and strength, making it beneficial in treating frailty (Jadczak et al., 2018).

As dementia progresses, many individuals transition to assisted living or nursing homes, where sedentary behavior prevails (Leung et al., 2021). Several studies showed that sedentary behavior is very high in older people with dementia in an assisted living facility and indicate the need for innovative ways to break sedentary behavior (Parry et al., 2019). When we look at the link between physical activity (PA), physical outcome measures, and fall risk, we see that a low amount of PA in older people in an assisted living facility causes worse scores on balance tests and increased fall risk (Bootsman et al., 2018). Furthermore, it has been shown that physical exercises contribute to preserving functional capacity, thereby reducing the burden on healthcare providers (Sampaio et al., 2021).

Multicomponent training is a method of treatment that combines at least three different types of training in one session (Labata-Lezaun et al., 2023). According to Jadczak et al. (2018), there

appears to be good evidence for multicomponent training in frail older adults in a residential care home. They have demonstrated that it positively affects muscular strength, gait speed, balance, and physical performance. Training best consists of strength, endurance, balance, and flexibility exercises. It is recommended to perform the training 2 to 3 times a week for 10 to 90 minutes (Jadczak et al., 2018).

However, adherence to exercise programs in individuals with dementia is low. When we look at adherence in residential care homes, it is even lower (Di Lorito et al., 2020). Motivation plays a crucial role in sustaining physical activity. van Alphen et al. (2016) investigated the barriers, facilitators, and motivators for physical activity among people with dementia. While music was not explicitly mentioned, enjoyment was identified as an essential factor for sustaining physical activity. Anderiesen et al. (2014) showed that music has a positive effect on physical activity, not specifically in individuals with dementia but in residents of long-term care facilities.

The effects of music therapy on cognitive functions in individuals with dementia have been thoroughly studied (Bleibel et al., 2023; Ito et al., 2022; Lin et al., 2023). However, only a few studies have investigated the impact of combined music and physical activity interventions. A systematic review by Li et al. (2022) investigated the effect of combining music and physical activity in people with dementia. They compared eight studies and concluded that an intervention incorporating balance, flexibility, and endurance exercises improves cognition, physical functioning, and quality of life and reduces fall risk (Li et al., 2022). Prinz et al. (2023) investigated the effect of a multidimensional music-based exercise program over 24 weeks in people with dementia. They found improvements in motor components such as gait, balance, and leg strength, improvements in attention and cognition, as well as quality of life (Prinz et al., 2023).

The music chosen by the participant shows more effective results on cognitive and behavioral outcomes and quality of life than when the therapist selects the music (Leggieri et al., 2019). Also, in people with diabetes, it has been shown that combining music and video is more effective in increasing positive emotions and enjoyment during exercise and reducing perceived exertion and blood glucose levels than music alone (Hutchinson et al., 2017).

There are only a few studies that have examined the impact of a music-based exercise program on individuals with dementia. Of those, very few studies investigated the effect on physical parameters such as balance and strength. Additionally, the sample size in these studies is small, and not every intervention was guided by a physiotherapist. There is no consensus on the frequency and duration of the intervention. None of these studies have investigated the effect on residents of nursing homes with dementia. Therefore, more research is needed.

Given the limited research on multicomponent training in dementia and the positive impact of music-based exercise interventions, this study aims to investigate the effects of a music and video-based exercise program on the physical decline in individuals with moderate dementia in nursing homes. Music in therapy is expected to motivate participants, indirectly slowing the physical decline.

Methods

Study design

The primary study is a single-blinded, randomized controlled trial. Older adults with dementia living in a nursing home were randomly assigned to the intervention group or the control group. Participants were matched between the two groups for age, sex, mobility, and Mini-Mental State Examination (MMSE). The ethics committee of UHasselt approved the protocol.

Participants

The participants were recruited from two residential care institutions: Sint-Elisabeth Hasselt and Aquamarijn Kasterlee. The inclusion criteria were: (1) Moderate dementia, defined as an MMSE score between 12 and 20 (Folstein et al., 1975), (2) age 65 years or older, (3) being a resident in a nursing home for at least 30 days, and (4) being able to stand for ten seconds with support and supervision. Exclusion criteria were: (1) inadequate functional hearing, (2) uncorrected visual problems, (3) rehabilitation from an orthopedic or neurological insult, or (4) a known disability that significantly influenced the six-month prognosis. If a participant met the inclusion criteria, informed consent was obtained from each participant and a close family member.

Preparations

Prior to commencing the study, an application was developed by an engineer, comprising videos and music. The videos featured pre-recorded exercises demonstrated by an 82-year-old

woman, categorized by difficulty level. This allows the therapist to select the appropriate exercises based on the participant's skill level. A pilot study assessing background preferences revealed no significant differences between a sea and plain room background. However, considering the potential triggering of Behavioral and Psychological Symptoms of Dementia (BPSD) by busy backgrounds, a neutral plain room background was chosen (Kales et al., 2015). Additionally, participants' favorite music was identified through surveys conducted in various nursing homes.

Interventions

In addition to usual care, the intervention group received a music and video-based exercise program in small groups of five. The intervention lasted 35 to 45 minutes twice a week for two months. It was ensured that each participant had enough space to move and that there were minimal distractions. Therapy consisted of six components: warm-up, strength, balance, functional, endurance, and flexibility exercises. The difficulty level of the exercises was adapted to the level of the participants. Before the start of each session, different songs were played, and the music for the session was chosen based on the participants' reactions.

The videos, previously recorded, were played during the session. A physiotherapist first selected the appropriate exercises and then supervised the sessions to ensure the safety of the participants. The physiotherapist remained the same during each session and in the different nursing homes. To ensure the safety of the participants, walking aids (such as walkers) were allowed.

The participants who were assigned to the control group received usual care in the nursing home.

Data collection

The assessment of the participants took place before the intervention (T0) and after two months of training (T2). The assessor was blinded for conditions. For the second measurement, the same order of measurements was maintained as at the beginning of the study to ensure consistent timing for all participants. Attendance during the tests was also recorded.

Strength

Strength was assessed using the Microfet 2 (Bokhorst & Ummels, 2023) and the modified Timed Chair Stand Test (mTCST) (Swinkels et al., 2023). For the strength measurement with the Microfet 2, the participant had to sit in a chair with the right leg in a 90° position. The

Microfet was held against the tibia of the participant's leg at the level of the malleoli (Figure 1). Peak knee extension force was measured using the beak method three times for five seconds. The highest value was then used. The Microfet has been validated in older adults and was found to be reliable (ICC > 0.90) and valid (high correlation between the Microfet and the Biodex) (Grootswagers et al., 2022). The mTCST was used to measure functional strength. The participant had to stand up and sit down five times. It was modified to allow participants to use the armrest. The mTCST was also a reliable outcome measure (ICC > 90)(Munoz-Bermejo et al., 2021). This test's cut-off score is 14.2 seconds (Swinkels et al., 2023).

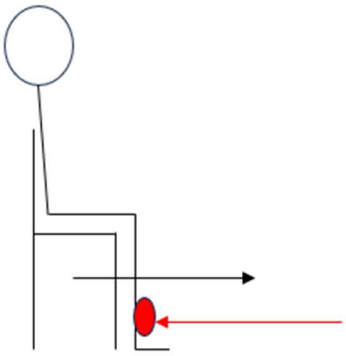

Figure 1. *Positioning Microfet*

Balance and gait

The Performance Oriented Mobility Assessment (POMA), developed by Tinetti in 1986, evaluated balance and gait. The reliability and validity of the overall score and balance assessment are deemed favorable, with correlation coefficients ranging from 0.74 to 0.93. Gait assessment exhibited slightly lower reliability yet remained within an acceptable range (correlation coefficients between 0.72 and 0.89)(Faber et al., 2006). The cut-off score of this test is set at 19, indicating a high fall risk (Bokhorst & Tinetti, 2024).

The tests used for this study were effective scales for assessing the physical capabilities of individuals with dementia, according to Trautwein et al. (2019). In this study, the mTCST was identified as a good tool for measuring strength, and the POMA test was recognized as a good tool for measuring balance (Trautwein et al., 2019).

Figure 2 shows the course of the intervention compared to the assessment moments.

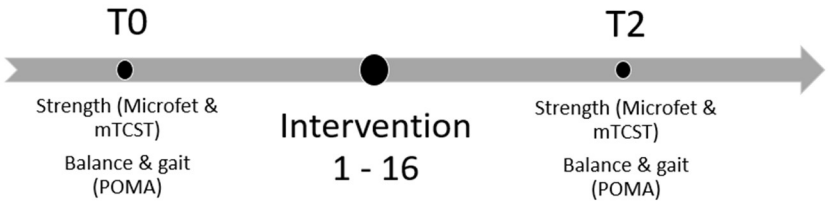

Figure 2. *Study timeline*

Note. mTCST = modified Timed chair stand test, POMA = Performance Oriented Mobility Assessment.

Statistical analysis

The data was analyzed using SPSS (*SPSS Software | IBM*, z.d.) version 29.

A power analysis was conducted using G*Power software to determine the required sample size. First, an ANOVA was performed using muscle strength as the primary outcome measure. Out of this output, the effect size was determined using Cohen's F. This effect size was used in the power analysis. The analysis aimed for a power of 0.80 and a significance level (α) of 0.05. The calculation resulted in a required sample size of 36 individuals, which equates to 18 per group.

The difference in age and MMSE was determined using a two-sample t-test, and the difference in walking aid was determined using a chi-square test. A linear mixed model with random effects was used to analyze the data, accounting for both the effects of the intervention (group) and time on the outcomes. The model also adjusts for initial differences in the outcomes (baseline values) and any imbalances between the randomization groups to obtain more accurate and less biased results in comparison with repeated measures ANOVA. The analysis of cut-off scores of the mTCST and POMA was done using a one-sample t-test The significance level was set at 0.05.

Results

Figure 3 illustrates the study flowchart. In total, 24 participants started the study. These participants were randomly assigned to the intervention group (n = 15) or the control group (n = 9). Table 1 presents the participant characteristics of each group. Four participants dropped out throughout the study, resulting in eight individuals remaining in the control group and 12 individuals in the intervention group by the end of the study.

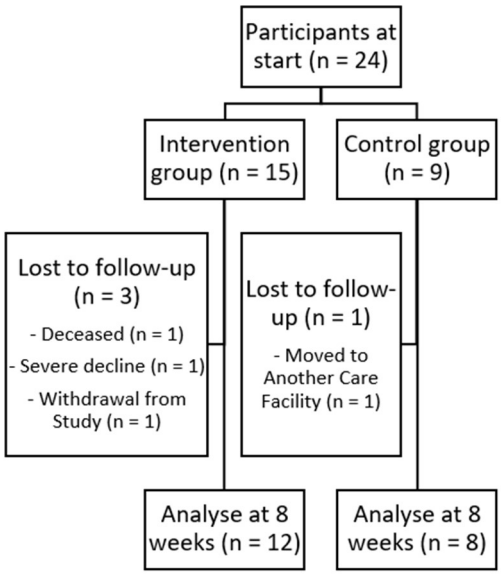

Figure 3. *Study flow chart*

Table 1

Participant characteristics

Characteristics	Intervention group (mean±SD)	Control group (mean±SD)	p-Value*
Age	89.75±3.84	89.25±6.63	0.83
Female	9 (75%)	6 (75%)	
Male	3 (25%)	2 (25%)	
Walking aid			0.95
None	2 (16.7%)	1 (12.5%)	
Cane	1 (8.3%)	1 (12.5%)	
Rollator	7 (58.3%)	4 (50%)	
Wheelchair	2 (16.7%)	2 (25%)	
MMSE	12.42±4.94	15.63±6.00	0.29
Adherence	78.13%		

Note. MMSE = Mini-Mental State Examination, M = Mean values, SD = Standard Deviations; * significant between-group difference (p<0.05).

Strength

The means and standard deviations are shown in Table 2. When analyzing the interaction effects between the intervention and control groups over time, no significant results were found in the measurement with the Microfet (p = 0.38). This indicates that the intervention had no significant effect in comparison with no intervention over time. Likewise, no significant differences were observed before and after the intervention (p = 0.78), indicating neither deterioration nor improvement in the Microfet measurements within either group. Furthermore, no significant distinctions were observed between the two groups (p = 0.40).

When analyzing the interaction effects between the intervention and control groups over time, no significant results were found in the mTCST measurement ($p = 0.91$). This indicates that the intervention had no significant effect in comparison with no intervention over time. Likewise, no significant differences were observed before and after the intervention ($p = 0.69$), indicating neither deterioration nor improvement in the mTCST measurements within either group. Furthermore, no significant distinctions were observed between the two groups ($p = 0.13$). When we analyze the cut-off scores, we see that both groups score significantly above this threshold of 14.2 seconds for both measurements ($p < 0.001$) (Swinkels et al., 2023).

Balance and Gait

When analyzing the interaction effects between the intervention and control groups over time, no significant results were found in the POMA ($p = 0.47$). This indicates that the intervention had no significant effect in comparison with no intervention over time. Likewise, no significant differences were observed before and after the intervention ($p = 0.47$), indicating neither deterioration nor improvement in the POMA within either group. Furthermore, no significant distinctions were observed between the two groups ($p = 0.20$). When we analyze the cut-off scores, we see that both groups score significantly below this threshold of 19 for both measurements ($p < 0.001$) (Bokhorst & Tinetti, 2024).

Table 2

Results from baseline (T0) and post-test (T2) for the intervention and control group

	Intervention group		Control group		*p-value*
	T0 (M±SD)	T2 (M±SD)	T0 (M±SD)	T2 (M±SD)	
MICROFET (N)	140.37±53.25	151.20±48.82	171.41±67.02	150.46±53.84	0.38[a] 0.78[b] 0.40[c]
mTCST	31.13±19.56	33.36±36.15	18.64±6.92	22.55±9.64	0.91[a] 0.69[b] 0.13 [c]
POMA	16.00±3.16	16.00±4.07	15.38±2.20	13.75±3.69	0.47[a] 0.47[b] 0.20[c]

Note. M = Mean values, SD = Standard Deviations, N = Newton; SD= standard deviation; mTCST = modified timed chair stand test; POMA = Performance Oriented Mobility Assessment.
[a]Interaction effects: between T0-T2 and intervention-control
[b]Within-group effects: between T0-T2
[c]Between-group effects: between intervention-control
* significant difference ($p<0.05$)

Discussion

This RCT investigated the impact of multicomponent training supplemented with video and music on physical outcomes over a two-month intervention period. The findings revealed no significant effects on the physical outcome measures. The lack of significant differences in lower limb strength and balance between the intervention and control groups suggests that the exercise program did not have a significant impact on improving lower limb strength and balance over time. Additionally, the absence of significant changes within each group before and after the intervention indicates that neither group experienced notable improvements during the study period. However, we observe that analysis of cut-off scores revealed that participants scored significantly above the threshold of 14.2 seconds on the mTCST ($p<0.001$), highlighting the participants' physical frailty (Swinkels et al., 2023). When examining the balance of the participants in this study, the participants score significantly below the threshold of 19 on the POMA assessment ($p<0.001$), indicating an increased fall risk (Bokhorst & Tinetti, 2024). When analyzing the MicroFET measurements, it is evident that the measured difference observed in the intervention group, amounting to 10.88N, is below the predetermined minimal clinically important difference (MCID) threshold of 14.28N (Alqahtani

et al., 2019). This indicates that the observed difference may not reach the level of clinical importance as defined by the MCID.

When examining prior studies, it becomes evident that physical activity combined with music primarily enhances participation, leading to a potentially positive effect on strength (Li et al., 2022). As this study is only a small part of the larger PhD study, participant engagement was not the scope of this thesis. Consequently, drawing a definitive conclusion regarding the influence of participation on strength is challenging. No studies were found that specifically utilized the MicroFET to measure strength. Prinz et al. (2023), who utilized a multidimensional music-based exercise program in individuals with dementia, demonstrated that the intervention group exhibited significant improvement in strength on the mTCST at 3 and 6 months ($p < 0.001$). Dominguez-Chavez et al. (2022) demonstrated a significant improvement in lower limb muscle strength measured by the mTCST among women in a nursing home following a physical training intervention incorporating music ($p<0.01$). Notably, these women did not specifically have dementia. Trombetti et al. (2011) showed that music-based multitask training led to better scores on balance and functional tests, consequently reducing the risk of falls. In the study by Prinz et al. (2023), balance was assessed using the FICSIT-4, where no significant improvement was observed. No studies have been found that used the POMA as a tool to measure balance.

There are several reasons these studies may have found significant results while this study did not. The power analysis resulted in a required sample size of 36 individuals, which equates to 18 per group. The current sample size appears inadequate, and the sample size calculation did not account for potential drop-outs, indicating that the true sample size should exceed 18 per group. Indeed, Prinz et al. (2023) and Trombetti et al. (2011) employed larger sample sizes in their studies. Additionally, Prinz et al. (2023) included participants with mild and moderate dementia in their study. The study itself does not mention the cutoff values that were utilized. In other studies, there is no indication of the severity of dementia. Moreover, the duration of the intervention is often longer than 8 weeks, and studies that utilize an 8-week intervention period primarily demonstrated significant results in terms of cognition, anxiety, and agitation (Li et al., 2022).

Confounding factors such as the MMSE, adherence, and participation during the sessions were not accounted for in this study, although they could impact the results. We see a slight but

non-significant difference ($p > 0.05$) between the two groups, with the MMSE being lower in the intervention group. Van De Winckel et al. (2004) demonstrated that music-based exercises improved MMSE scores. It would have been interesting to investigate whether this also impacted physical parameters. Additionally, the average adherence score in the intervention group was 78.13%, indicating that not all participants completed the planned 16 sessions, which could also influence the results. In the research conducted by Prinz et al. (2023), where significant results were obtained, the attendance rate was reported to be 93%. Furthermore, we know how often participants rested during the sessions or whether they participated in all the exercises. However, this is also part of the larger PhD study and is not considered in this study. This is also an essential factor that should be considered in future research.

Further research is needed, utilizing a larger sample size and an extended intervention period. Additionally, it would be intriguing to investigate whether participant adherence and cognitive status influence the measurements. This study provides limited information regarding the factors that may impact the outcome measures.

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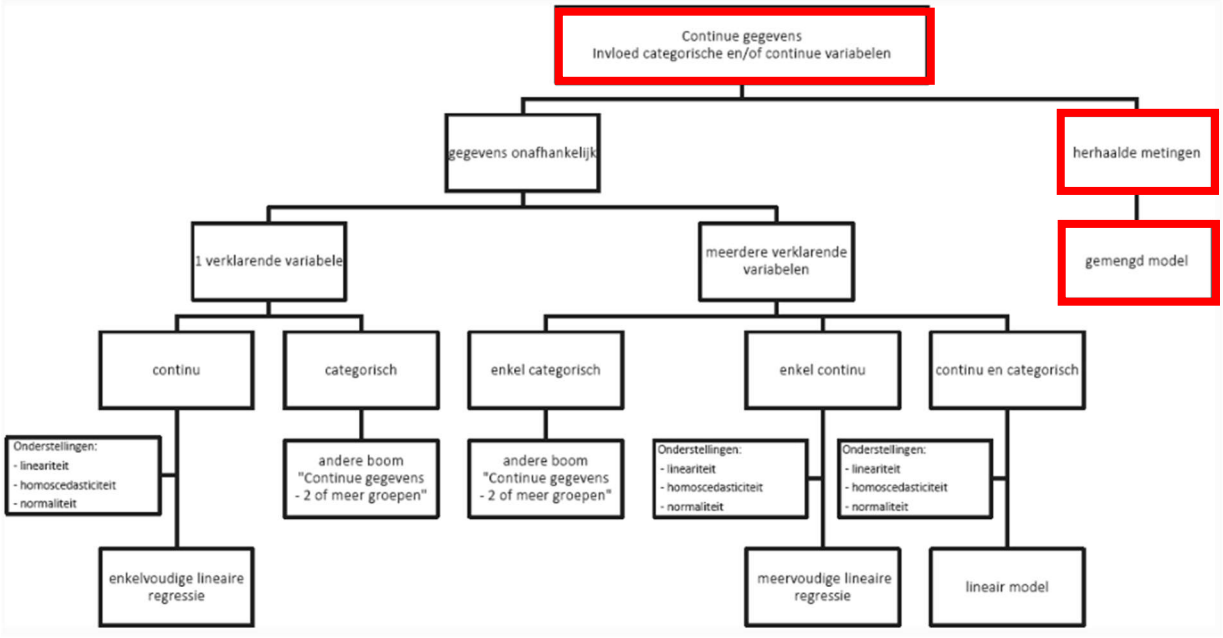
APPENDIX 1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Onderstellingen:
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- homoscedasticiteit
- normaliteit
andere boom
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