Measuring physical behavior after stroke is the main topic of this thesis. The general introduction in ***Chapter 1*** describes what physical behavior is and some of its components, i.e. sedentary behavior, body postures & movements, and arm use. Each of these components are introduced in relation to people after stroke, which was the study population in this thesis. In general, measuring physical behavior remains a challenge because it involves measuring a person's behavior in daily life. A suitable technique to objectively measure physical behavior is accelerometry. This is a relatively inexpensive and widely used technique in various activity monitors. With the use of activity monitors, a person can be continuously measured while he/she is freely moving in his/her own environment in everyday life. However, before applying these activity monitors, this thesis aimed to investigate two methodological aspects of measuring physical behavior from the perspective of stroke rehabilitation. Thereafter, an activity monitor was used to measure daily-life arm use during stroke rehabilitation.

Sedentary behavior, one of the components of physical behavior, is defined as '*any waking behavior characterized by an energy expenditure ≤1.5 METs while in a sitting reclining, or lying posture*'. However, most earlier studies investigating sedentary behavior measured only one component: either 'the amount of time someone sits' or 'the amount of time having a low energy expenditure'. Since it was unclear what the effect is of applying different operationalizations of sedentary behavior, this issue was investigated in ***Chapter 2***. In that study, we compared sedentary behavior operationalized as 1) sitting/reclining/lying, 2) low energy expenditure, and 3) the combination of both according to the definition. The results show that different operationalizations of sedentary behavior have a significant effect on the outcomes of sedentary behavior, e.g. total sedentary time, and the way sedentary time is accumulated in bouts. The differences between these operationalizations are large enough to be relevant, i.e. sedentary time differed by 15% and accumulation variables by almost 50%.

In addition to the study among healthy people, in ***Chapter 3*** we assessed the effect of the three operationalizations of sedentary behavior in people after stroke. The rationale for this follow-up study was that the frequency and the duration of both sitting and having a low energy expenditure are most likely to differ between people after stroke and healthy people. Therefore, the results of the study in ***Chapter 2*** may not be generalized to people after stroke. Moreover, in this population, it is important to decrease sedentary behavior because of their increased risk for cardiovascular disease and their possibly increased sedentary behavior due to motor problems caused by the stroke. The results of this follow-up study are comparable (with the same order of magnitude) with those of the study in healthy people, i.e. the operationalization of sedentary behavior has a significant effect on the outcomes of sedentary behavior.

Although accelerometer-based activity monitors can be used to measure physical behavior and many of these devices are commercially available, most are unable to measure body postures & movements. Measuring this component of physical behavior is important for people after stroke in order to assess functional status and motor recovery. The commercially available physical activity monitor 'Activ8' (30x32x10 mm; 20 g) is a one-sensor, accelerometer-based monitor that classifies body postures & movements, as well as their intensities. It is a device with considerable potential for use in clinical practice due to its additional features, including the ability to provide feedback, and the communication platform for caregivers and consumers. However, before using this device, it was important to assess its validity to measure body postures & movements, as presented in ***Chapter 4***. The results of that study show that the agreement between the Activ8 and the video reference data was sufficiently high to validly apply this activity monitor in stroke rehabilitation.

Measuring arm use is less common than measuring physical activity and sedentary behavior, possibly due to the lack of commercially available devices. Using accelerometry to measure arm use has one limitation: *arm movements* are measured instead of *arm use*, which is not the same thing. For instance, arm movements due to walking (e.g. arm swing) differ in terms of functionality from arm movements in a sitting or standing posture. Nevertheless, we used the Activ8 to develop an arm use monitor, because it is easy-to-use, comfortable to wear, and relatively inexpensive. ***Chapter 5*** describes the development and validation of the Activ8 arm use monitor (the Activ8-AUM). This monitor consists of three Activ8s: one attached to the unaffected thigh and the other two to each wrist. During the data analysis, we applied two principles to overcome the limitation of using accelerometry. First, we applied a threshold to the movement counts: small, less intense movements are categorized as no arm use, and more intense movements are categorized as arm use. Second, we used data on body postures & movements of the leg sensor to distinguish between arm movements during lying/sitting and standing, and arm movements during other body postures & movements. Results of the study in ***Chapter 5*** show that, after a stroke, the Activ8-AUM measured arm use sufficiently correctly to allow this arm use monitor to measure physical behavior.

During stroke rehabilitation, a person's ultimate goal is to restore actual arm use in daily life. However, since the ability to move and use the arms is not exactly the same as actually using them, it is important to assess actual arm use in daily life, as well as arm function. The Activ8-AUM was applied in people after stroke to measure recovery of arm use and its relation with recovery of arm function during the first 26 weeks after the stroke. The results of this study are presented in ***Chapter 6***. Arm use was measured at 3, 12, and 26 weeks after a stroke and was operationalized as the ratio of both arms; i.e. *'the* *movement counts of the affected arm divided by the movement counts of the unaffected arm'*. During the 26 weeks, there was a significant increase in the arm use ratio, although the ratio was low and dominated by the unaffected arm as compared to the reported ratio in healthy people. The arm use ratio seemed to be nonlinearly related with arm function, which was measured with the Fugl-Meyer Assessment. People with a better arm function had a more symmetrical arm use, although this was clearer in the higher arm functions. This nonlinear nature may indicate that a certain level of arm function is needed before the arms will be used in a more symmetrical way.

Chapter 7, the general discussion, summarizes and discusses the main findings of this thesis. These findings are discussed from two main perspectives: the different methodological aspects of measuring physical behavior, and the different components involved in physical behavior. These two perspectives are addressed from both a general and a stroke-specific viewpoint. Finally, the generalizability of these studies and their potential clinical implications are discussed, and some recommendations for future research are made.