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Medication Management and Patient Compliance in Old Age



Anna Beckman Gyllenstrand

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MEDICATION MANAGEMENT AND PATIENT COMPLIANCE IN OLD AGE

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TILL MINNET AV ANNA BECKMAN

1885-1973

*Jag åldras men lär ständigt nytt
Solon, omkring 600 f Kr*

ABSTRACT

In old age, many physiological functions decrease and many older people also suffer from multiple chronic conditions. This leads to high drug consumption, but may also impair the ability to manage these medications. The first objective of this thesis was to describe different aspects of medication management (MM) in the elderly, such as opening medicine containers, tablet swallowing and the cognitive components of MM. A second objective was to explore the relationships between MM and functions, demographics and compliance in an elderly population. Thirdly, we wanted to explore what older people do when facing difficulties with MM.

For this thesis, three different populations were used: the Kungsholmen project (paper I and III), the SWEOLD (paper II) and the Swedish National study on Aging and Care (SNAC) (paper IV). In the first and second studies we used tests of opening of containers and of MM respectively. In the third study data were collected on tablet sizes and volumes and correlated to age, gender, housing and self-reported ability to swallow medicines. For the fourth study we developed a questionnaire regarding several aspects of MM and patient compliance, also including questions of what the elderly do when facing difficulties with MM.

We found that a large proportion of older people living in the community have difficulties with MM. In the first study this was exemplified by the finding that a fairly large proportion was not able to open three different kinds of medicine containers. We also found that, among persons that did not manage to open the containers, a large proportion did not receive help with their own medications. In the second study we found that a test of MM including more cognitively demanding processes of MM, was very difficult to perform without making errors on one item or the other. In addition, the results from this test correlated poorly to the self-reported ability to manage medications.

In the third study we looked at self-reported ability to swallow tablets in relation to tablet sizes and volumes. The results show that there are older people that do experience difficulties when swallowing medicines and that they had a larger volume of tablets than others.

For the fourth study we used the theoretical framework of the International classification of functioning, disability and health (ICF). The questionnaire contained questions regarding a number of different aspects of MM, functions of importance to MM and patient compliance. We found that functions were highly correlated to activities of MM. We also found that functions and activities of MM both separately correlated to patient compliance. When asked about strategies when experiencing difficulties with their medications, the elderly in our sample reported that they find ways to manage these difficulties with or without help or aids of any kind.

SVENSK SAMMANFATTNING

När vi åldras påverkas många av kroppens funktioner negativt. Vi får till exempel svårare att gå, att höra och att se. Vår kognitiva förmåga drabbas också. Likaså drabbas många äldre av kroniska sjukdomar som kräver behandling, vilket i de flesta fall innebär farmakologisk behandling.

Ett vanligt perspektiv på läkemedelsanvändning är utifrån följsamhet till ordination, vilket kan beskrivas som "den utsträckning man följer råd om hälsan". Vad som inte är så väl studerat är däremot, hur väl man praktiskt klarar av att ta sina läkemedel. Denna avhandling studerar hur väl äldre klarar sin läkemedelshantering utifrån fyra olika perspektiv: hur äldre klarar av att öppna läkemedelsförpackningar (studie 1), hur väl äldre klarar ett test av läkemedelshantering med bland annat några kognitiva moment (studie 2), hur många äldre som har svårt att svälja samt hur stora tabletter äldre tar (studie 3), och slutligen huruvida en nedsättning i kroppsliga funktioner är kopplade till läkemedelshantering och till följsamhet, samt vad äldre gör när de har svårt att klara av sin läkemedelshantering (studie 4).

Tre olika projekt har legat till grund för dessa studier. Till studierna 1 och 3 har vi använt data från Kungsholmprojektets (KHP) andra uppföljning (1994-96), omfattande ett test av förmågan att öppna medicinförpackningar, information om aktuell läkemedelsanvändning, samt frågor om svårigheter att svälja sina mediciner. Studie 2 baseras på SWEOLD, nationell studie av äldre i Sverige, där deltagarna i samband med intervjun även fick göra ett test av läkemedelshantering (öppna en läkemedelsförpackning, läsa en apoteksetikett, förstå en instruktion på en medicin, räkna ut hur länge en medicin skulle räcka samt räkna ut växeln på ett apotekskvitto). Den fjärde studien baseras på den pågående undersökningen Swedish National study on Aging and Care (SNAC). Till ett slumpmässigt urval av de deltagare som var äldre än 80 år, skickade vi ut en enkät om läkemedelshantering, där det även ingick frågor om följsamhet, funktionell status och vad man gör vid problem med läkemedelshantering.

Resultaten visar allmänt att många äldre har problem med många olika delar av sin läkemedelshantering. I den första studien såg vi att många hade problem med att öppna vanliga typer av läkemedelsförpackningar och ta ut en tablett. Många av de äldre som inte klarade av detta fick heller inte någon hjälp med att ta sina mediciner.

I den andra studien fick de äldre genomföra fem olika moment i ett test av läkemedelshantering. Vi fann då att 66 % av dem som genomförde testet inte klarade av alla fem momenten. De som var svårast var de som var av mer kognitiv art. Det visade sig även vara en stor skillnad mellan den självrapporterade förmågan att klara av att hantera sin medicinering och resultatet av testet på läkemedelshantering.

Vi fann i den tredje studien, att 13 % av de äldre upplevde svårigheter att svälja mediciner. Vidare såg vi att de allra äldsta tog de största tabletterna, och att de som sade sig ha svårt att svälja mediciner också hade en större volym tabletter.

Till den fjärde studien använde vi en teoretisk modell som grund för studie av läkemedelshantering i relation till följsamhet. Vi utarbetade en enkät som skickades ut till ett slumpmässigt urval av deltagare, över 80 år, i SNAC, boende på Kungsholmen i Stockholm och i Nordanstig i Hälsingland. Resultaten visade att kroppsliga funktioner var starkt korrelerade till förmågan att hantera läkemedel. Vi fann också att dessa båda faktorer var kopplade till ett mått på följsamhet. Vi fann vidare att de flesta angav att de vid problem med hanteringen av sina läkemedel, skulle be om hjälp, från till exempel en anhörig. Oftast svarade man dock att man skulle klara sig bra, trots svårigheter.

Sammanfattningsvis visar dessa studier, att många äldre på olika sätt har svårt att hantera sina läkemedel, och att detta kan inverka på följsamheten. Det finns behov av mer forskning inom området.

LIST OF PUBLICATIONS

- I. The difficulty of opening medicine containers in old age. A population-based study. Beckman A, Bernsten C, Parker MG, Thorslund M, Fastbom J. *Pharmacy, World and Science* 2005;27:393-8
- II. Can elderly people take their medicine? Beckman AG, Parker MG, Thorslund M. *Patient Education and Counseling* 2005;59:186-91.
- III. Tablet size and swallowing in the elderly. Beckman Gyllenstrand A, Bernsten C, Thorslund M, Fastbom J. Manuscript.
- IV. Medication management among the oldest old living in the community. Beckman Gyllenstrand A, Bernsten C, Fastbom J, Johnell K. Manuscript.

CONTENTS

1	Thesis summary – Main Section.....	1
1.1	Background.....	1
1.2	Older people and medications.....	1
1.3	Compliance.....	2
1.3.1	Definition of compliance.....	2
1.3.2	Magnitude of non-compliance.....	2
1.3.3	Predictors of and reasons for non-compliance.....	2
1.3.4	Compliance as a health behavior.....	3
1.4	Definition of medication management (MM).....	4
1.4.1	What should be included in MM.....	4
1.4.2	The individual drug use and MM.....	5
1.5	Functions involved in MM.....	5
1.6	Body functions in the older person.....	6
1.6.1	Cognition and the older person.....	6
1.6.2	The concept of everyday cognition.....	6
1.7	Disability/ability.....	7
1.7.1	The chosen framework - ICF.....	7
1.7.2	How can ICF be used as a framework for MM?.....	8
1.8	MM in previous research.....	9
1.8.1	Tests of MM.....	9
1.8.2	Extent of problems with MM.....	11
1.8.3	Factors studied in relation to MM.....	11
1.8.4	MM and compliance.....	11
1.9	Individual parts of MM.....	12
1.9.1	Understanding instructions.....	12
1.9.2	Opening containers.....	12
1.9.3	Swallowing tablets.....	13
1.9.4	Inhaler techniques.....	13
2	Aims.....	15
2.1	Specific aims:.....	15
3	Patients and methods.....	16
3.1	Kungsholmen project.....	16
3.1.1	Population.....	16
3.1.2	Measures.....	16
3.2	SWEOLD II.....	17
3.2.1	Population.....	17
3.2.2	Measures.....	17
3.3	SNAC.....	17
3.3.1	Population.....	17
3.3.2	Measures.....	17
3.4	Statistical analyses.....	18
3.5	Ethical considerations.....	19
4	Results.....	21
4.1	Paper I: The difficulty of opening medicine containers in old age. A population-based study.....	21

4.2	Paper II: can elderly people take their medicines?	22
4.3	Paper III: Tablet size and swallowing in the elderly	23
4.3.1	Tablet size.....	23
4.3.2	Swallowing.....	23
4.3.3	Tablet size and swallowing.....	23
4.4	Paper IV: MM among the oldest old living in the community	24
5	Discussion.....	26
5.1	Methodological issues	26
5.1.1	Validity of tests of MM.....	26
5.1.2	Validity of measure of compliance.....	27
5.1.3	Selection bias?.....	27
5.2	Paper I: Opening containers	28
5.3	Paper II: Medication management	28
5.4	Paper III: Tablet Swallowing	29
5.5	Paper IV: MM among the oldest old	29
5.6	Choosing a framework for MM	30
5.6.1	Definition and structure of MM.....	30
5.6.2	Behaviors vs activities	30
5.6.3	Another view of MM	31
5.6.4	Choosing a framework for MM.....	31
5.6.5	The ICF model	31
5.7	Compliance and MM.....	32
5.8	Facing difficulties with MM	33
5.8.1	Compensating for difficulties	33
5.8.2	Help and MM	33
5.9	Conclusions	35
5.10	Future perspectives	36
6	Acknowledgements	37
7	References	39
8	Appendix	45
8.1	List of dissertations from Stockholm Gerontology Research Center and Aging Research Center 1991-2006.....	45

LIST OF ABBREVIATIONS

MM	Medication Management
IADL	Instrumental Activities of Daily Living
ADL	Activities of Daily Living
MMSE	Mini Mental State Examination
ICF	International Classification of Functioning, Disability and Health
SoS	National Board of Health and Welfare
WHO	World Health Organization (Socialstyrelsen)
SWEOLD	Swedish Panel Study of Living Conditions of the Oldest Old
SNAC	Swedish National study on Aging and Care

1 THESIS SUMMARY – MAIN SECTION

1.1 BACKGROUND

In the western society, people live longer and many reach older age in good health. In Sweden today, 17.4 % of the population is above 65 years and older and 8.8 % is 75 years or older.¹ Developing countries are also experiencing an aging of the population. In the present thesis, when talking about old people, I consider people who have reached the age over 75 years or above, which is an important age, with regard to both physiological and pharmacological changes. Many older people live healthy lives with only minor functional limitations. However, there are also older people that suffer from several different, both normal and pathological, aging processes that will limit their functional status. A large proportion of the elderly experience difficulties with their everyday tasks.² As described in more detail below, both functions and cognitive abilities decline with age.

In our society today, a great shift has occurred, with more people living at home much longer. Therefore, it is of great importance whether the older people living in their own home are actually capable to manage their medications.³

1.2 OLDER PEOPLE AND MEDICATIONS

Simultaneously with a decrease in function and activities, the older person experience more diseases and symptoms demanding medical treatment. Since the most common medical treatment today is pharmacological, elderly people use a substantial number of drugs; between 4 and 6 drugs per person and day.^{4,5} Older patients living in nursing homes use even more; on average ten drugs per person and day.⁶ One commonly recognized aspect of drug use is the notion of patient *compliance*. As we will discuss in more detail in the next section, the older person is about as compliant to medical advice as the younger person, though the reasons for not complying might differ.⁷ Another important aspect of drug use is the *medication management* (MM), which this thesis will investigate and discuss in more depth.

The most commonly used delivery form for pharmaceutical preparations today is the tablet. But all drugs cannot be manufactured as tablets and therefore will be found in other forms. Every preparation has special instructions for how to administer and handle it. And many delivery forms are sensitive to incorrect handling. The way these preparations are to be handled can be rather complicated, possibly demanding both intact cognitive and physical functioning.

Therefore, the activities involved in the handling of drugs, the MM, are of utmost importance for the older person.

1.3 COMPLIANCE

1.3.1 Definition of compliance

Compliance and *adherence* have been used interchangeably over the years. *Compliance* was defined already in the 70s to be “the extent to which a person’s behavior coincides with medical or health care advice”.⁸ One major criticism to the compliance research was the view of compliance as merely being the patient’s obedience to the authoritarian physician’s advice. The word *adherence* has been proposed to be used as an alternative to compliance but with the same basic definition.^{9,10} In this thesis I have chosen to use the term compliance. The main reason is that there is no clear difference between the terms with respect to the outcome of the behavior. Adherence has by some been argued to denote how much a patient follows the agreed-upon advice between the health care provider and the patient. Patient compliance is as described above, how well the patient follows the advice given by the health care provider. Hence, the difference in the outcome is negligible, since both concepts describe how well the person follows advice.

1.3.2 Magnitude of non-compliance

A lot of research has been devoted to study the magnitude of patient compliance, or rather non-compliance. There is, however, no consensus on this, partly due to the difference in measuring. Most figures show non-compliance to be between 30 and 70 %, ^{7, 11} with a mean of approximately 50 % ¹². Being old does not seem to be a predictor of poor compliance. Instead, the compliance rates seem to be similar or even higher in older compared to younger age groups.^{9, 13, 14}

1.3.3 Predictors of and reasons for non-compliance

The research on patient compliance is vast. Numerous studies have looked at patient compliance and tried to find predictors. Already in the late 70s, Haynes wrote a review of a large number of compliance studies and their findings on variables of interest for patient compliance. Over 200 variables had at that point been studied in connection to compliance.⁸ Also more recent research has investigated predictors of compliance.^{10, 14} There are, however, only a few variables that do show relationships to general compliance in repeated studies: the most often mentioned are number of doses per day and number of medicines.^{10, 14} Also, disability has been linked to higher levels of compliance, explained by a higher degree of supervision in most cases.¹⁰ Sociodemographic variables such as marital status and socioeconomic status have been shown to poorly predict compliance.^{9, 10, 14}

Other factors that have been of interest in this research, mainly in older people, is how functions and activities are related to compliance. Examples of such factors are functions such as vision and cognition, and activities such as ability to understand instructions, open medicine containers, literacy etc. There are a substantial number of studies examining the relation between these factors and patient compliance. Some have shown correlations between compliance and cognition.¹⁵⁻¹⁷ However, cognition is more complex than just being able to remember to take the medicine and therefore studies on cognition and compliance might not show clear relationships.

Some studies have looked at opening of medicine containers without finding any consistent association.¹⁸⁻²¹ In several other studies, having difficulties opening containers has been described as being reasons for not adhering to prescribed

directions.^{22, 23} There are also studies looking at the ability to read labels and the correlation to patient compliance, also with inconsistent results.²⁴

In addition, there are a large number of qualitative studies asking people about compliance and related issues. In an interesting work by Donovan and Blake they found that most people use internal cost-benefit analysis when deciding on whether or not to use the medicine.²⁵ From the synthesis of several qualitative studies in the field, Pound et al found that most people are reluctant to take medicines and that health-care professionals have to take this into account when prescribing and supporting patients.²⁶

In conclusion, people do not take their medicines. Individual persons have different reasons for not complying with medical advice. In this sense, we need to change perspective.

1.3.4 Compliance as a health behavior

Patient compliance can be viewed as a health behavior which can be studied using behavioral models.²⁷ Many different health behavior models can be used, for example the *Health Belief Model*, the *Theory of Reasoned Action*, the *Transtheoretical Model*, *Social Cognitive Theory* etc.²⁷⁻³¹ They all describe the behavior of interest as a result of both internal and external factors, such as attitudes, norms, perceived barriers and benefits and motivations. Many of these models have successfully been implemented in studies of patient compliance.

One such model of patient compliance is the one constructed by Horne.⁹ Here, compliance is described as either *intentional* or *unintentional*. Unintentional reasons for not complying with the instructions from the physician are mainly due to inability to manage the practical aspects of medications, problems with remembering to take the drug or misunderstandings of how or why the drug should be taken.⁹ Intentional noncompliance, on the other hand, is when the person decides not to take the medicine for some reason.⁹ This is depicted in figure 1. This way of viewing compliance has also been used by other researchers.³²

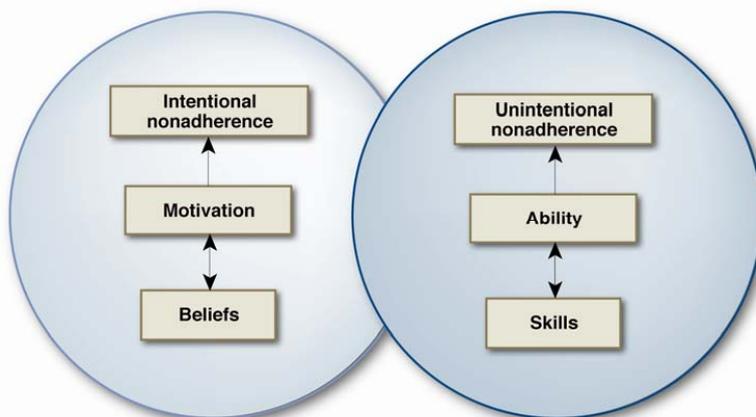


Figure 1: Model of compliance by Horne.

As can be seen in this model, the unintentional noncompliance is guided by the ability. The ability to handle drugs can also be seen as MM.

1.4 DEFINITION OF MEDICATION MANAGEMENT (MM)

In the literature, MM has been defined in many different ways. Some argue that MM has to do with the total management of drug use, in an organizational manner from the payer's perspective.³³ Others view MM as the practical part of patient adherence to medications.³⁴ There is also the view of MM covering the administrative aspects of drug use, such as prescribing patterns and administration of drugs.^{35, 36} Still others use the term MM to define the practical handling of drug use, such as knowing how and why to take the medicine and being able to perform the actions involved.^{37, 38} For example, Ruscin and Semla use this description: "managing medications is an instrumental self-care activity that requires cognitive and functional capacities to coordinate and carry out the associated tasks".³⁷

This thesis will use the latter definition of the concept and specifically describe MM in the elderly person. MM has historically been studied as different entities, such as ability to open medicine containers, use inhalation preparations, understanding instructions. From these separate entities, the broader concept of MM as the practical aspect of handling of medications has eventually emerged.

1.4.1 What should be included in MM

Legal documents from the National Board of Health and Welfare (SoS) describe the professional working process of MM in Sweden.³⁹ They use five steps to clarify the process of MM:

- Prescription
- Ordering of drugs
- Storing of drugs
- Prepare dose for administration
- Administration

This description of MM includes all the elements that take place when drugs are handled in institutional care in Sweden. This process comes from empirical knowledge of what is actually of importance for drug use when health care professionals are responsible for the care of a patient. Therefore, this description encompasses what actually takes place when drugs are handled. This view is close to what in England is called the medicines management, meaning how drugs are handled by professionals (though mostly in pharmacies). This view is still a professional perspective and there is a need to translate the process to a patient's perspective of what happens practically when a person handles his or her own medications. Therefore the elements of the process described by SoS have in this thesis been slightly modified, to fit an ambulatory setting and the individual use of medication in the home environment.

1.4.2 The individual drug use and MM

- Receiving a prescription.

In order to be able to receive a prescription for a drug there are a number of steps necessary to be carried out successfully. The person needs to find a physician, establish rapport with the physician, communicate the problem at hand, get the appropriate diagnosis and finally receive the appropriate prescription. Receiving a prescription was not shown to be of great concern to older patients in the study by Sorensen et al., although it was performed on a quite specific population of old persons.⁴⁰

- Filling the prescription

When filling a prescription, the person needs to find, reach and enter the pharmacy. At the pharmacy, he/she will have to communicate with the pharmacist about the prescription and medication, ask appropriate questions, pay for the drug and bring it home.

- Storing the drug

Drugs are to be stored under the proper conditions to maintain their proper action. Due to basic chemical reactions, substances change when affected by for example light, oxygen, water etc. This means that the person using the drug will have to remember instructions given at the pharmacy, or read instructions on leaflets, in order to store the medicine correctly.

- Preparing a dose for administration

When preparing a dose for administration there are several steps to undertake. The person preparing the dose needs to remember, or be able to read, dosing instructions, for example number of tablets at specific times. Next, the physical action needs to be taken in order to prepare the dose; for example opening a medicine container, take out a tablet and maybe dividing it in half.

- Administering a dose

Most drugs are manufactured as tablets or capsules that should be swallowed. In these cases, the administration of the drug is fairly simple, although, as shown below, this may not always be trouble-free. In other cases, however, the administration can be rather complicated, involving for example inhalation, applying eye droplets or injecting a drug subcutaneously.

To fully understand what predicts and affect MM, I will first discuss some of the body functions that are of importance to MM.

1.5 FUNCTIONS INVOLVED IN MM

In the five steps of the MM process described above, we find several functional components that are consistent over the whole course of MM. These components are vision; memory and comprehension; hand function and mobility. They are more or less salient and of more or less importance in each step, but crucial for the whole process.

This is also consistent with previous studies relating functions to different views of MM, where many have focused on vision,⁴¹ comprehension,⁴² hand function^{20, 43-45} and memory.^{20, 37, 46-49}

1.6 BODY FUNCTIONS IN THE OLDER PERSON

In the aging body, many abilities are affected – most often with a decreased function as a result.^{41, 50-55} Examples of functions affected by age and of importance to MM, are vision, hearing, balance, ability to walk, hand function, and cognition. Cognition is particularly relevant in this perspective, since this function is of such importance both for the elderly in general and for MM in particular.

1.6.1 Cognition and the older person

Cognitive function is usually described as several types of memory, reflecting different cognitive functions. The memory responsible for the knowledge of for example vocabulary is called the semantic memory. This is decreased by age, rather the opposite. With increasing age, the semantic memory increases. This is also the case with procedural memory (acquisition of skills occurring gradually as a function of practice) or primary memory (holding information in consciousness).⁵⁵

However, other forms of memory decline with age, for example working memory (processing, simultaneously with holding information), and different forms of episodic memory such as prospective memory (remembering future events).⁵⁵ This particular memory is of great importance to drug use, since this is what takes place in the everyday use of drugs. We need to be able to remember to take the drug at a specific point in time in the future. The prospective memory is shown to be differentiated in how it is affected by age. When external reminders are present, the prospective memory is not affected to the same extent as when the person has to rely on internal reminders.⁵⁵

In their study on adherence and cognition, Brown and Park used theories of cognitive aging to explain why older people adhere to medical advice to the same extent as younger people.⁵⁶ This is a useful view of how we age cognitively and how this will affect our behaviors. They divided cognition in two broader categories, *effortful processing* and *automatic processing*. *Effortful processing* includes the more complex cognitive processes, such as working memory and processing speed, where the person has to cognitively process received information. An effortful process can be exemplified as comprehending complex information or implementing a complicated treatment plan. The cognitive processes that take place in the effortful processing are highly affected by age. *Automatic processing* on the other hand, do not require considerable mental processing. Here, the person relies on external cues from their daily routines to fulfill the behavior. As described above, familiarity and relying on external cues are mental processes that do not decline with age by far to the same extent as the effortful processes.

1.6.2 The concept of everyday cognition

In the 90s the studies on cognition were criticized for their use of psychological tests. These tests were considered limited, since they only measured very abstract thinking and not the ability the person actually has to manage everyday situations and the context he/she acts within. The concept of everyday cognition evolved from this thinking and include tests of cognition that take into account competences of importance in order to be able to manage the everyday context we live in.^{42, 57} These everyday cognitive abilities are exemplified as IADL abilities. Among other studies, Diehl and colleagues showed IADL abilities to be closely related to cognitive abilities and mainly fluid intelligence which is close to effortful processing.⁴² A similar study

was performed by Grigsby et al., where MM issues were regarded as one dimension of IADL activities. They found that executive functions were of great importance for IADL in general and MM in particular.⁵⁸

Another paper on everyday cognition and MM, related several different research areas where these concepts are investigated.⁵⁹ For example they described the different notions of *inferential* and *literal* questions, where inferential questions demand the subject to use more than one source of information to answer the question, whereas the literal question is possible to answer from only one source of information. The inferential question is then more cognitively demanding and sensitive to cognitive changes within the subject.⁵⁹

When studying a concept such as MM it is helpful to put it into a theoretical framework. Using a framework makes the study of the concept easier to grasp and there is an opportunity to see the possible relationships with other factors. In the following section I will look at a research field, which uses models that might be of interest for the concept of MM.

1.7 DISABILITY/ABILITY

Disability has been studied extensively over the years. There are a number of models describing the concept of disability and how the person suffering from the disability is affected. One of the most influential models is described by Verbrugge and Jette.⁶⁰ They describe the disablement process as consisting of four stages: *pathology*, *impairment*, *functional limitation* and *disability*. Extra- and intraindividual factors are said to affect the functional limitation which in turn will affect the disability. The disability would be when the person has difficulties performing activities of daily life.

Bickenbach et al. wrote a review over other models of disability. In their review it is clear that the social aspect of disability, i.e. the society's response to a person's functional limitation, is of great importance.⁶¹ Until then, most research had focused on the person's handicap from a pathological perspective and as merely posing a demand on society.

1.7.1 The chosen framework - ICF

In 2002 the World Health Organization (WHO) released their second version of a disability model, called the International Classification of Functioning, disability and health (ICF).^{62, 63} This model is rather different than previous ones, in having a focus on ability rather than disability. This shift is of great importance for the individual, as well as for how society view people with a functional limitation. The model also includes contextual factors, such as social or psychological aspects of functional limitation (see Fig. 2).

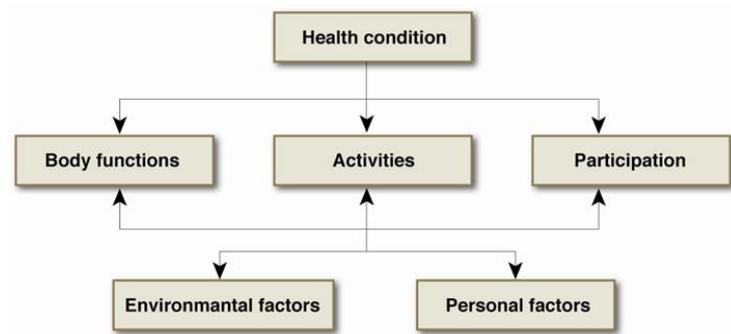


Figure 2: The ICF model

The terms used in ICF reflect the shift from *disability* to *ability*, with body structure/functions, activity and social participation as the main domains of the model (which can be compared to functional limitation, disability etc., that were used in other models). *Body functions* are described as “physiological functions of body systems”, *activity* “is the execution of a task or action by an individual” and *participation* “is involvement in a life situation”.⁶² Activity and participation are both describing functioning on the level of the individual meeting society. Therefore, these two domains can be difficult to disentangle.

ICF incorporates other aspects of importance to function, activity and participation, which makes it a biopsychosocial model. This is shown as the different components that will affect either one of function, activity and participation, but also a combination of them. This model can be used both to describe and investigate disabilities within certain populations or groups. But the main aim of it is to provide a classification system of limitations in function, activity and participation that can be used in clinical settings.⁶²

1.7.2 How can ICF be used as a framework for MM?

First, the process of MM described by SoS could be viewed as the activity domain of ICF. Secondly, the functional components of MM are viewed as body functions according to the ICF model. As a third step, we want to include a measure of participation. The participation part of the model is, however, not as clear-cut as the other parts. It can be viewed as the outcome part of the model, what the person is able to do in his/her social context, as a result of the functional, and activity limitations he/she is restrained by. And as such, patient compliance could be viewed as a possible concept for the participation domain in a model of MM. In this thesis we will use this view and investigate whether patient compliance with medication will fit as the participation aspect.

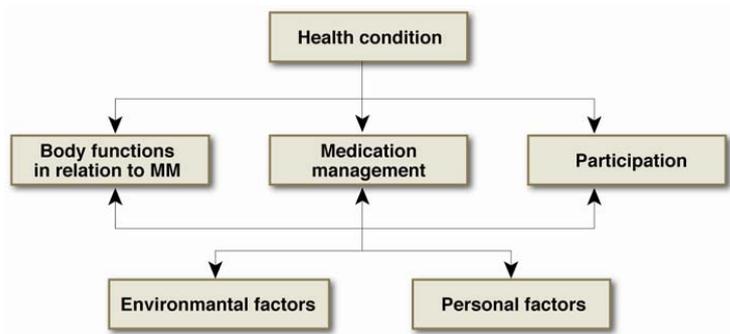


Figure 3: ICF as a framework for MM

1.8 MM IN PREVIOUS RESEARCH

In the first studies of MM, only one or two aspects of MM were examined, such as opening of medication containers, inhalation technique etc. In later studies of MM, however, a broader perspective of the subject has been used. For example, more issues relating to drug use has been incorporated and the term MM has been used more frequently. As mentioned previously, many of the studies have used the adherence perspective when studying MM. But there is still a lack of a consistent definition of MM, which means that most studies incorporate different aspects in their measure of the concept.

In this section the different ways of measuring the broader concept of MM will be described first, secondly some studies of the extent of problems of MM and finally we will deal with the factors that have been associated to MM in the literature so far.

1.8.1 Tests of MM

The first articles in this line of research, dealt with MM issues previously known to be of concern for older people.^{18, 19, 37, 64-67} Rather straight-forward tests were conducted to test older people's ability to manage medications, for example opening of several different medicine containers, reading different kinds of medicine labels, understanding simple instructions and differentiating between tablets of different colors.

The next line of research was more focused on MM from of a compliance perspective. The ability tested in these studies was the ability to implement a therapy. There are several major tests of this kind; *Regimen Comprehension Scale*, *Hopkins Medication Schedule*, *MMT*, *MMAA*, *DRUGS*, *MedTake* and *MedMaide*. These tests cover several aspects of MM in relation to implementation of a therapy, which in turn is related to patient adherence.

Other forms of measuring MM have been developed, such as questionnaires of MM with questions regarding self-administration of drugs. A brief description of the tests can be found in table 1.

Table 1: Tests of MM used previously in the literature.

Method	Assessment situation	Assessment technique	Medication management function tested	References
Hopkins Medication Schedule	Test	Filling a Dosett® from two bottles of medicines from two different dispensing schemes.	Comprehension, ability to handle pill bottles	Windham et al. 2005 ⁴¹ Carlson et al. 2005 ⁶⁸
Regimen comprehension scale	Interview	Questions asked to the subject about medication schedules presented simultaneously. Answers scored as right or wrong.	Comprehension	Yamada et al. 2001 ⁴⁶
Medication Management Test (MMT)	Test	Subject is asked to perform complex cognitive tasks that involve medication bottles and answering questions for which the answers can be found on the bottles.	Comprehension, ability to handle pill bottles	Albert et al. 2003, ⁴⁸ Fulmer and Gurland. 1997 ⁶⁹
Medication Management Ability Assessment (MMAA)	Test	Subject is asked to organize pills from pill bottles to a calendar according to dosing instructions and possibility to take with or without food.	Comprehension, ability to handle pill bottles	Jeste et al. 2003 ⁴⁷ Patterson et al. 2002 ⁷⁰
Drug Regimen Unassisted Grading Scale (DRUGS)	Interview and test	Identification, access, dosage and timing of the subject's own medications.	Knowledge and ability to handle pill bottles	Edelberg et al. 1999, ³⁸ Edelberg et al. 2000, ⁷¹ Kripalani et al. 2006, ⁷² Hutchison et al. 2006 ⁷³
MedTake	Interview and test	Evaluation of whether the subject took correct dose at the right time or own medicine, with right amount of water for the right indication.	Knowledge	Raehl et al. 2002 ³⁴
MedMaide	Interview	Assessment of knowledge of medications used, knowledge of how to use medications and knowledge on how to get medications.	Knowledge of medications and how to use them and how to get new prescriptions	Orwig et al. 2006 ⁵⁴
Older forms of medication management tests	Test	Tests of ability to open containers, divide a tablet, differentiating tablets of different color etc	Reading, comprehension and ability to handle medications	Ruscin and Semla, 1996 ³⁷ , Murray et al. 1986, ¹⁹ Griffiths et al. 2003 ⁷⁵
Medication management?	Interview	Question on ability of self-administration	Ability to self-administer drugs	Lieto et al. 2005 ⁷⁶
Observed Tasks of Daily Living	Test	Comprehending instructions, calculating length of treatment, loading a pill box	Comprehension and ability to handle medications	Diehl et al. ⁴²

1.8.2 Extent of problems with MM

The main problem in this research field is the lack of definition of the term MM. This makes comparisons between the different studies very difficult or even impossible, especially since the tests differ markedly in the way they are set. To further complicate matters, most studies are usually performed on specific patient groups and are not population based. Therefore, the possibility to generalize from the results is limited. Nevertheless, the studies describing the extent of problems with MM, show prevalence estimates of 8-78 %. Some studies do not present frequencies but only results of the test scores. In these studies one finds that most people seem to manage their medications rather well, since the scores are fairly high. However, as pointed out above, it is very difficult to generalize from these figures since so different methods and populations have been studied and no standard exists on what is considered a good result.

1.8.3 Factors studied in relation to MM

MM has been correlated to several aspects of function and medication, such as cognition, vision and activities of daily living. Cognitive ability has over the years been the most frequently described predictor of MM^{37, 46, 48, 64, 68, 70, 71} both in earlier studies of MM and in later, more adherence focused, papers.

The study on MM in HIV patients by Albert et al., showed that cognition was associated with both MM and consistency of medications taking in the day, which is an important factor when using HIV medications.⁴⁸ Vision⁴¹ and literacy⁷² has also been shown to affect MM. A broader concept of function as measured with ADL was correlating to MM in one study³⁷, although this was not repeated by others.³⁸ IADL has repeatedly been incorporated in studies of MM, but here MM has been regarded as part of, rather than a correlate to, IADL.^{57, 58, 77}

There are studies demonstrating that poor ability to manage one's medications is an important risk factor for living in some kind of assisted living facility.^{64, 71, 76} In addition, a study of heart failure patients, showed a correlation between both MM and medication knowledge, and number of visits at an emergency department.⁷⁸

1.8.4 MM and compliance

The main difference between MM and patient compliance is the fact that compliance is a health behavior governed not only by physical and mental restrictions, but also by, for example, attitudes, beliefs and norms.

In previous research, there are not many studies that have actually been able to find correlations between MM issues and patient compliance (see for example Vik et al., 2004¹⁴). This could partly be due to the fact that they have included only one or two different parts of the whole MM process. Nonetheless, the fact remains that there is no consensus on whether MM can actually affect compliance. And still, there are a number of people that experience difficulties with different aspects of MM. Why is there no correlation found between MM and patient compliance? What do people do when they cannot handle their medicines correctly?

1.9 Individual parts of MM

As can be seen from the previous section, MM has not been studied as the larger process proposed according to SoS, of handling of drugs. One main reason for this can be that the process is quite extensive and it is difficult to grasp as a whole. Therefore, it might add value to study individual parts of the process in more detail, which has been the focus of many studies over the years.

1.9.1 Understanding instructions

There is a number of studies dealing with the concept of understanding medical instructions such as advice regarding drug use and knowledge of drugs, especially in connection to the older person.^{32, 79-86} Older people have a lower level of understanding of medications, as shown by for example Kerzman et al. and Spiers et al.^{81, 86} In the study by Brown and Park they found that the older subjects learned less information, regardless of how familiar the disease was, than young people.⁸⁰ They attributed this finding to the fact that older people are less able to learn new information, due to decreased cognitive abilities of the older mind.⁸⁰

The functions mainly of importance for understanding instructions are cognition and communication, and in this case also the ability to read. Reading is in turn depending on vision. Moisan et al, found a clear relationship between reading ability and understanding instructions.²⁴ However, they did not find a correlation between reading ability/understanding instructions and patient adherence.

Understanding instructions has also been correlated to demographic variables. Wallsten et al. showed that the understanding of drugs were poorer in men and African Americans than women and Caucasians.⁶⁵ Comprehension of prescription drug warning labels was reported to be of concern for all subjects when they were presented as multi-step instructions.⁸⁷

The focus in many of these studies, is in relation to adherence.^{32, 79, 82, 85, 86} Barat et al reported patient adherence to be positively correlated to knowledge of the patient's drugs.⁷⁹ However, in other studies this has not been shown.²² The study by Okuno et al. used an experimental design to test whether home visits and counseling by a pharmacist would improve adherence.⁸⁵ They found that knowledge of drug purpose correlated positively to patient adherence in the counseled group, but the opposite direction was found in the un-counseled group. In other studies knowledge of drugs has only been found to be a reason and not a predictor for not adhering to medical advice (see for example Wallsten et al, 1995).⁶⁵

1.9.2 Opening containers

In the late 1970s, Charles Myers performed a survey of patients visiting a hospital pharmacy, asking them whether they had found it difficult to open a child-resistant container or not.⁸⁸ A few years later Sherman et al wrote an article discussing the problems many older people had with the opening of child-proof containers.⁸⁹ Several studies followed, describing different aspects of opening of containers in different settings and different medical conditions.^{44, 45, 88, 90-92} Several studies have shown that many older people have great difficulties when opening both child-proof and regular medicine containers such as a bottle with a flip-top.^{20, 45, 49, 90, 91} People suffering from

rheumatic disorders, mainly rheumatoid arthritis has also been shown to have great difficulties with medicine containers, especially suppositories.^{43, 44, 92, 93}

In later studies, the association between ability to open medicine containers and cognition has also been investigated. These studies have shown that patients with decreased cognition have more difficulties with their medicine containers than other people.^{20, 49}

Opening of medicine containers has also been correlated to patient compliance with different results. In the studies by Darnell et al., Murray et al. and Nikolaus et al., inability to open medication containers were related to a lower level of patient compliance.¹⁸⁻²⁰ In contrast, Botelho and Dudrak did not find any association with patient compliance.²¹ However, as these studies were all conducted on rather specific populations (elderly admitted to hospital, elderly living in public housing etc), the results might not reflect the situation of most elderly.

1.9.3 Swallowing tablets

A few studies have looked at the tablet intake in relation to MM or medication use. A Norwegian study investigated how patients at a GP clinic experienced swallowing tablets and found that 26 % reported difficulties, but only 19 % among the patients, aged 70 years and older.⁹⁴ There are also studies that have looked at ease of swallowing of different tablets, where one study showed that people usually prefer to swallow smaller tablets, and oval rather than round when the tablets are of larger size.⁹⁵ A similar study from Japan showed that people are more likely to be able to swallow several tablets at the same time when they are smaller.⁹⁶ This was repeated when a group of researchers found that patients preferred gelatin capsules over tablets, and, again, oval tablets rather than circular.⁹⁷ Another study looked at the transit time of tablets in the esophagus and found that it is prolonged in older people.⁹⁸ It might however be difficult to relate this finding to the perceived ability to swallow medications.

More recent papers on swallowing of tablets have shown that patients prefer orally disintegrating tablets over regular tablets,^{99, 100} and that many people divide tablets in order to make them easier to swallow.¹⁰¹

In an interesting paper by Gustafsson et al, the authors investigated how people with swallowing difficulties were treated by the physicians they met. They found that patients that were confirmed by their physician more often experienced improvement in swallowing difficulties.¹⁰² This study acknowledges the fact that psychosocial aspects of care are of great importance for both the care and outcomes for the patient.

Enlund et al. found, in their study on compliance factors, that some of the older people experienced difficulties with swallowing and, when prompted with answering options, stated this as a reason for not complying with the physician's advice.¹⁷

1.9.4 Inhaler techniques

One route of drug delivery that has received considerable attention over the years, is inhalation.¹⁰³⁻¹⁰⁷ Rather sophisticated delivery forms have been invented in the last decades, which require more precise handling than other forms of drug intake. Many reports have dealt with the fact that many of these inhalers are handled inappropriately.^{105, 106} The problem seems to be even more frequently occurring in older

age groups.¹⁰⁷ When inhaler technique has been studied in relation to other variables, a clear correlation was reported with cognition.^{103, 104}

2 AIMS

- To describe different aspects of MM, such as opening of medicine containers, tablet swallowing and the cognitive components of MM, in an elderly population
- To explore relationships between MM and functions, demographics and compliance in an elderly population
- To explore what older people do when facing difficulties with MM.

2.1 SPECIFIC AIMS:

- To study elderly people's ability to open different kinds of medicine containers in relation to their cognitive, visual and health status (paper I).
- To use performance tests of hand function, vision and medication competence, to assess the limitations in these dimensions in a population-based sample of elderly people (paper II).
- To study the different sizes, volumes and shapes of tablets and capsules used by the elderly and to correlate these measures to individual characteristics such as age, gender and living arrangement, as well as self-reported ability to swallow drugs (paper III).
- To study if MM can be investigated using the theoretical framework of ICF. To study if body functions are connected to activities of MM and if the body functions and activities of MM are correlated to patient compliance. Finally, to describe what elderly people do when they have difficulties with their MM (paper IV).

3 PATIENTS AND METHODS

Three different databases were used for this thesis, the Kungsholmen project (KHP), a follow-up study of the Swedish Panel Study of Living Conditions of the Oldest Old (SWEOLD II) and a sub-sample of the Swedish National study on Aging and Care (SNAC).

3.1 KUNGSHOLMEN PROJECT

3.1.1 Population

For paper I and III we used the second follow-up of the KHP, a population based cohort study on elderly people living in the Kungsholmen parish in Stockholm, Sweden. A more comprehensive description of the project can be found elsewhere.¹⁰⁸⁻¹¹⁰ All people aged 75 years and older were invited to this study on aging and dementia. A sample of 1810 out of a total of 2368 people, agreed to participate. The subjects were given a medical examination and were interviewed regarding psychological, medical and sociological matters. The subjects were then followed every three years and the same battery of questions and examinations were conducted each time. The second follow-up was performed between 1994 and 1996 and included 683 participants. The attrition between phase I and IV were 62.3 % (44 % due to death, 2 % due to relocation and 16.2 % due to refusal).

3.1.2 Measures

Included in the medical examination in all phases of the KHP, was a short test of cognitive function, MMSE.¹¹¹ The phase IV questionnaire also contained detailed information about drug use, collected by the examining doctor in connection to the medical examination. Participants were asked to bring medicine containers or prescriptions, for confirmation of the self-reported information.

The interview of phase IV also included a test on opening three different medicine containers: a bottle with a screw cap, a bottle with a snap lid and a blister pack. The test involved opening the container, taking out one tablet and closing the container again. Moreover, the interview included questions on how the person experienced swallowing of medicines. The data on ability to open medicine containers form the basis of paper I.

For paper III we used the information on drug use together with data from the ITAKA (Identifiering av tablett och kapslar, Swedish Corporation of National Pharmacies, 1994), a register containing information on size and shape of all tablet formulations in use in Sweden, with a new edition released every year. With these data, we made approximations on volumes of all tablets used in the Kungsholmen project, using four different formulas for the four types of shapes: capsules were calculated as cylinders with half a sphere at both ends, oval tablets were calculated as a cylinder with the base area of an ellipse. The round tablet was either calculated as a cylinder or as two tips of a sphere depending on whether the tablet was cupped or not. Based on these calculations we compiled a list of each person's tablet volumes (mean and total), largest tablet area and longest tablet length taken during one day, using a custom-designed Excel-spreadsheet.

In paper I and III we also included data from the inpatient register about medical diagnoses, which combined with the findings at the medical examination provided information on medical conditions including stroke, Parkinson's disease, rheumatoid arthritis and dementia.

3.2 SWEOLD II

3.2.1 Population

Sweold II is a follow-up study of a population-based study of elderly people in Sweden. This is a representative sample of older people aged 77 years and older, including 681 subjects. The subjects were interviewed in their homes by professional interviewers. When it was not possible to visit the person, or if the person did not want the interviewer to come, the subjects were interviewed over the phone.

3.2.2 Measures

The questionnaire in this study included questions on medicines, functional items and tests, social questions and some psychological questions. In phase II a test of MM was included, derived from the concept of everyday cognition.^{42, 58} The test involved the following dimensions: opening of a snap lid bottle, reading a text on a medicine label, understanding an instruction of a medication, calculating the length of a treatment and calculating change of a receipt. The last three items are more cognitively demanding and we therefore call them *medication competence*.

3.3 SNAC

3.3.1 Population

The fourth paper is based on a postal survey of a sample of the SNAC cohort.¹¹² The SNAC is an on-going population based cohort study of older people in four different regions in Sweden, with the main purpose of studying aging and dementia. The study began in 2001 when a random sample of people from different age cohorts was invited to participate. These cohorts were six years apart in the younger age groups and three years apart in the older age groups. The first data collection finished in 2004 and the same year the first follow-up was initiated. This follow-up was recently finished.

In our study we included a sample of participants from two of the regions: Kungsholmen in Stockholm and Nordanstig in northern Sweden that had taken part in the first follow-up of the SNAC study. We drew a sample with the following inclusion criteria: older than 80 years of age, MMSE above 24 and living in own home. In total, 543 cases were included.

3.3.2 Measures

A postal questionnaire was sent to the selected persons, with a reminder letter after a few weeks. The questionnaire contained questions specifically designed for this study, based on the framework of ICF and the process of MM described by SoS, including questions on different functions of importance for MM and some questions regarding compliance. These were asked as questions and statements with response alternatives in the form of a five-point Likert scale. The last part of the questionnaire contained questions regarding what people do to compensate for difficulties when handling medications. These were semi-structured questions with mostly fixed alternatives and one or two open-ended response alternatives.

Three scores were developed for the analyses. The first was a score of *functions* including ability to read medication labels, remembering to take medicines, communication ability (describe your problem to physician and hearing pharmacy conversation) understanding instructions and hand function (mobility and strength). The second score included items of *activities* of the whole process of MM according to SoS. The items were: ease of getting an appointment with the physician, ease of receiving a prescription, ease of getting to the pharmacy, receiving the medicine at the pharmacy, knowing dosing instructions, being able to open a medicine container, taking out a tablet and being able to swallow a tablet.

For the issue of *compliance* we used the Theory of Reasoned Action as an inspirational source when creating a score of drug use intention that included two variables: a question about satisfaction with medicines and the statement “a practical difficulty with your medicines is a good reason not to take them altogether”.

3.4 STATISTICAL ANALYSES

Statistical analyses were made using the software SPSS for Windows version 11-13 (SPSS Inc, Chicago, 1989-2005).

Study I: Frequencies of elderly people not able to open the different medicine containers were analyzed and comparisons were made with age, gender and living arrangements using chi-square analyses. Secondly, logistic regression analysis was performed including as the dependent variable ability to open the containers. Independent variables were age, gender, living arrangements, vision, MMSE and medical conditions. As a third step in this study we used chi-square analysis to investigate whether or not the subjects that did not manage their containers received help with their own medications.

Study II: For this study we used chi-square analyses for the investigation of the dependent variable (passed the test/items or not) in relation to age and gender. We also did a second analysis where we compared the self-reported ability to manage medications with ability to manage the test using chi-square. Also an analysis of mean number of drugs used for the groups that did and did not pass the test was performed using ANOVA.

Study III: In this study we used ANOVA to compare the means of the different tablet sizes for the different independent variables. We also used chi-square analyses for the comparisons of the categorical data in the last analysis where volumes, living arrangements and swallowing ability were compared.

Study IV: The scores that were developed as measures of functions, activities of MM and patient compliance were analyzed using logistic regression. In the first logistic regression analysis, three different models were used with activities of MM as the dependent variable: (1) including functions, age and gender as independent variables, (2) As model 1 but also including living alone or not; (3) as model 2 but also including self-rated health and satisfaction with medicines.

In the second logistic regression analysis patient compliance was included as the dependent variable. For the first model in this analysis we included functions, age and gender. In the second model age, gender and activities of MM were included. In the last model age, gender, functions and activities of MM were all included.

Table 2: The included studies, with population sizes, sample sizes, main outcome variables and statistical method used.

	Population	Population size	Sample size	Main outcome	Statistical analysis
Study 1	KHP, phase IV	683	604	Ability to open medicine containers	Chi-square, logistic regression
Study 2	SWEOLD II	621	492	MM ability: 5 times related to MM	Chi-square
Study 3	KHP, phase IV	683	558	Self-reported ability to swallow medicines	ANOVA
Study 4	SNAC (Sample from Kungsholmen, Nordanstig)	543	307	Activities of MM, compliance	Logistic regression

3.5 ETHICAL CONSIDERATIONS

When conducting research on people, there is always the need to have an ethical perspective on what you do and how you do it. In this study, three different samples from three different data collection projects have been used. In the fourth study, people were also asked to fill in an extra questionnaire. All these projects have included people from the general population, rather than healthy volunteers. Therefore, it is important to consider how these people were approached and consented to participate.

For both the KHP and the SNAC project, all potential participants were sent a letter of invitation, briefly explaining the project and their role in the project. As a second step, they were contacted by a nurse over the phone and asked whether or not they were willing to participate. Participation was voluntary and the participant could withdraw from the project at any time. If the person was severely cognitively impaired, a proxy was approached for consent of participation.

For the SWEOLD study, a similar approach was used. Possible participants were sent letters of invitation. In this study, the interviews were conducted by a company specialized in performing interviews. This company then approached the person and asked for consent and set a time for the interview.

In the fourth study, we sent the questionnaires to a sample of participants in the SNAC study. With the questionnaire, a letter was included explaining the particular project and the reason for performing it. Since we wanted to correlate the results from the questionnaire with previously collected data from the SNAC project, we asked for permission from the participant to do this.

The KHP, the SWEOLD project and the SNAC project have all been approved by Ethics Committees. Also the questionnaire sent out for our last paper has been approved by Ethics Committee. See approvals below:

Kungsholmen Project:	Karolinska Institutet	Dnr 94:122
SWEOLD II:	Karolinska Institutet	Dnr 03:413
MM project:	Regional ethics committee	Dnr 2006/5:3

4 RESULTS

4.1 PAPER I: THE DIFFICULTY OF OPENING MEDICINE CONTAINERS IN OLD AGE. A POPULATION-BASED STUDY

The original cohort in phase IV of the Kungsholmen project included 683 subjects. Of these, 604 performed the test for all three types of containers. Among those that did not perform the test, a higher proportion (67 %, compared to 18 %) lived in some form of institutional care. These subjects also suffered from more medical conditions and used more drugs.

Of the 604 subjects that performed the test, 86 %, 68 % and 90 % could open and take out a tablet from the bottle with a screw cap, the bottle with a snap lid and the blister pack respectively.

Table 3: Ability to open the three different containers included in the test.

	Bottle with a screw cap	Bottle with a snap lid	Blister pack
Total	85.8	68.2	90.2
Age groups			
81-84	88.4	84.7	95.8
85-89	88.1	71.7	92.2
90+	77.9	37.9	78.6
Gender			
Men	87.4	84.4	94.8
Women	85.3	63.5	88.9
Living arrangements			
Own home	90.7	76.1	96.3
Sheltered accommodation	83.9	48.4	83.9
Institution	38.8	14.3	36.7

In the logistic regression analysis we found that sheltered accommodation and dementia was highly correlated to the ability to open all three types of container. Age was also correlated to ability to open the blister pack.

We also correlated the ability to open drug containers to medical diagnoses of possible importance: previous stroke, Parkinson's disease, dementia and rheumatoid arthritis. Rheumatoid arthritis was significantly correlated to the ability to open the bottle with a screw cap. The odds ratio (OR) for the association between opening ability and Parkinson's disease was quite high (3.33, 12.25 and 6.33 respectively), although significant only for the snap lid bottle, probably due to the very small number of subjects suffering from Parkinson's disease. We also found that cognitive impairment, as measured by MMSE, was significantly associated with lower ability to open all the tested medicine containers (see figure 4) and impaired vision to decreased ability to open the blister pack. Finally, we found that 52.2 % of those that could not open all three medicine containers did not receive help with their medications.

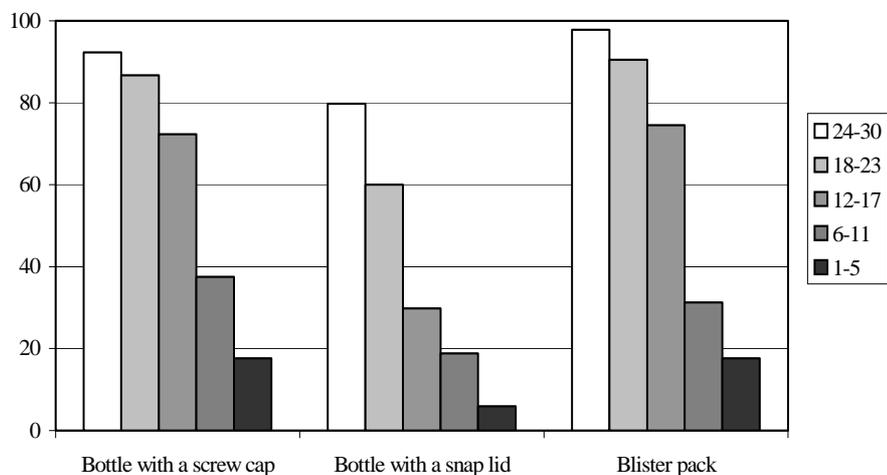


Figure 4: Ability to open the different containers correlated to MMSE

4.2 PAPER II: CAN ELDERLY PEOPLE TAKE THEIR MEDICINES?

The original sample comprised 621 subjects in the SWEOLD-cohort of 2002. In this study we used data from the performance test of MM and therefore excluded all the proxy interviews (n = 82) and interviews conducted over the phone (n = 47). Thus the study population included 492 elderly people who performed the test of MM.

The results from the individual items of the test showed that the less cognitively demanding items – opening of a container and reading a label – were the easiest to perform, 90.6 % and 85.4 % respectively were able to carry out these items.

The other three items – understanding an instruction, calculating length of a treatment and calculating change of a receipt – were more demanding; 59.3 %, 52.6 % and 80 % respectively, passed these items of the medication competence test.

We also investigated the performance on the individual items and found that the most demanding task was the calculation of treatment length. The medication competence tasks in general were more difficult than the more physical tests of reading and opening, and also more cognitively challenging.

When comparing different age groups we found that older age correlated with worse performance. Gender had no significant relationship with the performance, except for two items: opening of the medicine container and calculating change of a receipt, where men performed better than women.

In a second step of the analysis we examined how well the self-reported ability to manage one’s medication correlated with the results from the performance test. We found that a substantial proportion of the subjects who reported that they could manage their medication were not able to perform all the tests of MM (see table 4).

Table 4: Frequency that passed and did not pass the MM tests of those that stated that they were able and not able to take their medicines themselves. Also included is the mean number of drugs taken regularly by the people that did and did not pass the test.

	Passed	Did not pass all tests	Significance
Self-reported ability to take medicines			
Able to take medicines	39.5	60.5	***
Not able to take medicines	4.7	95.3	
Number of drugs	4.08	5.13	**

4.3 PAPER III: TABLET SIZE AND SWALLOWING IN THE ELDERLY

This study was based on 681 persons with complete information of drug use, out of the total of 683 in the population of phase IV of the Kungsholmen project.

4.3.1 Tablet size

We calculated the sizes of tablets or capsules used (hereafter referred to as *tablets*) from the detailed information on drug use combined with the information on the shape of different tablets derived from ITAKA, to obtain four different measures of tablet size, in each individual in the study:

- Total volume of tablets taken in one day.
- Mean volume of the tablets taken in one day.
- Largest tablet of any of the tablets taken in one day.
- Greatest length of any of the tablets taken in one day.

For this, we needed the exact information on the tablets used: brand, strength and dosage, and therefore had to exclude some of our subjects for whom we lacked some of this information. Also, some of the subjects did not use any tablets or capsules. Thus our final study population consisted of 558 people.

We found that the oldest age group had the highest total volume of tablets and the largest tablet area.

4.3.2 Swallowing

Thirteen percent reported to have difficulties with the swallowing of medicines. This did not significantly correlate to either age, sex or living arrangements. We also analyzed the relationship between swallowing ability and some medical conditions that may affect swallowing – Parkinson’s disease, previous stroke, rheumatoid arthritis and dementia – but did not find any significant association.

4.3.3 Tablet size and swallowing

The subjects reporting difficulties with the swallowing of medicines also took a larger total volume of tablets. When dividing the total volume into equally sized groups, we found that among those living in their own home and in sheltered accommodation the

elderly reporting difficulties with swallowing tablets had a larger total volume of tablets. In nursing home, the prevalence of tablet swallowing problems was high independently of tablet volume (Figure 5).

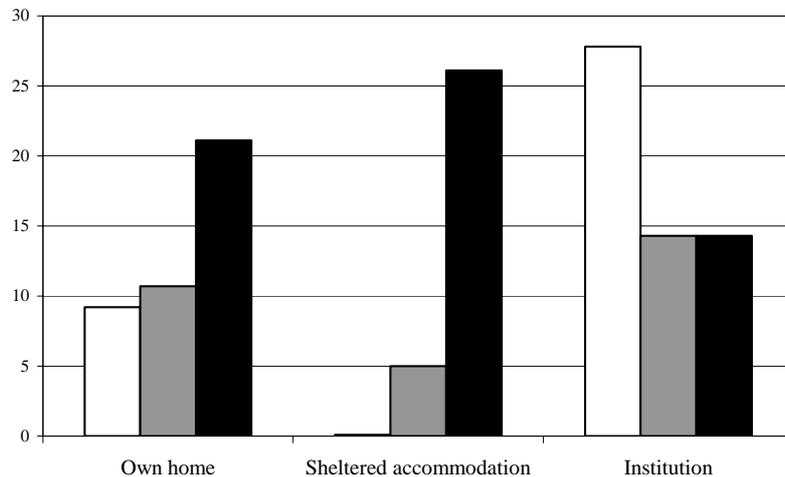


Figure 5: Frequency of difficulty swallowing tablets correlated to tablet volumes, stratified by housing. Open bars: <0.8 ml, grey bars: 0.8-1.6 ml, black bars: >1.6 ml

4.4 PAPER IV: MM AMONG THE OLDEST OLD LIVING IN THE COMMUNITY

Four hundred and fifty three questionnaires were sent out to older people in Kungsholmen (340) and in Nordanstig (113). Out of these, 372 (82 %) were returned and 307 (68 %) agreed to participate.

We started off by studying the individual items of functions and correlated some of them to the individual items of activities. Here, we found significant correlations between memory and vision and knowing what dose to take, as well as between hand function and opening of containers. No other correlations between individual items of functions and activities were observed.

Next, we analyzed the relationship between the scores of functions and of activities of MM in a logistic regression model. The analysis included three models. In model 1, functions, age and gender were analyzed against activities of MM. In model 2, the variable living alone was included. In the last model (3) we included self-rated health and satisfaction with medicines. Functions were clearly correlated to activities of MM in all models. There was also an association between gender and activities of MM in model 2, but this ceased when self-rated health and satisfaction with medicines were introduced. Satisfaction with medicines was also highly correlated to activities of MM. Secondly, we did another logistic regression analysis with functions and activities of MM against patient compliance. We found that both functions and activities were separately related to patient compliance, when adjusting for age and gender. When they were both included in the model, only the score of body functions remained significantly correlated to patient compliance.

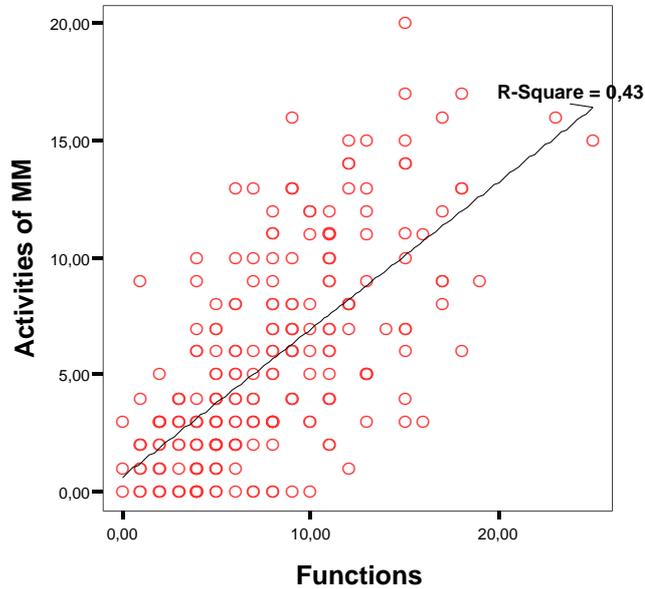


Figure 6: Regression of activities of MM correlated to functions

We also looked at what people do when facing difficulties with MM. We found that no-one responded that difficulties would stop them from taking the medicine altogether. Rather, most people responded that they would manage despite these difficulties. Many also responded that they would ask for help from someone such as a relative. Very few responded that this person could be a health care professional. In a similar question, we asked what they would do if they had difficulties understanding instructions. Several people responded that they would read the package insert of the medication. In contrast to the previous question, many people would ask a health care professional for help. Several persons also responded that they would read FASS (Swedish Drug Formulary) and some that they would ask a close relative. Neither here, nurses and home help services were the first choice for receiving help with instructions.

5 DISCUSSION

In this thesis several ways of studying MM have been used. I have included four different studies, using different population groups, different methods of measuring and different outcomes. What I have consistently found is that a large proportion of older people living in the community have difficulties with MM. In the first study we found that a fairly large proportion of the elderly were not able to open medicine containers. In the second study we found that a test of MM including the more cognitively demanding processes of MM were very difficult to perform without making errors in one process or the other. In the third study we looked at swallowing abilities in correlation to tablet size. Also in this study we could draw the conclusion that there are older people experiencing difficulties when swallowing tablets and that these people took a larger volume of tablets. In the fourth study we asked old people about a number of different issues regarding MM and found that functions were correlated to activities of MM and to patient compliance. We also found that when people face difficulties with MM they find ways to manage them.

5.1 METHODOLOGICAL ISSUES

5.1.1 Validity of tests of MM

An important distinction to make is between self-report and tests of MM. A test of MM may seem more appropriate since it measures the person's ability to manage for example a container or a treatment plan, and this has also been shown in, for example the study of subjective and objective measures of IADL performances by Shulman and colleagues.¹¹³ Such test will of course measure the ability to manage a new situation the person might face, such as a new form of delivery, a new treatment or a new instruction. However, the test does not measure the person's ability to handle his/her own medication in his/her own living situation. Performing a test of capacity is also a stressful situation. This has to be taken under consideration when developing and using tests of whatever kind, and especially when generalizing from the results.

The ICF model clearly differentiates between the ability and the environment, where the limitation comes from the incompatibility between the functional ability of the person and society's demand on the person's performance. Therefore, a handicap is only a handicap when society is not able to adjust to a person's functional limitation. From this perspective the value of a test of MM can be questioned. This is also highlighted in the ICF model as what the authors call the *qualifiers*. These qualifiers – performance and capacity – denote the magnitude of the level of health. The *performance* qualifier describes the ability to manage tasks in their own environment, while the *capacity* qualifier describes the ability to perform a certain task in an uniform environment.⁶²

As opposed to a test, a self-report measure of MM, may have the advantage of providing information on a person's real life experiences of MM issues. The disadvantage is that this measure might be affected by his/her wish to make a good impression and not exaggerating difficulties that are not of great concern. Therefore the sensitivity might be lower with a self-report measure of MM, but the specificity might be rather high.

The *MedTake* test³⁴ and the *DRUGS* test^{38, 71} provide an opportunity to measure this situation in a better way. The *MedTake* test is also supposed to be assessed in the person's own home. The disadvantage of such tests is mainly the cost of performing them, but this has to be viewed in relation to the great advantage of being able to discover the person's true ability to handle the medicines.

The conclusion that I want to draw from this reasoning is that probably the best way of assessing MM is to measure MM ability of the person in their own situation, managing their own medications.

5.1.2 Validity of measure of compliance

In paper 4, we introduced patient compliance in relation to MM. There are a number of ways by which patient compliance can be measured.¹⁰ The most commonly mentioned are pill-count, MEMS (medical event monitoring system) and self-report. Since there does not exist any "gold standard" for measuring compliance, the method to be chosen will have to be evaluated for each individual study objective.

In this study we chose to use a self-report measure of patient compliance. The validity of this method is very much dependent on how the questions are posed and how the questions are administered. A well-designed questionnaire can give data of good quality.^{10, 114} Pill-count is usually preferred since it can give a better estimation of the true compliance.¹¹⁵ However, this is demanding both in terms of costs and time, since the person has to be visited at least twice in order to get a baseline estimate, and this would not have been possible to carry out in our study population.

MEMS is a way of measuring compliance that is frequently used in for example clinical trials.¹⁰ Here, a special device is applied on the medication container, counting each time the container is opened. This will give data of high quality. For the objective of this study, using MEMS was, however, not an option. Since we wanted to measure the ability for example to open medication containers in relation to patient compliance, we could not have the subjects using a specially designed container.

We included only two questions in our rough measure of patient compliance: satisfaction with medicines and whether a practical limitation to use the medicine is a reason for not taking the medicine. This measure is inspired by the Theory of Reasoned Action.²⁹ Satisfaction with medicines is directly linked to patient compliance as being a proxy for attitudes towards medication.¹¹⁶ The second question can be viewed as the behavioral intention of patient compliance when challenged by practical limitations.

5.1.3 Selection bias?

In our first and second papers we used data from the KHP (phase IV) and SWEOLD II to study MM issues. These studies are population-based samples of older people living in Sweden. However, in our studies we had large drop-outs of subjects that did not perform the different tests of MM. We found these people to have a higher prevalence of medical conditions (study I), use more medications (SWEOLD II) and more often reporting not to be able to manage their medicines (SWEOLD II). This might therefore have led to an underestimation of the problems of MM in the general population.

In the first and third article we used the second follow-up of the Kungsholmen project. This population is a somewhat selected group of older people, in that the proportion of women and of old people living in the Kungsholmen parish is higher compared to Sweden at large. The educational level is also slightly higher than in other populations. Also, it is important to consider that the participants of the second follow-up had reached an advanced age, and therefore the population may be influenced by the so called healthy survivor effect. Thus, it is not self-evident that we can generalize our results to other populations.

In the last study, we used two sub-samples of the SNAC population, people living in the Kungsholmen area and people living in Nordanstig area. We sent the questionnaire to a sample of all participants aged 81 years and older living at home with a MMSE score above 24. Of these people, 372 responded and of this sub-sample 307 agreed to participate in the survey. This, clearly have lead to a selection of more healthy elderly. When comparing our sample to the original sample drawn from SNAC we found that the participants in our final sample did not differ much from the original sample, why the final sample is probably not specifically a selected group of the SNAC population.

5.2 PAPER I: OPENING CONTAINERS

This study showed that many elderly people clearly have difficulties with opening their medicine containers, which is consistent with previous findings.^{45, 49, 91} We also found that both dementia and Parkinson's disease were associated with opening difficulties. There was a clear correlation between ability to open the medicine containers and cognitive performance as measured with MMSE, which also agrees well with previous findings.^{20, 49} This shows that, even though it has been known for several decades that older people experience difficulties with their medicine containers, the problem remains unsolved. An important aspect of not being able to open a medicine container is whether you will receive any form of assistance when facing such problems in your own environment. We found that a large proportion (52 %) of those who were not able to open all three medicine containers did not receive any help with their own medicines.

5.3 PAPER II: MEDICATION MANAGEMENT

In this study we found that a substantial proportion (66 %) of the elderly people interviewed did not pass all the tests of MM (ability to read medicine label and open a medicine container, ability to understand instructions and calculate length of a treatment and change on a receipt). This result implies that difficulties managing medications are widespread in the older population.

The test used in this study was derived from tests of *everyday competence* that have been constructed as a measure of cognition put in a more everyday environment. Therefore, our test of MM is heavily loaded by the cognitive component. This differentiates our test from most other tests of MM that are more clearly aimed at testing the more obvious tests of MM, including for example ability to open bottles and placing tablets in the right compartment of a pill-box. On the other hand, in previous literature, MM has consistently been related to cognition,^{37, 46, 48, 64, 68, 70, 71} which suggests that a measure of MM with a cognitive load might be valuable. Indeed, the importance of cognition for the MM is substantial when for example a new drug is introduced in the person's life.

Another important finding was that self-reported ability to take medicines did not coincide with the results from our tests of MM. This indicates a very important point, namely that many older people who report being able to manage independently, might not be able to deal with the challenge of a new prescription.

5.4 PAPER III: TABLET SWALLOWING

In this study, we report a somewhat smaller proportion of elderly people having difficulties swallowing tablets compared to other studies.⁹⁴ On the other hand, we found a correlation between the ability to swallow tablets and total volume of tablets taken in one day. Interestingly, we also observed that the oldest old were taking the largest tablets. As there are virtually no previous studies in this particular field, this result cannot be confirmed, but suggest inappropriate conditions that warrant further research.

Since the number of drugs taken by older people seem to constantly increase,⁶ this is an issue that might be of more and more importance in clinical practice. When patients are prescribed three new drugs for a symptom rather than only one, the problem of swallowing those drugs probably increases.

The people living in their own homes or in sheltered accommodation and used larger tablets, more often reported that they experienced difficulties swallowing their tablets. However, people living in nursing homes, frequently experienced difficulties swallowing tablets, independently on volumes of tablets taken.

5.5 PAPER IV: MM AMONG THE OLDEST OLD

In the final study of this thesis we looked at MM using the framework of ICF. We found that functions are clearly associated with activities of MM and that they were each separately associated to patient compliance. Our results suggest that using a broader perspective when studying MM and the functions involved in the process, might be advantageous. Using a broader perspective of MM may help the practitioners when treating the older person, to see the larger picture of the drug use and not separate items of ability such as for example opening a medicine container or swallowing a tablet.

We also found that satisfaction with medicines was associated with activities of MM. Attitudes towards medications, exemplified by this variable, can be viewed as personal factors. Age, gender, living alone and self-rated health were also included in the logistic regression model, but no relationships with these factors were found, except for gender showing a correlation in one model but this was cancelled when satisfaction with medicines was included. These variables can be viewed as belonging to either health condition or environmental factors.

When we examined what the subjects in our study would do when facing difficulties with MM, we found that not one responded that they would not take their medicine. Most people instead answered that they would manage despite the difficulties. Many of them stated that they would use the help of a relative or use some sort of aid. This result points to the fact that many older people are resourceful when dealing with such difficulties and find way to deal with their everyday lives. The finding coincides with the theories behind the concept of everyday cognition, which use this way of viewing abilities to claim that their suggested tests of for example Observed Tasks of Daily Living is a better measure of cognitive ability than the regular psychological tests.⁴²

5.6 CHOOSING A FRAMEWORK FOR MM

5.6.1 Definition and structure of MM

Medication management has been defined quite differently depending on the view of the research field, as described in the introduction. One of the few papers that actually describe their definition of the term MM is that by Ruscin and Semla.³⁷ They write that “managing medications is an instrumental self-care activity that requires cognitive and functional capacities to coordinate and carry out the associated tasks”.³⁷ Another description of MM can be found in the paper by Orwig et al: “Medication management is a complicated process, involving selecting the right drug, ensuring that the patient can obtain it and take it correctly, and evaluating its action on the patient”⁷⁴

Other studies view MM as an aspect of patient compliance.^{34, 48, 68, 70} In some of them they actually try to explain patient compliance entirely through MM activities.³⁴ Viewing MM as part of patient compliance has disadvantages that lie within the two concepts. Patient compliance is defined as the extent to which a person’s behavior coincides with health care advice. That is, whether or not the behavior is fulfilled. Implicitly, the process leading to the outcome of interest is not taken into account.

I chose to use the process described by SoS when looking at MM, involving the following five steps: receiving a prescription, filling the prescription, storing the drug, preparing a dose for administration and administration of a dose. The reason for this choice is mainly that this view of MM is more comprehensive than most other descriptions of MM.

5.6.2 Behaviors vs activities

When choosing the best framework for the study of MM I first need to define what the concept is best described as. Is MM a behavior? Or rather an activity, or an ability?

I suggest that MM is an activity rather than a behavior. A behavior is governed mainly by cognitive processes, by attitudes and beliefs. The models used to describe behavior, *health behavior models* mainly take attitudes, beliefs, norms and cognitive processes into account when trying to best predict the behavior at hand. One definition of health behavior is: “those personal attributes such as beliefs, expectations, motives, values, perceptions, and other cognitive elements; personality characteristics, including affective and emotional states and traits; and overt behavioral patterns, actions, and habits that relate to health maintenance, to health restoration, and to health improvement”.¹¹⁷ Most often the functional capacity to actually perform the behavior is not considered to matter to the same extent as other personal attributes, as for example beliefs and attitudes. Also, when health behaviors are investigated, often the outcome is of interest rather than the process by which the outcome is achieved. This is easy to understand when the processes mainly involve cognitive elements that are difficult to study.

An activity, on the other hand, is how the person is able to perform a process. In the ICF model they define the construct of activity as: “the execution of a task or action by an individual”.⁶² An activity is also guided by other body functions such as sensory abilities, and not purely by cognitive processes. Attitudes and beliefs can affect the activities, but will not have the same influence as they have on the behavior.

The process we are studying here involves five steps that are governed by several different functions, and cognitive abilities are of great importance in this sense. According to the ICF model, activities are affected by both personal and contextual factors, as well as biological factors.

5.6.3 Another view of MM

There is also a view of MM as an outcome, in psychological studies of cognition (see for example Diehl et al, 1995).⁴² In these studies, the cognitive abilities, such as fluid or crystallized intelligence, are put as mediators between functions and age, and medication management abilities.⁴² As mentioned previously, in these studies, medication management is actually used as a proxy for cognitive ability.¹¹⁸

What I argue in this thesis, is that MM is best described through the processes of MM according to SoS. When studying this process, MM involves more aspects than cognition, although cognition seems to have a large impact on the ability to correctly manage this process.

5.6.4 Choosing a framework for MM

According to the definition proposed by Ruscin and Semla MM is an activity, rather than a behavior. In their definition they describe MM as “a self-care activity”³⁷ which makes it quite suitable for a model of disability.

The health behavior models describe behaviors and their determinants and correlates, which is suitable when behaviors are to be studied. However, as described above, an activity is slightly different from a behavior. The determinants and correlates of an activity are different as well as the action itself. The correlates lie both within the person and his/her norms, attitudes etc but are also heavily loaded by both social factors such as society’s ability to adjust to the person’s limitations and needs. And finally, the biological part is of great importance, such as a health condition affecting the body functions which will eventually affect the activity of the person.

5.6.5 The ICF model

As described earlier, several models of disability have been developed over the years. They often view disability as the person’s inability to conform to society’s norms and demands. Many of them have used a biopsychosocial perspective, yet they are biomedical in their “attitude”. The ICF model that was developed by WHO was mainly developed as a classification system of disability and limitations, but is also in many respects a model of how disability is linked to function, environment and personal factors. Therefore, ICF can be defined as a biopsychosocial model of disability, taking into account both the psychological aspects within the person, the social aspects of the environment and the biological aspects of illness and health. Thereby, this model might prove to be more useful to use when trying to explain abilities of different kinds.

As described above, ICF comprises three domains; body functions, activities and participation. I have included MM in the activity domain and in our fourth study we used this view, and successfully correlated the activities of MM to body functions of importance to MM.

The third domain is participation. In the ICF model participation is defined as: “involvement in a life situation”.⁶² This construct is much closer to a health behavior. In the fourth study of MM we also included compliance as participation. The measure of compliance that we used was also highly correlated to both activities of MM and functions. When viewing patient compliance as the participation, we also need to include attitudes, beliefs and other personality characteristics in the domain of personal factors. By using the ICF model this way we incorporate the attitudes and beliefs which are essential parts of compliance, into the disability model which will give us a much more comprehensive view of drug use.

5.7 COMPLIANCE AND MM

Patient compliance as a health behavior is often used as the main outcome when studying drug use. The practical aspects of drug intake, i.e. MM, has been considered as being of importance to patient compliance, but a relationship between the two has not been consistently found in previous research. Still, it would seem that these concepts are closely linked to each other.

Our findings from the fourth study suggest that there is indeed a link between activities of MM and patient compliance. The nature of this relationship is, however, unknown, and neither do we know whether patient compliance is in fact the overarching concept in which we find MM, or the other way around. We did not use compliance as the starting point for MM, rather we hypothesized patient compliance to be the final outcome as belonging to the participation domain of the ICF.

There are limitations in using compliance as the outcome of the ICF model. As patient compliance is a behavior, it is governed by more than just the ability. Looking at MM as an ability to use medicines, will help us shift the focus from the behavior towards the actual possibility to use the medicine. Many people do want to take their medicines as prescribed, but might not be able due to quite different reasons of practical demands. These practical inability are consistent with the limitation in MM. When we used this view of MM, we also did find a relationship with patient compliance. This points to the possibility that there actually is a correlation between patient compliance and MM, and that previous studies may have used a too limited view of MM when trying to correlate the two concepts.

In the fourth study, we included two different measures or perspectives of compliance. The first was a measure based on two questions, as mentioned above. Secondly, we developed a basic question on what the subject would do when facing difficulties with practical handling of drugs. When looking at the answers of the latter, we found that no one responded that their compliance would be affected if they could not take their medicine. This might indicate that their compliance is not affected by MM issues. However, it is also possible that elderly people when faced with such a question will overestimate their true ability. This is supported by our finding in study II where there was a poor congruence between the self-reported ability to handle medications and their results on the test of MM.

Previously, no consistent relationship has been demonstrated between MM issues and patient compliance, (see for example Vik et al., 2004)¹⁴ although MM issues has been reported as reasons or risks for poor compliance.^{14, 23} Individual items of MM have been associated with compliance in some studies but not in others, for example knowledge of instruction,^{22, 65, 79} ability to read labels,²⁴ ability to open medicine

containers.¹⁸⁻²¹ Common to the studies that have found correlations between MM and compliance is that they have examined parts of MM such as opening of medicine containers or similar attributes. However, to our knowledge, there are no studies that have used the broader perspective of MM that we propose and correlated it to patient compliance.

5.8 FACING DIFFICULTIES WITH MM

5.8.1 Compensating for difficulties

Not being able to manage one's medications can be viewed as a stressful situation. According to the transactional Model of Stress and Coping, the person will use different coping efforts in order to deal with a stressful situation.¹¹⁹ These coping strategies can be either problem or emotionally oriented. Problem-focused strategies are those leading to changes decreasing or limiting the effect of the stressor.

In the last study of this thesis, we asked the subjects what they would do when experiencing difficulties with MM. We found that no one responded that this would stop them from taking the medicine, which was rather surprising, considering the theory of Horne.⁹ According to this theory, non-intentional compliance takes place when the patient is intended to use the medication but is unable due to practical limitations, and is one major reason for not adhering to medical advice. Instead, in our study, most people responded that they would manage anyway despite difficulties. Some stated that they used some kind of tool, such as a knife or a pair of pliers or that they would ask for help. In this context it is important to keep in mind that the subjects in this study were older people living independently in the community.

This could also be explained by the fact that self-reported MM is not in congruence with the tested MM, as has been described previously.

5.8.2 Help and MM

As we have seen in our studies, many older people show a decreased ability to handle their medications. In the first and second studies we also found that the self-reported ability is not by far in accordance with what they show in the tests of MM, although we cannot exclude the possibility that the results from the tests overestimate the problems that actually exists in the person's daily living. Moreover, in our first study on opening of medication containers, we also found that a large proportion of those that were unable to open their medication containers did not receive any home-help.

In previous research it has been suggested that MM is one of the more demanding processes in the activities in the everyday life of older persons. Therefore, the MM process may be an important measure of how the aging person manages this.

As has been described previously, we use a broad perspective of MM which includes many steps in the process. Therefore, a large number of functions will be important for the process to work. In the case of the individual person caring for MM, this demand is purely on the person him-/herself. In the case the person receives help with MM, the person offering help will have to be able to provide this ability. A previous study showed that 39% of all informal caregivers helped administer medications.¹²⁰ This help also has to include specific knowledge about drugs, specific instructions on administration and storage, and so on. In the above mentioned study, only 18 % of the informal caregivers reported that they had received some form of instructions on how

to help with the administration of medicines.¹²⁰ This can be related to another study that reported formal caregivers to have rather poor knowledge concerning medication administration.¹²¹ Even people living in an assisted living facility will probably receive help with their medications even though most staff working in these facilities are not medically educated.¹²²

5.9 CONCLUSIONS

- ✓ Many elderly people have difficulties opening medicine containers.
- ✓ Somatic, neurological and cognitive disorders may affect the ability to open medicine containers.
- ✓ Many elderly people who have difficulties opening medicine containers do not receive any help with their medication.
- ✓ In a Swedish population aged 77+, a large proportion (66%) was unable to perform rather simple tests related to medication management.
- ✓ The difference between self-rated ability to manage medications and the results from the tests of medication management was substantial.
- ✓ The oldest elderly (90+) use the largest tablets, and those residing in institutions take the largest volume of tablets.
- ✓ Those who reported having difficulties swallowing tablets also used a larger total volume of tablets regularly.
- ✓ Those living in institution reported more swallowing difficulties than others independent of tablet volume, suggesting that the patient's condition plays a major role.
- ✓ Functions are closely connected to activities of MM.
- ✓ Both functions and activities of MM are associated with patient adherence in old age.
- ✓ However, experiencing difficulties with MM was not reported as being a reason for not adhering to medical advice.

5.10 FUTURE PERSPECTIVES

Using a larger perspective on MM can help us view different aspects of drug use in more depth, aspects of great importance to the individual person.

What is evident when reading the literature on MM is the lack of a definition as well as a description of what is considered good MM. Not being able to manage ones medication is closely correlated to independence and therefore it is of great importance to state what a good level of MM actually involves.

Another future direction is that of the correlation between MM and patient compliance, which needs further exploration. Is there actually a link between the two concepts? Or are they parallel dimensions of the broader concept of drug use? Are there other views of importance in younger people?

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8 APPENDIX

8.1 LIST OF DISSERTATIONS FROM STOCKHOLM GERONTOLOGY RESEARCH CENTER AND AGING RESEARCH CENTER 1991-2006

1991

Herlitz Agneta. Remembering in Alzheimer's disease. Utilization of cognitive support. (Umeå University and Karolinska Institutet).

1992

Borell Lena. The activity life of persons with a dementia disease.

1993

Fratiglioni Laura. Epidemiology of Alzheimer's disease. Issues of etiology and validity.

Almkvist Ove. Alzheimer's disease and related dementia disorders: Neuropsychological identification, differentiation, and progression.

Basun Hans. Biological markers in Alzheimer's disease. Diagnostic implications.

1994

Grafström Margareta. The experience of burden in care of elderly persons with dementia. (Karolinska Institutet and Umeå University).

Holmén Karin. Loneliness among elderly - Implications for those with cognitive impairment.

Josephsson Staffan. Everyday activities as meeting-places in dementia.

Stigsdotter-Neely Anna. Memory training in late adulthood: Issues of maintenance, transfer and individual differences.

Forsell Yvonne. Depression and dementia in the elderly.

1995

Mattiasson Anne-Cathrine. Autonomy in nursing home settings.

Grut Michaela. Clinical aspects of cognitive functioning in aging and dementia: Data from a population-based study of very old adults.

1996

Wahlin Åke. Episodic memory functioning in very old age: Individual differences and utilization of cognitive support.

Wills Philippa. Drug use in the elderly: Who? What? & Why? (Licentiate thesis).

Lipinska Terzis Beata. Memory and knowledge in mild Alzheimer's disease.

1997

Larsson Maria. Odor and source remembering in adulthood and aging: Influences of semantic activation and item richness.

Almberg Britt. **Family caregivers experiences of strain in caring for a demented elderly person.** (Licentiate thesis).

1998

Agüero-Eklund Hedda. Natural history of Alzheimer's disease and other dementias. Findings from a population survey.

Guo Zhenchao. Blood pressure and dementia in the very old. An epidemiologic study.

Björk Hassing Linda. Episodic memory functioning in nonagenarians. Effects of demographic factors, vitamin status, depression and dementia. (In collaboration with the Department of Psychology, University of Gothenburg, Sweden).

Hillerås Pernilla. Well-being among the very old. A survey on a sample aged 90 years and above. (Licentiate thesis).

1999

Almberg Britt. Family caregivers caring for relatives with dementia – Pre- and post-death experiences.

Robins Wahlin Tarja-Brita. Cognitive functioning in late senescence. Influences of age and health.

Zhu Li. Cerebrovascular disease and dementia. A population-based study.

2000

Hillerås Pernilla. Well-being among the very old. A survey on a sample aged 90 years and above. (In collaboration with H. M. Queen Sophia University College of Nursing, Stockholm, Sweden).

von Strauss Eva. Being old in our society: Health, functional status, and effects of research.

2001

Jansson Wallis. Family-based dementia care. Experiences from the perspective of spouses and adult children.

Kabir Nahar Zarina. The emerging elderly population in Bangladesh: Aspects of their health and social situation.

Wang Hui-Xin. The impact of lifestyles on the occurrence of dementia.

2002

Fahlander Kjell. Cognitive functioning in aging and dementia: The role of psychiatric and somatic factors.

Giron Maria Stella T. The rational use of drugs in a population of very old persons.

2003

Jönsson Linus. Economic evaluation of treatments for Alzheimer's disease.

2004

Berger Anna-Karin. Old age depression: Occurrence and influence on cognitive functioning in aging and Alzheimer's disease

Cornelius Christel. Drug use in the elderly - Risk or protection? Findings from the Kungsholmen project

Qiu Chengxuan. The relation of blood pressure to dementia in the elderly: A community-based longitudinal study

Palmer Katie. Early detection of Alzheimer's disease and dementia in the general population. Results from the Kungsholmen Project.

Larsson Kristina. According to need? Predicting use of formal and informal care in a Swedish urban elderly population. (Stockholm University)

2005

Derwinger Anna. Develop your memory strategies! Self-generated versus Mnemonic strategy training in old age: Maintenance, forgetting, transfer, and age differences.

De Ronchi Diana. Education and dementing disorders. The role of schooling in dementia and cognitive impairment.

Passare Galina. Drug use and side effects in the elderly. Findings from the Kungsholmen Project.

Jones Sari. Cognitive functioning in the preclinical stages of Alzheimer's disease and vascular dementia.

Karp Anita. Psychosocial factors in relation to development of dementia in late-life: a life course approach within the Kungsholmen Project.

Nilsson Jan. Understanding health-related quality of life in old age. A cross-sectional study of elderly people in rural Bangladesh.

2006

Klarin Inga. Drug use in the elderly – are quantity and quality compatible.

Nilsson Erik. Diabetes and cognitive functioning: The role of age and comorbidity.

Ngandu Tiia. Lifestyle-related risk factors in dementia and mild cognitive impairment: A population-based study.

Erika Jonsson Laukka. Cognitive functioning during the transition from normal aging to dementia.

2007

Tamanna Ferdous. Prevalence of malnutrition and determinants of nutritional status among elderly people. A population-based study of rural Bangladesh. (Licentiate thesis).

