# The use of the stimulant khat, war-related trauma and psychosis in Somalia:

## How changed use patterns of a traditional drug are related to psychiatric problems in a country in the transition from war to peace

Dissertation zur Erlangung des Doktorgrades

Eingereicht an der mathematisch-naturwissenschaftlichen Sektion der
Universität Konstanz

von

Dipl.-Psych. Michael Odenwald

21. Dezember 2006

# Content

# Preface and Acknowledgement

Menschliches Engagement und wissenschaftliches Arbeiten lohnt sich. Das ist eine der persönlichen ‘Lessons’ dieser Jahre, in denen ich neben der Arbeit an meiner Dissertation und den vielen Patientenkontakten auch die Nichtregierungsorganisation vivo mit aufbauen durfte. Ich musste aber auch lernen, dass die Arbeit in internationalen Krisengebieten oft von Konkurrenz und Ellenbogenmentalität geprägt ist. Die eigene Menschlichkeit in diesem Umfeld nicht zu verlieren, ist eine hohe Herausforderung.

Ich schätze mich glücklich, im Laufe meiner Dissertation besondere Menschen und Lehrer kennengelernt zu haben, die mich in vielerlei Hinsicht geprägt haben. Dies ganz besonders für meine Betreuer Prof. Thomas Elbert und Prof. Brigitte Rockstroh, denen mein größter Dank gilt. Meinen Kollegen und Freunden Dr. Maggie Schauer, Prof. Frank Neuner, Elisabeth Schauer, Dr. Claudia Catani, Martina Ruf, Dr. Sandra Janzen, Dr. Patience Onyut, Heike Riedke, Dr. Nathan Weisz und Dr. Stephan Moratti bin ich für menschliche und fachliche Unterstützung während der vergangenen Jahre verbunden. Für die wohl-wollende fachliche Unterstützung und Anleitung bin ich Dr. Harald Hinkel, Dr. Hans Watzl und Dr. Karl Pröpster verpflichet.

Dem Kollegenkreis am Institut, der Ambulanz für Flüchtlinge und auf der Station 33 sei Dank gesagt für die freundschaftliche Athmosphäre. PD Dr. Andreas Keil, Dr. Christian Wienbruch, Dr. Patrik Berg und Dr. Willi Nagl bin ich zu Dank verpflichtet, da sie mir in vielerlei Hinsicht in statistischen Fragen, bei Hard- und Softwareproblemen Hinweise und Hilfestellung gaben. Meinen ehemaligen Hilfskräften und Diplomanden Tobias Schmitt und Birke Lingenfelder sei Dank gesagt für ihre harte Arbeit im Laufe der Jahre. Nicht zu vergessen sind die Kollegen, die mich bei meinen Forschungen in fremden Ländern unterstützen, v.a. Zeinab Aden, Brigitt Hotz, Christine Klaschik, Dr. Rebecca Horn.

Nicht zuletzt möchte ich mich bei meiner Familie, besonders meiner Frau Yvonne und meinen beiden Söhnen Frederik und Felix für ihre jahrelange Geduld und Unterstützung bedanken, ohne die diese Arbeit nie zustande gekommen wäre.

Allensbach, im Dezember 2006

Michael Odenwald

# 1. Introduction

Mental disorders are responsible for a large proportion of the global burden of diseases and premature deaths, as the 2001 World Health Report (World Health Organization, 2001) and the Global Burden of Disease Report (Lopez *et al.*, 2006) emphasized. In low-income countries, poverty, malnutrition, analphabetism, the exposure to war and violence and discrimination are linked to ill-health (Brown & Pollitt, 1996; V. Patel *et al.*, 2006; Saraceno & Barbui, 1997). Mental health is influenced by a complex network of factors involving the individual, family, community and societal level. A deeper understanding of relationships, causal mechanisms and effective intervention is necessary to assist a sustainable development of the poorest countries in the world.

This work highlights the interaction of one set of factors in one specific country setting: the consumption of the amphetamine-like drug khat, the exposure to war and violence and the consecutive development of Posttraumatic Stress Disorder and the prevalence of disorders of the Schizophrenia spectrum in Somalia.

This work and the many other related studies, carried out in this area seem to be pieces of a puzzle that has only started to be put together.

In this chapter, I will at first focus on the amphetamine-like drug khat, give an introduction to its traditional use and its growing importance for the economy in the past decades and related health problems. Then I will briefly give an overview on how trauma and Posttraumatic Stress Disorder and disorders of the Schizophrenia spectrum are related to drug use. Finally, I will introduce the study setting, by giving a brief introduction to Somalia, its history and political situation.

## 1.1 Khat

The khat leaves are traditionally consumed at the Horn of Africa, the Arab Peninsula, Eastern and Southern Africa and parts of Asia (Krikorian, 1983). Khat (*Catha edulis forssk*) is an evergreen shrub or tree of the *Celastraceae* family, usually reaching up to 7 m of height, but it might even grow up to 25 m under the more favorable conditions of equatorial climate (UNODC, 1956). For economical usage it is mostly grown in altitudes between 1,500 and 2,500 m above sea level and often pruned to about 2-4 m (Lemessa, 2001; Ward, 2000). Khat cultivation can be found at the Abissinian highlands, the Horn of Africa, in Eastern and Southern Africa, the Arab peninsula and Afghanistan (Krikorian, 1983). The first historical reference was made in a medieval Arab manuscript of the first half of the thirteenth century (UNODC, 1956). Khat was presumably first cultivated in the Hararge highlands in today's Ethiopia from where it was brought to Yemen (Gebissa, 2004; Krikorian, 1983). The first botanical description was provided by the Swedish naturalist Petrus Forsskål (1732-63), who participated in a Royal Danish expedition to Arab countries. His description of *catha edulis* was published post-mortem in the manuscript entitled ‚*Flora Aegyptiaco Arabica*' in 1775, edited by the German Carsten Niebuhr (Meampel, 1992). For a complete botanical description of khat see Nordal (1980).

Khat is traditionally used for recreational purposes, but also as medical plant or during religious ceremonies, traditional rituals, when studying the Koran or for reducing physical fatigue while travelling or working. In most of the countries, where it is used, the young and tender leaves and stems are chewed and an egg-sized bolus is kept in a cheek for up to several hours before it is spat out or swallowed, while the extracted juice is swallowed. The traditional setting is the so called ‘khat party’, an important social institution in countries like the Yemen or Somalia: political, business and social affairs are settled during khat parties (Al-Motarreb *et al.*, 2002; Baasher, 1980; J. K. Kennedy, 1987).

In Somalia, the dangers inherent to khat chewing, especially its psychotomimetic properties were traditionally known. Therefore, young people were traditionally not allowed to chew khat until about 20 years; then, they were initiated during a khat party (S. L. Patel *et al.*, 2005). Furthermore, strong social norms regulated the use of the drug, e.g. limiting it to the afternoon and evening. The Somali people’s contemporary knowledge about the dangers of khat is illustrated by the tales of khat chewers, who sometimes experience in the course of intoxication a temporary psychotic state, called ‘bah’ (literally translated ‘plastic bag’): when a chewer after a long khat session walks home in the middle of the night through the dark streets of a typical Somali town, numerous plastic bags and other litter lies on the street and the wind moves them and provokes the typical crickling sound. ‘Bah’ involves that the khat chewer would misinterpret the shape and sounds of the moving plastic bags as wild dogs, hyenas, or his personal enemies lying in ambush, whereby this can develop to an illusion and sometimes has even hallucinatory and delusional quality. Typically, the person becomes frightened and runs his way home, and only the next morning he realizes that this could not have been real.

The main psycho-active ingredient of the khat leaves is the alcaloid cathinone, S(-)alpha-aminopropiophenone, which was detected in the WHO laboratories in the 1970ies

(Szendrei, 1980). It is rather instable and can only be found in the fresh plant material. Besides cathinone, cathine, i.e. (+)-norpseudoephedrine, cathedulins, other alkaloids and tannins were identified (Al-Hebshi & Skaug, 2005). Numerous laboratory studies have shown that cathinone is similar to amphetamine in many ways and, thus, was characterized as 'natural amphetamine' (Kalix, 1992). A detailed overview over pharmacological research on khat will be given in Chapter 2. As cathinone is chemically instable and decays rapidly as soon as the leaves wither the khat leaves have to be consumed within 48 hours after harvest.

Therefore, khat could not be commercialized in large quantities. Since rapid transportation was possible, starting with the railway connection between Dire Dawa and Djibouti in the beginning of the 20th century to today's daily air freight and deep frozen transports, khat has become an economic success story (Gebissa, 2004; McKee, 1987). Within a few decades, its macro-economic importance grew from a marginal niche product to an important cash crop, for instance becoming Ethiopia's second largest export product in 1999 (CSA, 2004). In Yemen, the khat sector accounts today for 10% of its GDP and provides jobs to approx. 500.000, i.e. one in seven working Yemenites (Worldbank, 2005).

In parallel to the economic development, the patterns of use have changed profoundly. What has formerly been a socially controlled and a strongly formalized habit in specific ethnic groups and regions of the above mentioned countries, often related to religious or traditional rites (Carrier, 2005), is now found among the general population at the Horn of Africa and Eastern Africa (Selassie & Gebre, 1996; UNODC, 1999) and spreads to neighboring and even to Western countries (UNODC, 2005). New patterns of use developed, stripped off its connections to formal and ritual settings and without being controlled by social norms (Beckerleg, 2006; Carrier, 2005). In the 1990ies an estimated 5–10 million people used khat each day (Balint *et al.*, 1991; Kalix, 1996).

## The prevalence of khat chewing

The estimation of the exact prevalence of khat use is difficult, as the consumption still largely depends on socio-economic, ethnic and geographic factors.

In Yemen, the habit of chewing khat was once restricted to higher classes and special social happenings due to its high costs, while today the population at large can afford to buy khat (Ward, 2000). Based on the Household Budget Survey 1998, Yemenite households spent around 9-10% of their income on buying khat (Worldbank, 2001). In a recent cross-sectional study including 792 persons of the general population aged 15 or above, Numan (2004) found a lifetime prevalence of 81.6% among men and 43.3% among women; current every day use of khat was found in 23.6% of the total sample (men 31.8%, women 8.9%). In another study, among 2,500 patients of the Sana'a University dental school, 61.1% were current khat chewers, 87.0% of men and 12.9% of women (Ali *et al.*, 2004).

Khat chewing is traditionally a habit in the southern and eastern part of Ethiopia, especially among the Muslim populations. There are no prevalence studies for the general population on a national level, but some studies on a regional level. A household survey in the khat-producing, predominantly Muslim, rural community of Butajira including 10,468 adults above the age of 15 found 75% of men and 35% of women as current khat users, while daily use was found in 8.7% (Alem *et al.*, 1999). In another household survey among 1,028 adult respondents in the rural district of Adamitulu, in southern central Ethiopia, with mixed-religions community (Belew *et al.*, 2000), current khat chewing was reported for 40.4% of men, 18.2% of women while daily use was found in 5.7% of the total sample. Khat chewing was also more frequent among the Oromo ethnic group, among Muslims, married respondents, those with lower education and the farmers. In a representative national assessment of 16,606 adolescents and young adults (15 – 24 years of age), Kebede *et al.* (2005) found a 4-weeks prevalence of 16.2% and every day use by 4.3%. Khat chewing was more frequent among out-of-school youth and related to unprotected sex. Other studies among Ethiopian high school or university students revealed current prevalence rates between 17.5% and 64.9% (Adugna *et al.*, 1994; Y. Kebede, 2002; Zein, 1988) and differences between urban and rural areas (Kassaye *et al.*, 1999).

In Kenya, khat chewing is traditionally practiced by the Muslim, mostly Somali community, in the Northern part of the country. No prevalence data for the general population are available. Some studies of patients of general health services in different parts of the country disclosed a lifetime prevalence rate of 10.7% in an region without khat production (Othieno *et al.*, 2000) and a current prevalence rate of 29% in a khat producing region (Omolo & Dhadphale, 1987).

In the last cross-sectional assessment of khat-intake in Somalia, Elmi (1983) reported that in the north of the country, 64% of adult males from the general population regularly consume khat compared to 21% in the south. Press articles state that currently in all Somalia per day 300.000 $ are spent on khat (Masciarelli, 2002).

Few studies investigated khat use among adult immigrants in Western countries, mainly among Somalis in the UK. In a non-representative sample of 207 Somalis (male

152, female 55) living in London Paul Griffiths (Griffiths, 1998; Griffiths *et al.*, 1997) found 78% (79% of males and 76% of females) with a life-time history of khat use, 67% had been using it in the week before the interview, 6% on a daily base. A recent study relying on the methods developed by Griffiths and colleagues (S. L. Patel et al., 2005) found among 602 Somalis (324 male, 278 female) in four cities in the UK that 38% (231) had ever chewed khat (male 58%, female 16%), that 34% had been using it in the month prior to the interview and that 3% would use it currently on a daily base. Among the 180 subjects (91 male, 89 female) of a representative sample of the Somali community in Greenwich (Bhui *et al.*, 2003) a current prevalence of 62.6% among male and 16.9% among females was found.

## Khat and consumers' health

Recent literature reviews on health consequences show multiple somatic and psychiatric consequences of khat consumption (ACMD, 2005; Al-Habori, 2005; Al-Hebshi & Skaug, 2005; Al-Motarreb et al., 2002), e.g. cardiovascular diseases, sexual dysfunctions, low birth weight, tooth decay, oral and digestive tract cancers and others. Whether or not khat produces negative health effects at all is still discussed, with beneficial effects, e.g. strengthening social contacts and cultural identity (Numan, 2004), being contrasted with negative consequences of self-reported symptoms (Belew *et al.*, 2000). However, there is a lack of data, especially from the low-income countries, where it is traditionally used. Among the most controversially discussed phenomena are khat-induced psychotic phenomena and khat dependence. The former will be addresed in Chapter 2, the latter will be discussed in the following section of this chapter.

## Khat and dependence

According to the World Drug Report 2004, referring to the year 2002, khat was the main drug of abuse among 75.6% of patients treated for drug-related problems in Ethiopia; in Kenya, this figure was 14.3% (UNODC, 2004). No statistics are available for other countries.

Studies confirmed that cathinone resembles amphetamine in chemical structure and affects the central and peripheral nervous system (Kalix, 1990) as well as behavior (Woolverton & Johanson, 1984; Zelger *et al.*, 1980) similarly (for a review see (Kalix, 1991; Nencini & Ahmed, 1989)). In the CNS, it provokes a release of catecholamines, especially dopamine, from presynaptic stores, being about half as potent as amphetamine (Pehek *et al.*, 1990). Moreover, it inhibits its re-uptake, can produce depletion of central dopamine (Schechter, 1990a, 1990b), and was shown to be similarly rewarding as amphetamine or cocaine in discrimination and preference studies (Johanson & Schuster, 1981; Woolverton & Johanson, 1984). Cathinone seems to affect the mesocorticolimbic reward system, the physiological substrate of addictions (Deslandes *et al.*, 2002; Spanagel & Weiss, 1999).

Kalix (1991) postulated a higher potential to induce dependence because: (1) cathinone has a more rapid onset of action in discrimination experiments (Johanson & Schuster, 1981; Woolverton & Johanson, 1984); (2) tolerance to cathinone's anorectic effects develops faster and is more pronounced; (3) in conditioned taste aversion experiments cathinone is less aversive than amphetamine (Goudie & Newton, 1985); and (4) in self-administration experiments respondence rates are higher than those maintained by amphetamine (Johanson & Schuster, 1981; Yanagita, 1986).

The potential to induce psychological dependence is confirmed by two British studies, using the Severity of Dependence Scale (Gossop *et al.*, 1995), a five-item instrument thought to measure the psychological component of dependence. About 10% of a sample of Somali khat users scored at a level comparable with a clinical population with severe heroin dependence in need for treatment (Griffiths, 1998). In a more recent study with Yemenite immigrants this figure was 39% (Sabah & Croucher, 2006).

The relationship to dependence is further strengthened by the specific 'drug language' among Somali users, which contains terms related to dependence and withdrawal and has strong similarities to the ‚amphetamine' language: 'xaraaro' means feelings of craving and nervousness which are experienced by habitual chewers at the time of day before their usual khat intake starts; 'dubaab' refers to unpleasant dreams involving the sensation of being suffocated that are usually experienced by heavy chewers in the first days after cessation. The phenomenon of 'ijabane' involves the use of khat in a group setting in order to reduce aversive symptoms in the morning.

The most compelling studies of enhanced addiction potential of cathinone used the drug-induced conditioned taste aversion and self-application paradigms. In the latter, animals are trained to self-administer drugs in order to quantify their primary rewarding properties. When trained to self-administer cathinone, monkeys administered it in the first three hours 160-480 times, significantly more often than amphetamine (Johanson & Schuster, 1981). When uninterrupted, they went on without food intake or sleep up to 59 hours and repeated this 'spree' after a resting period of less than 24 hours until their physical condition deteriorated to a severe extent (Yanagita, 1986). Self-administration of cathinone has also been shown in rats (Gosnell *et al.*, 1996). In the conditioned taste aversion paradigm, the nausea induced by different drugs orally administered is used as unconditioned stimulus (UCS) which is experimentally associated to a novel taste (conditioned stimulus, CS), e.g. that of saccharin in water (Welzl *et al.*, 2001). The suppression of drinking in the presence of the CS is a measure of the drug-induced aversive properties (UCS). While amphetamine has highly aversive properties and suppresses the drinking behavior effectively, cathinone elicits these characteristics to a much lesser extent (Goudie & Newton, 1985).

In humans, khat effects were studied using either repeated questionnaire-based measurement of emotional reactions or retrospective inquiry of usual reactions. Immediate euphoric effects followed by depression were demonstrated in controlled application studies (Brenneisen et al., 1990; Hassan *et al.*, 2002; Widler et al., 1994). Thus, it was argued that the depressive phase after the end of the khat session motivates to continue chewing (Griffiths, 1998).

But also the environment is a key factor for understanding the development of drug addiction. A number of laboratory studies demonstrated that an impoverished environment might be a risk factor for the development of addiction after repeated drug use whereas an enriched social environment might act as protective factor (Alexander *et al.*, 1978; Hadaway *et al.*, 1979). Thus, the typical environment of Somalia, where the largest part of the population is unemployed and lives under very poor conditions, might have additional influence on khat effects.

Not every khat user will develop a dependence syndrome as defined by ICD 10 or DSM IV. Anthony *et al.* (1994) reported from the National Comorbidity Survey that 11.2% of lifetime stimulant users in the US developed a dependence syndrome; however, only 15.3% of the general population (age range 15 -54) ever had used stimulants, so that the total prevalence was 1.7%. Assuming a parallel between khat and amphetamine, the high prevalence of khat chewing in countries like Yemen or Somalia would produce khat dependence as high as 5 – 10% of the adult male population. An Ethiopian study (Awas *et al.*, 1999), using the Composite International Diagnostic Interview (CIDI, (World Health Organization., 1997) found a prevalence of khat dependence of 5% among males in a traditional khat producing area but without indicating the overall prevalence of khat chewing.

### *The discussion about physical dependency*

There is an academic debate around the question whether khat produces a physical dependency syndrome in addition to physiological.

*Khat-related withdrawal symptoms:* The dominant view in the psychological literature is that khat produces mild or even no physical dependency (Eddy *et al.*, 1965; Halbach, 1972). Along the same line withdrawal symptoms upon discontinuation after prolonged use are expected to be mild (Giannini *et al.*, 1986; Kalix, 1991). This view is based on the recent reviews that most khat consumers would not develop physical dependency (ACMD, 2005; Al-Habori, 2005; Al-Hebshi & Skaug, 2005; Al-Motarreb et al., 2002). However, only very few studies present any data supporting this claim. Rather anecdotal reports and expert opinions are still cited (Alem et al., 1999; Belew et al., 2000). The 'classic' description of khat-related withdrawal symptoms by Kennedy *et al.* (1980) include profound lassitude, anergia, difficulty in initiating normal activity, slight trembling, several days after ceasing, nightmares, often paranoid in nature for example being attacked, strangled or followed; the authors stated that these symptoms occur only after heavy chewing and are mild in nature. This description, based on clinical work dates back to the Yemen of the 1970ties. As khat chewing has become more prevalent and has profoundly changed throughout the last decades, this description might not necessarily be valid any more. In addition, the Ethiopian prevalence study on khat dependeny reported above (Awas et al., 1999) and other recent studies reported discrepant details. For example, some studies found comorbid use of tranquilizers or alcohol in heavy chewers, which might be used to fight withdrawal symptoms (Belew et al., 2000; Selassie & Gebre, 1996; Zein, 1988). Others concluded withdrawal in heavy chewers (Toennes & Kauert, 2004). In sum, the knowledge about khat-related withdrawal symptoms needs further studying.

*Khat tolerance:* Today, it is generally believed that khat use does not induce tolerance (Giannini *et al*., 1986; Kalix, 1991). But it is known that tolerance can develop in amphetamine users, e.g. for the euphoric effects, the anorectic effects and the lethal effects, whereas the psychotomimetic effectstend to sensitize. For cocaine and amphetamine, tolerance development, the upward shift in the set point for reward and the subsequent dysphoria ('opponent process') are closely related to the development of 'binge' consumption patterns. Users need to increase the dose and the frequency of drug administration in order to experience the desired psychological effects (Koob & Le Moal, 2005). For khat, it has been argued that the chewing mode of ingestion limits the possible amount to consume in a certain time and, thus, tolerance development is prevented (Kennedy et al., 1980). However, no studies have ever directly targeted the topic of tolerance to desired psychological effects, e.g. euphoria. Tolerance development might especially be related to the extension of the time spent for consuming khat in order to increase the amount ingested. Personal observations in Somalia and data from the UK Somali community indicate that heavy khat users consume without a break for up to 48 without sleep (Nabuzoka & Badhadhe, 2000; S. L. Patel et al., 2005). Several studies reported that such 'binge' consumption patterns among khat users do occur, e.g. that experienced users are trained to chew such large quantities a novice would never manage (Luqman & Danowski, 1976; Nabuzoka & Badhadhe, 2000; Nencini *et al*., 1984). Other studies reported details on excessive and prolonged intake above what is considered normal e.g. that 12 -14% (Griffiths, 1998; S. L. Patel et al., 2005) of subjects reported a consumption of four or more bundles on one occasion; one single subject reported to consume 15 'bundles' in one day (Griffiths, 1998, see also Dhadphale *et al*., 1981; Mion & Oberti, 1998). In a study from Germany (Toennes & Kauert, 2004) blood and urine levels of cathine in subjects arrested for khat-related traffic offences ultrapassed levels ever measured in controlled studies. In addition, the development of tolerance to physiological effects of khat was reported several times (Nabuzoka & Badhadhe, 2000; Nencini et al., 1984). In sum, evidence supports the hypothesis that the development of tolerance occurs in khat chewers.

There is evidence that khat has the power to dependency because of its pharmacological properties and the sequence of its short-term emotional effects, which might motivate further intake. All authors agree that psychological dependence can result from heavy khat chewing. On the other hand, criteria of khat-specific physical dependence, like withdrawal and tolerance, have not been addressed in appropriate research designs. The current opinion is rather based on anecdotal reports and individual observations. The bulkiness of the plant material – the main argument against tolerance development - might not only be a protective characteristic that avoids negative effects in most users, but at the same time it might also lead to specific features of harmful behavior in some others, as the prolonged chewing over several days in a row, which might constitute a different way of tolerance development.

## The controversy on khat

Since the start of its economic success story some 120 years ago, khat was accused for being responsible for social evils, from economic unproductiveness to mental health problems, first by the colonial administrations, then by the independent post-colonial governments and by religious leaders (Barre, 1983; Carothers, 1945). The scientific discourse was unanimously negative towards khat, resulting in attempts to ban or to restrict the cultivation, trade or consumption, e.g. by the British colonial administration in 1921 or by the Somali government in 1983 (Elmi *et al.*, 1987; Gebissa, 2004). However, all attempts were merely obstacles to the triumphant advance in the field of agriculture and economy. This unanimously negative scientific attitude towards khat culminated in a 1983 conference, organized by the International Council Against Alcohol and Addiction (ICAA) in Madagascar (Shahandeh *et al.*, 1983). The growing anthropological interest of the 70ties and 80ties led to a rehabilitation of the bad reputation of the crop. In the western countries, the generation of the 70ties got to know khat as the mysterious peace herb from Yemen and the scientific interest in its genuine cultural value led to a number of anthropological publications (Kennedy, 1987; Weir, 1985). Since then, the scientific discussion has input from a wide array of opinions, from the development of concepts such as ‘khat-driven economic development’ to ‘khat-induced psychotic disorders’. After the identification of cathinone in the 1970ties, growing fields of laboratory researchers work on khat-related pharmacological topics and since the 1980ties group and community based studies emerged. But especially the most recent developments have seldom been the topic of research; furthermore, the different scientific disciplines working on khat rarely discussed and exchanged their views in interdisciplinary meetings.

In this section, I highlighted why it is of utmost importance to study khat today. It is necessary to evaluate its role in the current general development at the Horn of Africa and neighboring countries. We need a better understanding of the balance of its advantages and disadvantages on the micro- and on macroeconomic level, in the cultural, social and health domain.

## 1.2 Posttraumatic Stress and drug intake

Many low income countries are challenged by war, organized violence and natural disasters with severe consequences for the mental health of people and for communities. Posttraumatic Stress Disorder (PTSD) represents a common, if not the most frequent mental health problem found in community studies in post-conflict areas (Cardozo *et al*., 2004; Karunakara *et al*., 2004; Onyut *et al*., 2005; Scholte *et al*., 2004; Somasundaram & Sivayokan, 1994; World Health Organization, 2001). Traumatic experiences constitute the major risk factor for PTSD: The risk to develop PTSD is positively related to increasing number of traumatic experiences following a dose-response curve, leading to a 'building-block effect' (Neuner *et al*., 2004; Schauer *et al*., 2003). Thus, in the sample of civil-war survivors studied by Neuner and colleagues, those reporting more than 20 traumatic experiences in their lives all met criteria for a PTSD diagnosis. Similarly, extremely elevated PTSD rates were found in especially vulnerable groups who had suffered multiple or continuous trauma, like former child soldiers or tortured refugees (Derluyn *et al*., 2004; Thabet & Vostanis, 1999; Van Ommeren *et al*., 2001). Among adult combatants the prevalence of combat-related PTSD is also substantial (Kulka *et al*., 1990) with consequences for adjustment to civilian life, e.g. job and maritial problems (Prigerson *et al*., 2001; Savoca & Rosenheck, 2000). Exposure to traumatic experiences, posttraumatic symptoms and PTSD and drug abuse are frequently comorbid conditions (Bremner *et al*., 1996; McFall *et al*., 1992; Orsillo *et al*., 1996). Current evidence suggests that drug-related disorders in individuals with PTSD often originate in the attempts to 'self-medicate' trauma symptoms (Brady *et al*., 2004; Chilcoat & Breslau, 1998). It is well understood that alcohol intake transiently relieves typical PTSD symptoms (Keane *et al*., 1988). However, once a person has developed a dependence syndrome, the alcohol-related withdrawal symptoms are accompanied by a ‚rebound' of PTSD symptoms (Jacobsen *et al*., 2001). Thus, individuals are caught in a vicious circle. Furthermore, alcohol use in PTSD is related with comorbid behavioral problems, e.g. aggressive acting out (Savarese *et al*., 2001).

## Posttraumatic Stress Disorder and stimulant drugs

Amphetamine-like drugs, on the other hand, were supposed to provoke an increase of PTSD symptoms (Bremner et al., 1996). A number of prevalence studies in western countries confirm that stimulants like cocaine or amphetamines are used by a subgroup of traumatized individuals even though other substances are available (Orsillo et al., 1996). Brady et al. (1998) suggest that stimulant abuse and PTSD can be related in two ways: either stimulant use acts as risk factor for the experience of traumatic events and for the development of a PTSD or as means to ameliorate the typical numbing and depressive symptoms.

For khat, it has been hypothesized that increased use and subsequent dependence might be consequent upon psychological problems related to the immigration or traumatic life events (ACMD, 2005; Fountain *et al*., 2004; Nabuzoka & Badhadhe, 2000; Yousef et al., 1995), especially in those groups of immigrants who do not use alcohol because of religious reasons. However, no study ever tried to study the mechanisms or to test the ‚self-medication' hypothesis for khat users by quantitative methods.

## 1.3 Schizophrenia spectrum disorders and drugs

### Schizophrenia and Drug-Induced Psychotic Disorders

Schizophrenia spectrum disorders are among the most expensive illnesses, due to their chronic course, the long periods of in-patient and rehabilitative treatments and a high proportion of chronically disabled and unemployed individuals (Rossler *et al.*, 1998). For developing countries with their very low expenditures for mental health services (Saxena *et al.*, 2003), especially the immense indirect costs, e.g. the loss of productivity through the illness itself and the caretaking, are a high burden for families and communities.

Recent decades brought new insights in its etiology, epidemiology and symptomatology. Today, schizophrenia is conceptualized as a ‚neuro-developmental disorder', because perinatal brain lesions increase the risk for its onset, which is typically during late adolescence or early adulthood (Laruelle, 2003; Thompson et al., 2004). In recent years, substantial evidence has accumulated that schizophrenic patients develop a dysregulation of dopaminergic neural activity especially of the mesolimbic and mesocortical dopaminergic systems (Laruelle, 2003). This dysregulation is closely related to deficits in glutaminergic, GABAergic and serotonergic activity in limbic structures and prefrontal cortex, which normally modify and down-regulate the dopaminergic response to external stressors (Moggaddam & Krystal, 2003; Thompson et al., 2004). In summary, vulnerability to schizophrenia is expressed as a hyperreactivity of mesolimbic dopamiergic projections to exogenuous stressors, i.e. a dysfunctional down-regulation of the system. This hyperreactivity was referred to as ‚endogenuous sensitization' (Laruelle, 2003). Although genetic studies revealed a substantial genetic contribution to the vulnerability for schizophrenia, in many cases the genes are not sufficient to explain why a single individual develops schizophrenia (McGue & Gottesman, 1991). Besides complications during pregnancy or birth, certain severe somatic diseases, like Chorea Huntington or Alzheimer's disease, as well as virus infections of the brain during early childhood increase the risk for schizophrenia substantially (Hafner, 2001).

A number of studies highlight the fact that early drug use be related to the development of schizophrenia. In animal studies, damage imposed on the developing brain, e.g. by drugs, increased the potential of amphetamine-like agents to change neuro-chemical systems and to induce psychotic-like behavior (Lipska *et al.*, 2002; Lipska *et al.*, 1995). In humans, early onset of stimulant abuse might be related to the development of acquired vulnerability (Mueser *et al*,, 1990) and additional risk factors and particular stressors, such as traumatic experiences, may also contribute to increase it (Mueser *et al.*, 2002).

Most patients develop schizophrenia in their late adolescence and early adulthood with unspecific symptoms, e.g. depressive mood, social withdrawal, loss of motivation, often occuring years before the first hospitatization, These, in turn, may account for poor school performance and other problems. For a long time it was believed that in this period, patients start abusing drugs, like nicotine, alcohol, stimulants or cannabis (Farrell *et al.*, 2002; Hambrecht & Hafner, 2000; Holtmann *et al.*, 2002). While it was assumed that drug use should counteract symptoms (Schneier & Siris, 1987), Hambrecht & Hafner (1996) concluded from a retrospective assessment of a representative sample of 232 first-episode patients that about a third of them each started substance abuse before, simultaneously with and after the onset of prodromal symptoms. Moreover, Andreasson *et al*. (1987) found in a prospective study that among a national cohort of over 45.000 military conscripts cannabis use was related to an increased risk for subsequent schizophrenia, even when predisposing personality traits and the use of other drugs were controlled and a current prodromal phase was excluded (Zammit *et al*., 2002).

Irrespective of the different ways to determine the onset of the disorder (e.g. first positive symptom, first admission to in-patient treatment, etc.), the onset of schizophrenia is about four years earlier in men than women (Hambrecht & Hafner, 1992). In the above mentioned study, male patients developed their first positive symptom on average at the age of 27.8 years, female patients at the age of 30.9 years (Hafner *et al*., 1998). The cumulative life-time incidence is similar for both genders because of more frequent late-onset courses in women. At age 60 men had a cumulative lifetime incident rate of 13.1 cases per 100.000 and women 13.2. This is in line with the outcomes of a large international study including ten countries conducted by the WHO (Jablensky *et al*., 1992; Sartorius *et al*., 1986), which showed that the cumulative lifetime incidence rates of a narrowly defined schizophrenia (Cathego S+) is about 10 per 100.000. Stimulant abuse during puberty has been found to be related to earlier onset of the disorder and earlier hospitalization (Mueser *et al*., 1990), as well as to more comorbid behavioral problems (Hambrecht & Hafner, 1996) and poorer treatment outcome (Buhler *et al*., 2002). Studies in low-income countries show that the course of schizophrenia seems to be more favorable than in western countries (Jablensky *et al*., 1994; Manton *et al*., 1994). However, the recent increased use of cannabis and other drugs in these countries

(UNODC, 1999, 2004) might produce a different picture by now. Its effect on psychotic disorders have not yet been studied.

In schizophrenia patients, drugs like amphetamines can exacerbate the symptoms or even provoke a relapse (Janowsky & Davis, 1976; Lieberman *et al.*, 1987), which challenges the management of the disorder (Kavanagh *et al.*, 2002). Drug-effects on the course of illness may be attributed to sensitization (Sato *et al.*, 1983; Sato et al., 1992; Yui *et al.*, 2002) or to lasting neuro-toxic effects of prolonged stimulant intake (Robinson & Becker, 1986). Many researchers believe that schizophrenic patients under treatment often consume drugs like nicotine, cannabis or amphetamines in order not just to self-medicate the nonspecific physical symptoms but also typical side effects of neuroleptics (Mueser *et al.*, 1998).

Some drugs have circumscribed psychotomimetic properties and neurotoxic effects that can induce temporary or long-lasting psychotic states; examples are Psilocybin, Phencyclin (PCP, ‚Angel Dust'), Ketamin , L-Dopa and amphetamines. In the following we will only focus on amphetamine-like drugs, which include cathinone, the main psycho-active agent of the khat leaves.

## Amphetamines, khat and psychotic disorders

Experiments in humans (Bell, 1973) and animals (Robinson & Becker, 1986) have shown that amphetamines and some of its derivatives induce psychotic symptoms. The underlying neurophysiological mechanism is amphetamine-induced dopaminergic hyperactivity of mesolimbic projections (Laruelle *et al.*, 1997; Sharp *et al.*, 1987). Repeated administration to amphetamines leads to 'behavioral sensitization', i.e. the increased dopaminergic reaction and its behavioral correlates to subsequent stimulant administrations or stress exposure (Kalivas & Stewart, 1991). Despite the ongoing scientific debate about amphetamine-induced psychosis it remains unclear whether the use of amphetamine-like substances may actually *cause* disorders of the schizophrenia spectrum in otherwise healthy individuals, or *triggers* its onset in individual with high vulnerability to the disease (Phillips & Johnson, 2001; Poole & Brabbins, 1996). Several authors suggested that chronic amphetamine use might produce a long-lasting schizophrenia-like disorder (Flaum & Schultz, 1996; Machiyama, 1992; Sato et al., 1992). In the clinical setting, upon admission of a psychotic patient, the possibility of a stimulant-induced psychosis is usually considered when the amphetamine drug screening is positive and the recent use of the drug can be confirmed. The further decision whether or not a drug-induced psychotic disorder is diagnosed largely depends on the time course of the remission. Drug-induced states usually remit very fast, i.e. within two weeks, often without medication, in contrast to disorders of the schizophrenia spectrum, which remit slowly. On the symptom level, the acute picture cannot be easily distinguished between the two disorders, although on a group level there might be differences, e.g. related to whether a clear consciousness is maintained or related to the quality of hallucinatory symptoms (Connell, 1958). The fact that presumed amphetamine psychoses do not fully remit within weeks of abstinence in a substantial percentage of individuals (Sato *et al*., 1992) may also suggest that those individuals actually had a amphetamine-triggered schizophrenia.

Early, medical researchers visiting Yemen have claimed that khat use can provoke an acute psychotic condition that cannot be distinguished from schizophrenia; furthermore, they reported that schizophrenic patients are frequently chewers of khat

(Luqman & Danowski, 1976). According to the currently prevailing opinion, khat-induced psychotic disorders are rare phenomena due to the bulky nature of the drug (Halbach, 1972; Kalix, 1987). However, khat-induced psychopathology might not be detected as caretakers habitually lock-up or chain psychotic patient within their houses due to the lack of psychiatric services. This was reported for Yemen (Luqman & Danowski, 1976), Ethiopia (Alem & Shibre, 1997) and Somalia (Odenwald *et al.*, 2005b). Psychiatrists from African countries noted khat-induced psychoses in their units (Dhadphale & Mengech, 1987) or hypothesized that many undetected cases exist within communities (Alem & Shibre, 1997).

In summary, we do not know much about the relationship between khat and disorders of the schizophrenia spectrum.

## 1.4 Somalia – the study setting

The studies reported here were carried out in Somalia, which is frequently referred to as a ‘failed state’ (Gros, 1996). Since the overthrow of the Siyad Barre regime in 1991 a central state-like power in the capital Mogadishu could not be re-established. However, in several parts of the country regional administrations developed who assume the functions of the missing government; in other parts of the country, the local communities themselves frequently introduced the Islamic sharia law to guarantee law and order and set up sharia courts on an institutional level. Most of the research reported here was done in the north-western part of the country, which refers to the self-declared Republic of Somaliland, a regional administration which established itself within the boarders of the former British protectorate. Somaliland has a relatively strong regional administration, organized along democratic principles but with the backing of a consensus-oriented system of clan elders, assuring political stability and peace for the last ten years. However, Somaliland still awaits international recognition.

With probably millions of consumers, Somalia is one of the main export markets for khat, as the country has only a very small domestic production. From the neighboring countries Ethiopia and Kenya, tons of khat find their way to the consumer via air freight or road transport each day; especially as there is no state-like entity which might regulate the khat trade within the country. It is known that the khat import from Northern Kenya and Ethiopia’s Harar region to Somalia is operated by a few Somali companies with a monopoly-like position; also the trade within Kenya is firmly in the hand of Somali middle-men (Lemessa, 2001; Maitai, 1996). Additionally, khat is a good which was and has been smuggled for decades in the boarder regions of Somalia (Gebissa, 2004). The involvement of some Somalia warlords in the khat business, by owning shares of the respective khat companies, is well known. Thus, it was frequently speculated that khat is a source of income for civil war factions (Grosse-Kettler, 2004), even though hard facts are missing. The current sparse knowledge about increased drug trafficking and marihuana production in Somalia (UNODC, 2002) is in line with such thoughts.

Anecdotal reports stress that in the course of the Somali civil war, khat consumption has changed profoundly. Our informants in Somalia were convinced that the many years large parts of the Somali population has spent uprooted, idle and disillusioned in Ethiopian refugee camps close to the khat producing regions where the supply was abundant and the price cheap, led to a habit of binge consumption not having being known before.

Thus, the study of khat in Somalia is especially important as there is no central government who would regularly assess data on imported quantities, regulate its use or monitor consequences. With the exception of Somaliland, Somalia is a black box related to khat and other drugs, as no information is available.

*Map 1.1: Somalia*

## Historical background of Somalia

In the 19th century the colonial powers of Great Britain, France, Italy and the Abyssinian Empire colonized and divided the land of the Somali people, which had not existed as a state-like territory before, into five parts.

In 1960 the British protectorate Somaliland (capital Hargeisa) and the former Italian colony and trusteeship Somalia (capital Mogadishu) obtained independence and a few days later entered into a union that formed the Republic of Somalia (capital Mogadishu). In 1969, Major-General Mohamed Siyad Barre, of the Darod-Marehaan clan, came to power through a coup d´état. He established an autocratic regime under which the army rose to be the most powerful institution in the country. Barre was first allied to the Soviet Union. However, the USSR switched its military support to the Mengistu regime after Ethiopia's revolution. Although Somalia approached the US and received financial and military support from Western countries, Ethiopia defeated Somalia during the Ogaden war in 1977/1978. Triggered by the resulting influx of 1.5 million Ogadeni refugees to Northern Somalia, and continued marginalization of the Northern clans (in particular the Isaq), armed opposition groups arose. Meanwhile, the regime turned more and more into an outright dictatorship, which mainly relied on three Darod subclans: Marehaan, Ogaden and Dulbahante.

Based mainly on the Isaq clan, and with the support of its mighty neighbor Ethiopia, the Somali National Movement (SNM) launched increasingly successful attacks on the Somali National Army in the Northwest (the former British Somaliland) during the 1980s. Initially, the SNM fought alongside the Somali Salvation Democratic Front (SSDF), which was based on the Majeerteen clan from North-east Somalia. Both SSDF and SNM took refuge in Ethiopia, which permitted the installation of training camps, military bases and supply routes on its territory. Following an agreement between Barre and Mengistu to expel each other's armed opposition groups, the SNM changed its approach and briefly captured the towns of Hargeisa and Burao in 1988. The Somali National Army and Air Force in turn bombarded Hargeisa with airplanes which took off from the town's own airport. Hargeisa was reduced to rubble, and an estimated 50,000 people were killed between May 1988 and March 1989. What had previously been considered a guerilla war turned into open warfare, and many Isaq soldiers in the government army deserted to the SNM. Hundreds of thousands of civilians fled to neighboring countries where they stayed in refugee camps for years.

As the war escalated, armed groups were formed all across Somalia. The United Somali Congress (USC) was a movement in south-central Somalia, mainly recruiting its members from the Hawije clan family. The Somali Patriotic Movement (SPM) was a Darod-Majerteen-based movement in the South. Following an agreement between SNM, SPM and USC in August 1990 to set up a joint front against Barre, the SNM supplied weapons to the USC. In December 1990, the faction took the war to Mogadishu while Barre's forces were occupied fighting the SNM in the North. Siyad Barre was overthrown early in 1991.

The sudden end of the war in early 1991 brought a new development: In the north-west, large parts of the SNM demobilized themselves, clan militia began to control airports, the port of Berbera and transit roads. Clan elders initialized a peace and reconciliation process. The Burco Conference in May 1991 declared to end the union of the former British Somaliland with the South, and a transitional administration was formed under the SNM's leadership. However, violence and instability characterized the two-year transitional period. In 1993, the process of negotiation and conflict resolution between different factions advanced significantly: The Somaliland Armed Forces were formed, and militiamen of all clans and former SNM fighters were successively brought under its control. A clan-based mode of power-sharing was defined and Mohamed Ibrahim Egal was appointed as Somaliland's second president.

Nevertheless, brief and severe fighting re-surfaced in Hargeisa and Burco between 1994 and 1996. Clan elders started another mediation process, and the Somaliland has remained peaceful since. In May 2002, President Egal died. His deputy, Dahir Riyale Kahin – a member of the minority Gadabursi clan - was swiftly sworn into office for the remainder of the term. Riyale was elected president in the first democratic presidential elections after the civil war in April 2003. Parliamentary elections, described as free and fair by international observers, took place in September 2005. While Somaliland has not yet succeeded in its efforts to achieve international recognition, and was challenged by assassinations of international aid workers and a border conflict with neighboring Puntland in 2003 and 2004, larger military operations could be avoided and the former North-West Somalia has proven stable for almost a decade.

In the South, the United Somali Congress split into rivaling clan-based factions soon after the victory over Siyad Barre, which produced a chaotic situation in this part of the country. Continued inter-factional fighting and acute food shortages by Summer 1992 led the UN to estimate that 1.5 million Somalis faced risk of immediate starvation, and another 4.5 million were not supplied fully with food, resulting in tens of thousands of deaths (AKUF, 2003) and hundreds of thousands of refugees and IDPs (UNHCR, 2005).

The international community tried to access these populations but faced enormous difficulties, as the security situation hardly allowed for the distribution of food. Additionally, humanitarian organizations had to pay “duties” to factions and humanitarian goods were diverted to supply the militia. In 1992, the UN Security Council eventually approved the US-led Operation “Restore Hope”, followed by the establishment of the UNOSOM II Mission, a multilateral force tasked to stabilize Somalia and to open humanitarian access. When US forces entered into a hunt for General Farah Aidiid (one USC faction leader), the situation escalated seriously. Aidiid instrumentalized the confrontation with the superpower and portrayed himself as a liberation fighter among the Somali population. In 1993, a number of serious clashes between U.S. troops and supporters of Aidiid led to the decision of the White House to withdraw the troops from Somalia. The UN intervention ended when the last soldiers left Somalia in 1995, leaving the country divided between numerous factions. Since then, peace could not be restored, though parts of the country (such as Puntland in the Northeast) were stabilized by local forces. Often conflicting peace initiatives by neighboring countries never succeeded to reverse Somalia’s full-fledged state collapse.

In 2002, the regional organisation IGAD managed to bring major Somali faction leaders together in a peace conference, which was first situated in the Kenyan town of Eldoret and later transferred to Mbagathi (Nairobi). After countless setbacks, the conference managed to select a parliament from its ranks, and in 2004, Abdillahi Yussuf Ahmed, the by then president of the autonomous Puntland region, was elected President of the Transitional Federal Government of Somalia (TFG). He subsequently appointed a cabinet involving his political opponents. In 2005, Abdillahi Yussuf managed to return to

Somalia. He first made camp in Jowhar, about 100 km north of Mogadishu, entering into a year-long stand-off with his opponents in the capital. The TFG is split over the location of the government and the president's demand to deploy an international force. In 2005, both sides mobilized their forces and imported large quantities of weapons. While Ethiopia, Yemen and other African governments support the President, the Mogadishu factions are believed to have received unofficial US support in their bid to fight Mogadishu's Sharia courts. Early 2006, an agreement with the speaker of parliament led to Abdillahi Yussuf's effective relocation to Baidoa, where the parliament met for its first session inside the war-torn country. This has given rise to hopes that Somalia's latest effort to re-establish a central government could be rescued from its divisions and stalement. However, in May 2006, Somalia was again in the news, when the Mogadishu Sharia courts and their heavily armed militias, equipped with the money of local businessmen and probably foreign assistance, managed to thrive out most of the warlords, who have divided and paralyzed the capital for 15 years, in a bloody military action and even managed to overrun Jowhar. At the time of writing these pages, the consequences of these happenings are not foreseeable.

## 1.5 The use of the stimulant khat, war-related trauma and psychosis in Somalia: How changed use patterns of a traditional drug are related to psychiatric problems in the transition from war to peace

Chapter 2, reviews evidence on the association between khat use and psychiatric disorders with special emphasis on psychotic disorders, in order to set up prospects for future research.

On this background, a cross-sectional household survey and case-control study was performed in Hargeisa, the capital of Somaliland (Chapter 3). The aim of this study was to identify disabled cases due to mental disorders and to diagnose their mental health problems in two successive interviews. Thereby cases with schizophrenia spectrum disorders were identified in the community. The study addresses the questions whether khat use and functioning problems due to mental disorders were more frequent in individuals who had ever been exposed to war and violence and whether patients with psychotic disorders had a different khat use history compared to healthy matched controls.

Chapter 4, adds a case study of a patient with a long-lasting psychotic disorder and comorbid khat use. This case first, serves to illustrate how khat abuse is an integral part in the life of a psychotic patient in Somalia (in this aspect this case might present the overall situation in a nutshell). In addition, the case represents the medico-legal consequences of a crime committed in a state of paranoid delusions and under khat intoxication, also illustrating how such cases are managed in the legal and juridical system of Somaliland.

The study presented in Chapter 5 aim at developing a psycho-diagnostic instrument to assess Posttraumatic Stress Disorder (PTSD) in Somali language, which can be applied by trained, local interviewers.

With this instrument, tested per reliability and validity, a cross sectional study on drug use was carried out in a large sample of more than 8.000 active and former combatants in all Somalia (Chapter 6). The study addressed whether khat and drugs other than khat (hashish, psychoactive tablets, alcohol, solvents and hemp seeds) would be consumed among Somali military personnel and whether patterns of consumption differed between the northern and the southern part of the country; in the latter, being controlled by a large numbers of rivaling clan-based militia, state power is virtually absent; in the former, two regional administrations, Somaliland and Puntland, have re-established law and order.

These studies provide the base for a model on the relationship of khat use, posttraumatic stress and disorders of the schizophrenia spectrum. Although aspects of this model remain speculative, given the limited knowledge on khat and its consequences in nowadays Somalia, this model allows testable hypotheses and thereby stimulates more focused studies in the future.

# 2. Chronic khat use and psychotic disorders: a review of the current literature and future prospects[1]

[1] Source: Odenwald, M. (in press). Chronic khat use and psychotic disorders: A review of the current literature and future prospects. *Sucht*.

## 2.1 Abstract

In the recent decades, the traditional habit of chewing the leaves of the khat shrub, which contain the amphetamine-like cathinone, has undergone profound changes in African and Arab countries, from a socially regulated use pattern towards uncontrolled consumption. This is of special public mental health concern. In this chapter, a review of the scientific literature on the relationship between khat use and psychosis is provided.

Several case studies, but only a few group and community-based studies have addressed this topic. The studies show inconsistent results, have methodological problems, and fail to report quantitative results. Many important questions remain unaddressed.

The frequently stated association between khat use and psychosis contrasts with the small number of sound studies. Currently, only a few conclusions can be drawn, that excessive khat use can cause brief psychotic disorders and that people with a preexisting vulnerability should be discouraged to consume it. The direction of causality between general psychopathology and khat use remains unclear. This review confirms the urgent need for quantitative, controlled, and longitudinal research studies, which can help deepen the scientific and clinical understanding on the mental health effects of exposure to khat use at various ages and its link to the development of psychosis.

## 2.2. Introduction

Khat (*Catha edulis forssk*) is an evergreen shrub of the *Celastraceae* family, normally reaching 6 m of height but in an equatorial climate it might grow up to 25 m (UNODC, 1956). Khat can be found in the Abyssinian highlands, the Horn of Africa, in Eastern and Southern Africa, the Arab peninsula and Afghanistan (Krikorian, 1983). The first historical reference to it is found in a medieval Arab manuscript from the first half of the thirteenth century (UNODC, 1956). The first botanical description goes back to the naturalist Peter Forsskål (1732-63; Meampel, 1992). For a complete botanical description see Nordal (1980). For commercial purposes, it is grown in altitudes of 1,500 to 2,500 m above sea level, mostly pruned to 2–7 m (Kennedy, 1987; Lemessa, 2001).

In Ethiopia, Yemen, Somalia and Kenya the fresh young leaves and tender stems are traditionally consumed for their stimulating properties (Halbach, 1972). The freshness of the plant material is considered crucial, because 48 hours after its harvest the desired properties will have largely diminished. Khat was traditionally used during Muslim religious ceremonies and when studying the Koran, for recreational purposes, as a natural plant remedy with medicinal properties and for reducing physical fatigue while traveling or working. The leaves are mostly chewed, and an egg-sized bolus is kept in the cheek for several hours before it is spat out; the extracted juice is swallowed. Especially among Somali consumers, the whole plant material might be swallowed (personal communication, Peter Hansen). However, it is also used as tea (Abysinnian, Arabic or Bushman's tea), paste or as dried powder. The most common traditional setting for consumption is the 'khat party' (Baasher, 1980; Kennedy, 1987; Weir, 1985), which is known to have taken place for centuries among the higher classes (Schopen, 1979). Men usually gather on weekends after lunch in specially prepared rooms in private houses ('mafrish', 'mafrij') and chew khat until early evening. Nowadays, khat parties also take place in public teashops or cafes, where sodas, sweet tea, water, chewing gum and cigarettes are often consumed at the same time. Women are said to chew less frequently, and mixed-gender khat parties seem to be rare. A detailed description of the khat party is provided elsewhere (Al-Motarreb, Baker & Broadley, 2002; Baasher, 1980; Kennedy, 1987). These gatherings were and still are an important social institution, because political, business and social affairs are settled during khat chewing, and khat is also an integral part of other rites and celebrations, e.g. weddings and rites of passage (Al-Motarreb et al., 2002; Carrier, 2005). The lower classes and inhabitants of rural areas, e.g. farmers, traditionally used khat throughout the day during heavy work, for fighting physical fatigue, or the suppression of hunger (Gebissa, 2004; Luqman & Danowski, 1976; Schopen, 1979). The cultural, social and national importance of khat chewing has been emphasized by many researchers (Gebissa, 2004; Kennedy, 1987; Weir, 1985).

## Chemical agents, pharmacology and neurophysiological effects

Since the 19th century, pharmacologists have tried to isolate the agents that are responsible for the stimulating effect of the khat leaves (Halbach, 1972). Today it is known that the unstable alcaloid S-(-)-cathinone (S(-)alpha-aminopropiophenone) is the main psychoactive agent (Szendrei, 1980). In addition, cathine (S,S-(+)-norpseudoephedrine), other alkaloids and tannins have been identified (Al-Hebshi & Skaug, 2005).

Cathinone content depends on the origin and freshness of plant material, and these factors are correlated with the estimated quality and market price (Al-Motarreb et al., 2002; Geisshusler & Brenneisen, 1987). By chewing the khat leaves, cathinone is effectively extracted into the saliva and directly absorbed through the oral mucosa and in the stomach (Toennes, Harder, Schramm, Niess & Kauert, 2003). For cathinone, maximal plasma concentrations are reached 2 to 2.5 hours after the start of a session, for cathine, after 2.6 hours. Cathinone has a mean terminal elimination half-life of 1.5-4.5 hours; for cathine, it is approximately 5 hours (Toennes et al., 2003; Widler, Mathys, Brenneisen, Kalix & Fisch, 1994). In different experimental khat sessions, after the ingestion of 0.6 and 0.8 g of khat leaves per kg of body weight, the maximum concentrations of cathinone in plasma were 58.9 ± 18.8 ng/ml and 127 ± 53 ng/ml, for cathine, they have been 71,2 ± 13.9 ng/ml and 89 ± 49 ng/ml (Toennes et al., 2003; Widler et al., 1994). After ingestion, S-(-)- cathinone is reduced to its main metabolites R,S-(-)-norephedrine and S,S-(+)-norpseudoephedrine (Brenneisen, Geisshusler & Schorno, 1986; Toennes et al., 2003).

Numerous laboratory studies have confirmed that cathinone resembles amphetamine in chemical structure and that it affects the central and peripheral nervous system (Kalix, 1990) and behavior (Woolverton & Johanson, 1984; Zelger, Schorno & Carlini, 1980) similarly (for a review see Kalix, 1991; Nencini & Ahmed, 1989). In the CNS, cathinone provokes the release of catecholamines, especially dopamine, at the presynaptic storage sites, and is about half as potent as amphetamine (Pehek, Schechter & Yamamoto, 1990); it inhibits re-uptake and can produce depletion of central dopamine (Schechter, 1990a, 1990b). Cathine has a much smaller effect in the release of central catecholamines. Peripherally, cathinone and cathine are equipotent in the release of noradrenaline at the presynaptic storage sites; thus, both have sympathicomimetic effects. The short-term physiological effects of khat reflect the sympathicomimetic and central dopaminergic activity, e.g. increased heart rate and elevated diastolic and systolic blood pressure (Brenneisen, Fisch, Koelbing, Geisshusler & Kalix, 1990; Hassan et al., 2000; Toennes et al., 2003; Widler et al., 1994). The immediate emotional effects in experimental human settings are euphoria (Brenneisen et al., 1990; Widler et al., 1994) and a subsequent depressive reaction (Hassan, Gunaid, El-Khally & Murray-Lyon, 2002). Thus, it has been argued that the depressive phase after the end of the khat session motivates the user to continue to chew (Griffiths, 1998).

Kalix (1991) postulated a higher potential to induce dependence than amphetamine because: (1) cathinone has a more rapid onset of action in discrimination experiments (Johanson & Schuster, 1981; Woolverton & Johanson, 1984), (2) tolerance to cathinone's anorectic effects develops faster and is more pronounced, (3) in conditioning experiments, cathinone is less aversive than amphetamine (Goudie & Newton, 1985), and (4) in self-administration experiments, response rates are higher to cathionone than those maintained by amphetamine (Johanson & Schuster, 1981; Yanagita, 1986).

## Economy and consumption

For centuries khat has probably been used only among the production and neighboring regions; long-distance transport was not feasible because of the short-lived nature of khat's stimulating properties (Gebissa, 2004). During the past decades, the economic importance and consumption of khat leaves have increased dramatically, from a custom practiced only by certain social or ethnic groups in parts of Africa and the Arab Peninsula, to a widespread habit in the general population of these countries (Alem, Kebede & Kullgren, 1999; Belew, Kebede, Kassaye & Enquoselassie, 2000; Kebede et al., 2005; Selassie & Gebre, 1996) and among immigrant communities all around the world (Nencini, Grassi, Botan, Asseyr & Paroli, 1989; Patel, Wright & Gammampila, 2005). One decade ago it was estimated that on a world-wide scale, there were 5 to 10 million consumers each day (Balint, Ghebrekidan & Balint, 1991; Kalix, 1996). Today, the main producing countries are Ethiopia, Yemen, and Kenya, where the production, trade, and use of khat are not legally restricted. Ethiopia is considered to be the world's largest producer, with khat being the country's second largest export product in 1999 (FAO, 2001). In Yemen, the area under khat production has expanded dramatically, and the khat sector now produces 10% of the national GDP (Ward, 2000; Worldbank, 2005). Also in Kenya, the economic importance of khat is considered great, with remarkable monopoly-like trading structures linked to Somalia, its main export destination (Maitai, 1996). The khat sector today feeds millions of farmers and people involved in its trade. Due to its high and stable market prices and its resistance against drought and frost, farmers have a more secure and higher income from khat than from other crops (Feyisa & Aune, 2003; Gebissa, 2004; Kennedy, 1987; Seyoum, Kidane & Gebru, 1986). Thus, khat growing communities were found to be more prosperous than others (McKee, 1987; Seyoum et al., 1986). However, the khat boom has also caused marked changes of the traditional agriculture and land-use systems (Feyisa & Aune, 2003) as well as ecological problems, e.g. through the exploitation of scarce water resources for irrigation farming (Worldbank, 1999).

There is evidence that khat-chewing habits have changed qualitatively during the last decades. What was previously a formalized and strongly regulated social habit, now has features of excessiveness, informality, and decoupling from normative control, at least in some user groups (Nabuzoka & Badhadhe, 2000). This is apparent in individuals' consumption of higher quantities of the drug (Dhadphale, Mengech & Chege, 1981; Griffiths, 1998; Nabuzoka & Badhadhe, 2000; Odenwald, Hinkel et al., submitted; Patel et al., 2005), longer continuous consumption time (Nabuzoka & Badhadhe, 2000; Odenwald, Lingenfelder et al., submitted), and parallel use of other drugs, e.g. benzodiazepines or alcohol (Nabuzoka & Badhadhe, 2000; Odenwald, Hinkel et al., submitted; Omolo & Dhadphale, 1987; Selassie & Gebre, 1996; Zein, 1988).

Although previously khat chewers were traditionally 'initiated' at about 20 years of age, nowadays they start using the drug earlier, and especially in Kenya consumption has become part of the youth culture (Carrier, 2005; Nabuzoka & Badhadhe, 2000; Patel et al., 2005). Furthermore, the formerly adult male habit is now practiced more and more by women (Alem et al., 1999; Griffiths, 1998; Nabuzoka & Badhadhe, 2000; Patel et al., 2005) and, alarmingly, also also during pregnancy and lactation (Belew et al., 2000; Eriksson, Ghani & Kristiansson, 1991). Cathine has been identifed in human breast-milk (4 of 7 samples tested positive 2–4 hours after following chewing; positive samples ranged between 90 ng/ml and140 ng/ml) and in infant urine (one sample that was taken 12 hours following chewing with 200 ng/ml; Kristiansson, Abdul Ghani, Eriksson, Garle & Qirbi, 1987).

New patterns of use, which were not previously described in the academic literature, have been observed in Somalia and Ethiopia: 'ijabane' or 'igabana' ('eye opener'). This consumption during early morning hours was previously known only among khat farmers (Gebissa, 2004). Today, during morning hours, crowds of khat chewers gather in the proximity of khat markets. They chew together and share with one another, in order to chase away the typical khat-induced 'qaadiro' ('hangover'; personal observation, confirmed by Peter Hansen, personal communication). Some researchers highlight the special function of khat chewing in immigrant communities in western countries, where it apparently serves an identity-defining role (Ahmed & Salib, 1998; Griffiths, 1998; Patel et al., 2005).

### Controversy surrounding khat and medical knowledge of its consequences

The benefits of and harm from khat use has long been debated. Since colonial times, there have been descriptions of adverse behavioral reactions and negative health effects from khat use (Carothers, 1945). Its use has been linked to economic problems, general unproductivity, underdevelopment, and disease (WHO, 1983; for a review see Gebissa, 2004). Thus, attempts to ban khat have been undertaken, for example, in 1957 in the territories under British control and in 1983 in Somalia (Elmi, Ahmed & Samatar, 1987; Gebissa, 2004; Luqman & Danowski, 1976). After World War II, the WHO and other UN organizations became active (UNODC, 1956) and initiated basic research on khat (Szendrei, 1980), which eventually led to its placement under the International Convention on Psychotropic Substances (U.N., 1971) in 1986.

Another line of argument was introduced by Islamic scholars, who considered khat to be 'haram' and forbidden by the Holy Koran (Al-Ghdaian, 1983), leading to its ban by the 'World Islamic Conference for the Campaign against Alcohol and Drugs', in Medina in 1982 (El-Kader, 1983) and in some Islamic countries, especially Saudi Arabia.

During the last two decades, there has been an increase in scientific research on the health effects of khat use beyond the question of addiction, and recently several scholars have written extensive reviews of the literature (ACMD, 2005; Al-Habori, 2005; Al-Hebshi & Skaug, 2005; Al-Motarreb et al., 2002). The following consequences of khat chewing on physical health have been confirmed: (a) Some evidence has accumulated for a link between khat chewing and myocardial infarction, although confounding factors, such as smoking, should be studied further; (b) certain gastro-intestinal problems, such as constipation, and lesions of the oral mucosa are clear consequences of khat chewing; (c) khat chewing appears to be associated with the development of oral cancers, however, the mechanisms involved are not clearly understood; the evidence for other forms of cancer and for duodenal ulcer is less clear; (d) there is some evidence that khat has cytotoxic effects and causes histopathological changes, e.g. in liver tissue; (e) acute effects on reproductive functions, e.g. spermatorrhoea and changed libido, might occur and chronic use might have negative effects on male semen parameter; (f) lower birth weight of babies born to khat chewing mothers have frequently been found.

Currently there is no comprehensive review on khat and psychopathology. However, several observations were noted above: (a) khat causes psychological but not physical dependence, but and tolerance does not develop; and (b) khat-induced psychotic disorders are thought to be rare. The authors acknowledge the lack of conclusive data, especially regarding the effects of khat on mental health.

The goal of this review is to systematically analyze the available scientific literature on the association between psychotic symptoms and disorders and chronic khat use. This relationship has often been suggested because of the similarities between cathinone and amphetamine. Emphasis is placed on methodological aspects of the published literature.

## 2.3 Method

A literature research was conducted using Pubmed and PsychInfo with the search terms ‘khat’ or ‘qat’ and ‘psychosis’ or ‘psychopathology’. Literature cited in articles or books that was not listed in the databases was also used. Because of the limited number of published works, articles with methodological problems were included. In total, there were 46 articles or reports that provided original quantitative or qualitative data on khat chewing and psychotic symptoms.

## 2.4 Psychopathological effects of chronic khat consumption

Early medical researchers visiting Yemen claimed that khat use could have behavioral effects that could be distinguished from schizophrenia only by their transient nature and that schizophrenic patients were frequent chewers of khat (Luqman & Danowski, 1976). According to the currently prevailing opinion, khat-induced psychotic disorders are a rare phenomenon because of the bulky nature of the drug (Halbach, 1972; Kalix, 1987). However, others have stated that khat-induced psychopathology might not have been detected because caretakers habitually lock or chain psychotic patients inside their homes due to the lack of treatment facilities. This practice has been documented in Yemen (Luqman & Danowski, 1976), Ethiopia (Alem & Shibre, 1997), and Somalia (Odenwald et al., 2005). Psychiatrists from Africa have noted that patients with khat-induced psychosis had been seen in their units (Dhadphale & Mengech, 1987), and they speculated that there were many undetected cases in the communities (Alem & Shibre, 1997). According to the World Drug Report 2004, in Ethiopia khat was the main drug of abuse among 75.6% of all patients who were treated for drug-related problems; in Kenya this figure was 14.3% (UNODC, 2004).

### Khat and psychosis – theoretical background

Amphetamines and some of its derivatives have been shown to induce psychotic symptoms in experiments in humans (Bell, 1973) and animals (Robinson & Becker, 1986), and they have been known to exacerbate psychotic states in psychiatric patients (Angrist, Rotrosen & Gershon, 1980; Janowsky & Davis, 1976). However, the scientific debate about amphetamine-induced psychosis is ongoing, and it remains unclear whether the use of amphetamine-like substances can actually *cause* a psychotic disorder in an otherwise healthy individual, or whether it *triggers* the onset of schizophrenia in an individual with high vulnerability to the disease (Phillips & Johnson, 2001; Poole & Brabbins, 1996). Increased drug use among psychotic patients may also result from their attempt to counteract nonspecific physical symptoms or side effects of neuroleptics (Mueser, Drake & Wallach, 1998).

In animal models of dopamine-related psychopathology, the effects of cathinone and khat extract have been addressed. Behavioral responses to single high doses of amphetamine have been proposed as an animal model for stimulant-induced psychosis (Robinson & Becker, 1986). Much like amphetamine, single cathinone or cathine administrations have been shown to elicit dose-dependent locomotor activity or stereotyped behaviors, e.g. sniffing in rodents, with higher doses eliciting a greater behavior response (Calcagnetti & Schechter, 1992; Zelger et al., 1980). The behavioral sensitization paradigm is another model of stimulant-induced psychotic behavior (Robinson & Becker, 1986). One study has shown that cathinone and khat extract have similar effects in this paradigm as amphetamines (Banjaw, Miczek & Schmidt, 2005).

Khat consumption might be related to the development of psychosis in various ways. If psychosis is considered to result from genetic and acquired vulnerability and additional stress factors or other triggers (Nuechterlein et al., 1992; Zubin, Magaziner & Steinhauer, 1983), the repeated or early life exposure to the chemical agents in khat might increase an individual's vulnerability (Sato, Numachi & Hamamura, 1992). At a later stage in life, khat use might trigger for the onset of psychotic disorders in individuals who have a genetically determined or acquired vulnerability for it. Moreover, khat consumption may affect the course of a psychotic disorder.

In the context of khat use and its psychiatric sequelae in human beings, four questions are important or have been addressed by researchers: (a) Is there an association between khat chewing and general psychopathology? (b) Can khat induce short-lived psychotic reactions that are clinical relevant and are distinct from schizophrenia-spectrum disorders? (c) Can khat trigger psychotic disorders in vulnerable individuals or exacerbate symptoms in psychotic patients? (d) Can khat use increase the vulnerability for developing a schizophrenia spectrum disorder?

### (a) Is there an association between khat chewing and general psychopathology?

This question raises a number of related issues: *First*, is psychopathology among chewers different than among non-chewers? *Second*, is the prevalence of khat chewing among psychiatric patients different than among other groups? *Third*, is there a causal link between khat chewing and psychopathology?

*Psychopathology among chewers and non-chewers:* Some studies have addressed the question whether khat users show nonspecific signs of psychopathology, anxiety, depression, or suicidal tendencies more frequently than non-chewers. Five such studies were undertaken in the African and Arab countries.

Between 1974 and 1976 an American research project (Kennedy, Teague, Rokaw & Cooney, 1983) recruited 706 respondents from three major urban centers of the Yemen Arab Republic, selecting quotas for khat use (non-users, light to moderate users, heavy users), gender, age and socio-economic status. Local Yemeni staff interviewed the respondents about their khat habits and invited them to a hospital where a physician 'blind' to their khat use carried out a medical examination and assessed the medical history without a structured instrument. The diagnosis of current psychiatric problems did not reveal clear relationships; unfortunately, the authors did not report the related statistics. However, among male patients, the lifetime prevalence of a psychiatric or psychosomatic problem was associated with khat chewing: 29.8% of non-users, 45.9% of light to moderate users and 61.9% of heavy users had a life-time history of such a problem ($Chi^2 = 22.14$, $p < .001$; $OR = 2.29$). Women had a higher prevalence of psychiatric and psychosomatic problems than men (about 75%) regardless of their khat use.

Dhadphale & Omolo (1988) randomly selected 100 persons (50 men and 50 women) from a file waiting for medical consultation at a hospital in a khat-growing region of Kenya, and assessed khat use and psychiatric symptoms with the Self Report Questionnaire (SRQ; Harding et al., 1980). Whereas moderate users (n = 23) were not different from nonusers (n = 71; t = 0.32, p > .05), heavy users (n = 6) had a higher SRQ total score than the other groups (heavy versus moderate: t = 2.59, p < .02; heavy versus nonusers: t = 2.96, p < .02).

In a cross-sectional household survey conducted in 1994 and 1995, Alem and colleagues (1999) assessed the prevalence (current and life-time) and frequency of khat use in a representative sample of 10,468 respondents from a traditional khat-growing rural community in Ethiopia (response rate = 85%). Psychiatric cases were identified with the SRQ. The authors reported the results only for the variable ‘current daily khat use’. Among the daily chewers (n = 911, 8.7% of the total sample), 17.0% (155) were identified as psychiatric cases, compared to 17.5% (n = 1.671) of other types of users ($Chi^2$ = 3.10, n.s.). The authors assumed that khat chewers in the sample were using the drug moderately according to the local tradition. However, they did not quantify the amount of khat intake, and did not control for the impact of other factors, e.g. stressful life events. In 1997, the same Ethiopian research group (Belew et al., 2000) interviewed 1,028 randomly selected persons above the age of 15 from a cross-sectional household survey (response rate = 86.6%) in another rural district of Ethiopia, where khat was not traditionally produced; they used the SRQ and additional ad-hoc items to measure psychiatric symptoms. They reported that current khat chewers (31.7% of sample) were more likely than non-chewers to score above the SRQ cut-off (OR = 8.3, CI (95%) = 5.20 - 13.31) and that they more frequently had sleep problems (OR = 3.75, CI (95%) = 2.63 – 5.37). They report the same effect for frequency and duration of khat use (frequency: OR = 8.20, CI (95%) = 4.88 – 13.85; duration: OR = 8.14, CI (95%) = 5.06 – 13.17). The authors attributed the differences between the two studies to the different composition of the two samples: 83% of respondents in the the first study were members of the Guarge ethnic group. In the second study, the majority (68%) of the sample were members of the Oromo ethnic group who also had the highest prevalence of khat chewing (36%). This explanation is supported by the finding that among the Oromos, the widespread habit of khat chewing was probably adopted only in recent decades (Gebissa, 2004), and, thus, the traditional knowledge about the dangers of the drug and the related social-control mechanisms might not have developed.

In a cross-sectional household survey in urban and rural areas of Yemen (Numan, 2004), 792 subjects were recruited using random selection procedure, 538 of whom were khat users (187 of them every-day users). They were assessed with the Symptom Checklist 90 (SCL-90; Derogatis, 1977). There were no differences between khat chewers and non-chewers, except that substantial anxiety symptoms were more common among the non-khat chewers. The means of the SCL-90 subscales and the relationship between frequency of khat intake and the measures of psychopathology were not reported. There are some concerns that the sample was not representative, because the author indicated that he did not find any case of manifest mental or physical illness or even a history of mental illness in his sample. Furthermore, there are doubts about the validity of the data, because khat users were interviewed during group khat-use sessions. Presumably, the intoxication and the group situation affected the responses.

Four controlled studies are available with immigrant groups in Western countries.

Litman, Levav, Saltz-Rennert & Maoz's (1986) study drew a random sample of 136 persons between 15 and 65 years of age from two Yemenite agricultural villages inhabited by immigrants who had been resettled in Israel after 1948. Using the Psychiatric Epidemiology Research Interview (PERI, Dohrenwend, Shrout, Egri & Mendelsohn, 1980) the authors identified respondents who were likely to have a psychiatric disorder. In the more traditional village, they found more such cases among khat chewers than among non-chewers: 8 of 11 heavy chewers (72.7%), 13 of 33 infrequent chewers (39.4%) and 10 of 36 non-chewers (27.8%; $Chi^2 = 7.182$, $df = 2$, $p < .05$). They did not report sufficient information from the multivariate analysis they ran, or give the socio-demographic characteristics of the cases and non-cases.

Using the General Health Questionnaire (GHQ; Goldberg & Hillier, 1979), Ahmed & Salib (1998) compared 27 khat users with 25 non-users, all of whom were male and recruited from the Somali community in Liverpool. A Somali social worker conducted the interview in a community setting. Although the authors identified a relatively large number of individuals above the cut-off point, there was no no group difference (chewers: 41%; non-chewers: 36%, $p = .72$). Khat use was not quantified, and confounding variables were not controlled.

Bhui and colleagues (Bhui et al., 2003; Bhui, Audini, Singh, Duffett & Bhugra, 2006) conducted two studies among Somalis living in London. In the first study, they interviewed 180 randomly selected adults from a Somali community panel from Greenwich. They assessed symptoms of depression and anxiety using the Hopkins Symptom Checklist (HSCL; Derogatis & Melisaratos, 1983), suicidal ideation using the Beck Depression Inventory (BDI; Beck & Steer, 1987), prevalence of substance abuse (no quantitative information), traumatic experiences with the Harvard Trauma Questionnaire (HTQ; Mollica *et al.*, 1992), and immigration-related stressful experiences. They trained their non-professional interviewers to probe for selected psychotic symptoms (grandiose delusions, hallucinations, unusual thought content) from the Brief Psychiatric Rating Scale (BPRS; Overall & Goreham, 1962). The authors identified respondents as 'cases' from the distribution of HSCL scores (upper quartile), when they had a score of one or higher on the BDI suicide item or when at least the one psychotic symptom was judged to be present. Among the 72 khat users, the cases with suicidal ideation were more frequent than among the non-users (66.1% vs. 33.9%, $p < .001$), a result which confirmed previous qualitative reports (CVS Consultants & Migrant and Refugee Communities Forum, 1999). The frequency of cases with a critical load on anxiety/depression symptoms or of psychotic cases did not differ between the khat chewers (21.7% and 16.1%) and non-chewers (26.0% and 20.4%). This study reported neither quantitative results nor a detailed analysis of confounding variables e.g. traumatic experiences. In the second study (Bhui et al., 2006), the researchers interviewed 143 Somalis randomly recruited from GP registers and community sites; they used a Somali version of the MINI-International Neuropsychiatric Interview (Sheehan et al., 1998) and also assessed respondents' khat intake. The prevalence of 'common mental disorders' (CMD, anxiety and depression) was 34%; PTSD was 14%; and suicidal ideation 9.1%. In a logistic regression model, khat use was a highly significant predictor of any mental disorder diagnosed with the MINI (OR = 10.47, CI 95% 1.11 – 98.25). However, quantitative measures of khat chewing were not obtained, and results on symptom levels were not reported.

*Prevalence of khat use among psychiatric patients:* Few studies have addressed the question of whether khat chewing is different among psychiatric patients than other groups. Most group and community-based studies on the psychiatric effects of khat have excluded participants with severe psychiatric illnesses (Alem et al., 1999; Belew et al., 2000; Bhui et al., 2003). Some anecdotal reports have mentioned that khat use is a common among psychiatric inpatients at the Horn of Africa (Alem et al., 1999). In a study that we conducted in Hargeisa, Somaliland (Odenwald et al., 2005), all except one of 38 male psychotic cases had used khat, in contrast to 25 of the 38 matched controls ($p < 0.001$). In the week before the interview, 54% (i.e. 20 of 37) of the male patients who were lifetime khat users and 36% (i.e. 9 of 25) of the control group had chewed it ($p = 0.162$).

*Underlying mechanisms*: In the currently available literature, the underlying mechanisms - how khat use and psychopathology are associated - are not specifically studied. Many authors have implicitly tested the hypothesis that khat chewing causes psychopathology (Belew et al., 2000; Numan, 2004). In contrast, several researchers have espoused the hypothesis that increased khat use and subsequent development of dependence are a response to psychological problems related to stressful or traumatic life events (e.g. 'self-medication'; ACMD, 2005; Fountain et al., 2004; Nabuzoka & Badhadhe, 2000; Yousef, Huq & Lambert, 1995). In a study in Somalia, we found that among 64 ex-combatants that those with Posttraumatic Stress Disorder (PTSD, n =

14) spent on average two hours per day more than other on chewing khat (Odenwald, Lingenfelder et al., submitted). In another study, we found a positive association between number of traumatic events experienced and quantity of khat used (Odenwald et al., 2005). These results show that several hypothesis about how khat use and psychopathology are related should be tested; based on the current literature, no definitive statements can be made.

In summary, there are only few studies that have ever assessed whether khat use is related to general psychopathology; furthermore, the studies have many methodological problems, and important information was not reported. Of general concern are the types of instruments used to measure nonspecific symptoms of psychopathology, which usually include a large number of items referring to psychiatric patients' typical somatic complaints. However, these complaints (e.g. digestion problems) can also be direct consequences of khat use, making it difficult to disentangle cause and effect. A recent study in Yemen (Date, Tanida & Hobara, 2004) reported more chronic health complaints among chewers who habitually used pesticide-polluted khat compared to users from an area where no pesticides were used. Furthermore, the effects of khat chewing cannot be studied without assessing traumatic experiences or stressful life events as confounding variables. These factors alone might have a significant impact on the mental health of respondents and on their drug use, for example, as means of 'self-medication'. Thus, the reported symptoms among chewers can be attributed to various factors and are not necessarily related to or caused by khat chewing. Another important methodological issue is the interviewers' level of training. In the two controlled studies that employed poorly trained interviewers (Ahmed & Salib, 1998; Alem et al., 1999), no association was found between khat use and respondents' mental health. In all controlled studies, in which well trained interviewers were used, at least one association between khat use and a psychiatric symptom was found (Belew et al., 2000; Bhui et al., 2003; Bhui et al., 2006; Dhadphale & Omolo, 1988; Kennedy et al., 1983; Litman et al., 1986). One study was not included because of serious methodological problems (Numan, 2004).

It is not possible to draw a definite conclusion about the association between khat chewing and general psychopathology, although there is tentative evidence that the two are related under certain circumstances. We might speculate that this association occurs especially among heavy users, in groups that have only recently acquired the habit of khat chewing (Belew et al., 2000), in individuals who use khat outside the traditional regulative mechanisms (Nabuzoka & Badhadhe, 2000) or among immigrants with a high load on stressful and traumatic life experiences (Bhui et al., 2003).

Future studies on psychopathology among khat chewers should always assess khat use quantitatively, because excessive use rather than khat use per se might be related to psychopathology. In order to disentangle cause and effect, both specific and unspecific psychiatric measures should be used, and research methods and designs should be used that allow confounding variables to be controlled, for example by using adequate control groups. Persons who are severely psychiatrically disturbed should not be excluded from future studies, because the negative consequences of khat use might be strongest among them. Finally, longitudinal assessments are required for identifying causal relationships between khat chewing and psychopathology.

### (b) Can khat induce clinically relevant, short-lived psychotic reactions that are distinct from schizophrenia-spectrum disorders?

In Griffiths and colleagues' study (Griffiths, 1998; Griffiths et al., 1997), trained Somali interviewers used an ad-hoc structured interview to ask 207 Somalis living in London about khat intake and associated symptoms. Among khat users (n = 161), 19% reported paranoia (heavy paranoia 4%) and 14% reported hallucinations (2%) after khat chewing at any time in their lives.

Patel et al.'s (2005) report of 602 Somalis (324 male, 278 female) in four cities in the UK used the same methods. Among recent khat users, approximately 20% reported paranoid symptoms (heavy paranoia < 5%) and approximately 15% reported hallucinations (< 5%). They also found a higher frequency of khat use among those participants who reported life-time hallucinations after chewing khat (4.1 days per week versus 2.7 days per week). However, the assessment of psychopathology was done by way of self-reports, leaving it unclear whether the reports clinically meaningful. Neither of the studies systematically compared khat users and non-users. They also did not analyze khat use quantitatively, nor did they assess the influence of confounding variables.

A better source of information is the 20 up-to-date descriptions of cases of khat-induced brief psychotic episodes that are available in the medical literature (Alem & Shibre, 1997; Carothers, 1945; Critchlow & Seifert, 1987; Dhadphale et al., 1981; Giannini & Castellani, 1982; Gough & Cookson, 1984; Jager & Sireling, 1994; McLaren, 1987; Nielen, van der Heijden, Tuinier & Verhoeven, 2004; Pantelis, Hindler & Taylor, 1989; Yousef et al., 1995). All except one of the patients in these studies were male. All were natives of countries in which khat has been traditionally used: 12 were of Somali origin, four were Yemenite, and four Kenyan. Most of the cases were detected in Western countries to which the patients had immigrated: eleven in Great Britain, two in the Netherlands and one in the United States; five were seen in Kenya and one in Ethiopia. Seventeen cases reported excessive khat use before the onset of psychotic symptoms. In 11 cases, violent behavior was reported during the development of acute psychiatric symptoms. All of the cases had completely remitted after six months and 17 after 4 weeks; the median time for complete remission was two weeks. Seven of the cases were not treated with any medication and remitted only upon cessation of khat use. In eleven cases, more than one episode was reported. An average of 2.1 episodes (range 1 to 6) occurred across all cases. A frequently reported pattern of khat use among these cases was the solitary use, in contrast to the traditional social use. Pantelis et al. (1989) reviewed 12 of these cases and identified three types with different symptom clusters: (1) The most common type was a paranoid psychotic state, often associated with auditory hallucinations and clear consciousness. (2) Others showed manic symptoms associated with grandiose delusions. (3) Less common was a depressive syndrome, possibly related to cessation after a period of excessive use.

From the evidence accumulated through these case reports and the information on similarities between cathinone and amphetamine and the laboratory research on cathinone, we conclude that khat has the capacity to elicit short-lived psychotic states, which usually develop after excessive chewing and remit completely usually within four weeks, in many cases without neuroleptic medication. The prevalence of such clinically relevant psychotic states in immigrant populations and in the countries where khat use reaches highest levels is not known, especially because these individuals might not be referred to medical services (Luqman & Danowski, 1976) or they might be misdiagnosed due to the lack of specific knowledge about khat (Granek, Shalev & Weingarten, 1988). Currently also unclear are the risk and resilience factors, e.g. sensitization through prior episodes, co-morbid psychiatric or somatic disorders, and traumatic experiences.

In the descriptions of such cases, the following information should be included: the quantification of khat-intake prior to the current episode (e.g. units per week), duration of the last intoxication, when the person first started to use khat, number of previous episodes and their relationship to khat use.

### (c) Can khat trigger psychotic disorders in vulnerable individuals or exacerbate symptoms (e.g. aggressive outbreaks) in psychotic patients?

Very few studies have ever addressed this topic. Two case-reports describe the exacerbation of psychotic symptoms in patients with pre-existing psychotic disorders (Granek et al., 1988; Mion, Ruttimann, Oberti & Aversenq, 1997), one of them had used only a small amount of khat.

We found in our study with psychotic patients in Somaliland (Odenwald et al., 2005) in which we used a retrospective assessment that the onset of lifetime khat use preceded the first psychotic episode in 31 of 38 male patients. Furthermore, in the weeks preceding the onset of psychotic symptoms, patients had chewed an average of 2.5 ± 2.0 bundles/day, compared to 0.5 ± 0.6 bundles/day for controls ($p < 0.001$). Excessive khat intake (> two bundles/day) during this period was found in 78% (i.e. 29 of 37) of the male patients who were chewers but in only 4% (i.e. 1 of 25) of chewers in the control group ($p < 0.001$). At the time of the interview, khat chewing did not differ between psychotic patients and matched controls; psychotic patients used an average of 1.5 ± 1.0 bundles/day, whereas controls used an average of 0.9 ± 0.7 ($p = 0.172$). However, the amount of khat that was used during the week before the interview was correlated with scores on the Positive and Negative Syndrome Scale (PANSS, Kay, 1991) Anergia subscale ($r = - 0.35$, $p = 0.029$, $N = 38$).

In respect to aggressive behaviors induced by khat intake, the only clinical data available are from the 20 published cases with a brief khat-induced psychotic disorder. From them, eleven showed aggressive behaviors. Additionally, one recent laboratory study showed that cathinone and khat extract increase the isolation-induced baseline aggression (Banjaw et al., 2005), an animal model for serotonin-related psychopathology.

Despite the scarcity of data, based on the similarities between cathinone and amphetamine and the animal models of psychosis, we expect that khat might indeed exacerbate pre-existing psychiatric disorders or trigger long-lasting psychotic disorders in vulnerable individuals. Khat's relationship to aggressive behaviors, however, remains unclear. The empirical evidence is scarce, and all of these questions need to be further addressed. It is unclear whether moderate use or only excessive, chronic or prolonged chewing might have the adverse effects. Of special importance in this context is the question of whether sensitization to the effects of khat is associated with relapses or deterioration of symptoms (Yui et al., 2002). The longitudinal assessment of patient data (e.g. in hospitals) or systematic retrospective assessment of the number of previous episodes and the relationship to khat intake remains an important task for future studies.

### (d) Can khat use actually increase the vulnerability for a schizophrenia spectrum disorder?

In this section, we discuss the evidence on whether or not khat use can directly increase lifetime vulnerability. No study has directly addressed this topic, but the results of a few studies encourage further research on this issue.

From longitudinal research on cannabis and psychosis, there is growing evidence that excessive cannabis use early in life enhances the vulnerability to later schizophrenia (for a review see Arseneault, Cannon, Witton & Murray, 2004). Other studies have shown that in contrast to healthy controls, among schizophrenia patients drug use had started in early adolescence (Hambrecht & Hafner, 1996). Among the above reviewed case studies we find the onset of khat use as early as with 12 years of age (McLaren, 1987). In the study with psychotic patients in Somalia cited above (Odenwald et al., 2005), the average age of onset of khat intake was found to be about four years earlier among psychotic cases ($16.6 \pm 4.8$ years) than among matched healthy controls ($20.7 \pm 7.0$ years, $p = 0.010$). The time between first khat use and the onset of positive symptoms was on mean $8.6 \pm 6.6$ years (median = 7 years); therefore, it seems likely that the onset of khat chewing occurs prior to the prodromal phase in a substantial proportion of schizophrenia patients.

Furthermore, international epidemiological studies of schizophrenia have shown that its prevalence is evenly distributed between males and females (Jablensky et al., 1992). However, because khat chewing in Somalia is a predominantly male habit, a higher prevalence of male schizophrenic patients would be in concordance with the hypothesis that khat chewing increases vulnerability. In our Somali sample (Odenwald et al., 2005) that was randomly selected among a representative group of psychiatric patients from a large household survey, there was a higher than expected prevalence of male psychotic cases (38 of 43).

Finally, it is known that brain damage during the perinatal period and infancy increases the vulnerability to the development of schizophrenia (for a review see Hafner, 2001). In animal models, brain damage induced by poisonous substances in rodents during pregnancy causes a higher vulnerability to the effects of CNS stimulants in animal models for psychosis (Lipska, Halim, Segal & Weinberger, 2002; for a review see Thompson, Pogue-Geile & Grace, 2004). In a study with guinea pigs, pre-natal exposure to khat caused EEG changes that were measured in the neonatal period (Thordstein, Jansson & Kristiansson, 1991). Additionally, from laboratory studies evidence for the neuro-toxic effects of khat is growing (for a review see Carvalho, 2003). This evidence warrants special attention because some studies have report khat use by pregnant and breast-feeding mothers (Alem et al., 1999; Eriksson et al., 1991) and because cathine has been found in breast milk of khat chewing mothers and in the urine of their infants (Kristiansson et al., 1987).

To date, very little evidence has been accumulated that khat use increases the vulnerability to a schizophrenia spectrum disorder, this is not surprising because no studies have ever significantly addressed this topic. There are, however, findings that would justify further research on this topic, as discussed above. For the public health of countries at the Horn of

Africa this question is of high importance. Longitudinal assessments but also cross-sectional studies would provide valuable information. Another important step would be the improvement of treatment and documentation standards in psychiatric hospitals. In Somali hospitals, client charts are often poorly filled or are non-existent (Alkan & Ali, 2001). Clinicians should try and assess retrospectively the development of psychotic symptoms by using standardized methods, for example the Inventory for the Retrospective Assessment of Schizophrenia (IRAOS, Hafner et al., 1992).

## *2.5 Discussion: Current situation and future prospects*

The current knowledge base concerning its effect on mental health, thirty years after the detection and isolation of the 'natural amphetamine' (Kalix, 1992) cathinone, is very thin. Although its economic importance and use are growing, and profound changes in the traditional use patterns are occuring, the research on mental-health consequences falls short. Most studies have used a weak methodology, have not referred to insights gained from schizophrenia research, e.g. on vulnerability-enhancing factors, and have reported only qualitative data. The research on the topic of khat and mental health often seems to implicitly test the hypothesis that khat chewing *per se* is detrimental to mental health, and research designs and methodologies are consistent with this reasoning. The current review shows that the relationship is not so simple – khat use and mental problems are related to each other in various, probably multiple, ways. Specific patterns of khat use, not khat chewing *per se* should be the focus of scientific studies. This implies that completely different research strategies should be used. Important questions for the public health in the countries at the Horn of Africa and Eastern Africa and among immigrant groups in Western countries remain unanswered.

Concerning the long-lasting effects of khat chewing, Peter Kalix stated more than 15 years ago ): "With regard to the chronic effects of khat use, it is difficult to make definite statements, mainly because the literature tends to either overindict the habit because it is strange and obvious, or to minimize its consequences in the view of its long-standing tradition and ethnological interest“ (p. 411). This view also depicts the current situation and its pitfalls for research, the controversy around khat research remains emotional. This situation might explain why the both the focus and the quality of the research often seem to be inadequate.

A number of important questions urgently need to be addressed as discussed above, for example the prevalence of khat chewing among psychiatric patients, the effect of khat chewing on pre-existing mental disorders, the development of sensitization in human khat chewers, the direction of the association between khat use and psychopathology and the consequences of khat use during pregnancy and lactation on children’s health. Because khat use has changed qualitatively and quantitatively during the last decades, there might be an undetected and silently growing public health problem in the countries around the Horn of Africa.

Researchers, clinicians and decision makers should be aware that khat is part of a long-standing tradition and that it is an important economic factor that cannot simply be eliminated by laws, as is the case with other drugs. On the other hand, many users are not aware of the dangers related to khat use. Thus, public health measures are needed to raise awareness for its potential dangers, and governments need to better monitor and influence its production, trade and consumption. But in order to find sustainable solutions, multi-disciplinary research is needed, from economics to anthropology, medicine and pharmacology. The researchers from these different backgrounds need to work together in joint projects. An interdisciplinary platform for scientific discussions and exchange is urgently needed.

## 2.6 Conclusions

Current knowledge on the impact of khat use on mental health has a thin evidence base. With the most urgent questions unanswered, an important public health threat at the Horn of Africa might remain unrecognized.

Heavy khat use can induce short-lived psychotic states, which remit under cessation within several weeks.

Khat use by vulnerable individuals should be discouraged, because it might exacerbate pre-existing schizophrenia spectrum disorders or trigger them.

The existing knowledge base shows the need to study whether khat use can increase the vulnerability for schizophrenia spectrum disorders, especially when infants, children and adolescents are exposed to the toxic agents of the khat leaves.

Under certain conditions, khat chewing might be associated with other co-morbid psychopathology, e.g. anxiety or suicidal ideation, although the direction of causality remains unclear. These conditions might include the absence of regulating social norms and traditional knowledge on the dangers of khat, e.g. in groups having acquired the habit only recently, or a high load on stressful or traumatic life events, e.g. among immigrants or in post-conflict regions. Public health measures are needed to raise awareness about the potential dangers of khat use.

# 3. Khat use as risk factor for psychotic disorders: A cross-sectional and case-control study in Somalia[1]

[1] Source: Odenwald, M., Neuner, F., Schauer, M., Elbert, T. R., Catani, C., Lingenfelder, B., Häfner, H. & Rockstroh, B. (2005). Khat use as risk factor for psychotic disorders: A cross-sectional and case-control study in Somalia. *BMC Med, 3*(1), 5.

## 3.1 Abstract

Little is known about the prevalence of khat-induced psychotic disorders in East African countries, where the chewing of khat leaves is common. Its main psycho-active component cathinone produces effects similar to those of amphetamine. We aimed to explore the prevalence of psychotic disorders among the general population and the association between khat use and psychotic symptoms.

In an epidemiological household assessment in the city of Hargeisa, North-West Somalia, trained local interviewers screened 4,854 randomly selected persons from among the general population for disability due to severe mental problems. The identified cases were interviewed based on a structured interview and compared to healthy matched controls. Psychotic symptoms were assessed using the items of the WHO Composite International Diagnostic Interview and quantified with the Positive and Negative Symptoms Scale. Statistical testing included Student's t-test and ANOVA.

Local interviewers found that rates of severe disability due to mental disorders were 8.4% among males (above the age of 12) and differed according to war experiences (no war experience: 3.2%; civilian war survivors: 8.0%; ex-combatants: 15.9%). The clinical interview verified that in 83% of positive screening cases psychotic symptoms were the most prominent manifestations of psychiatric illness. On average, cases with psychotic symptoms had started to use khat earlier in life than matched controls and had been using khat 8.6 years before positive symptoms emerged. In most cases with psychotic symptoms, a pattern of binge use (> two 'bundles' per day) preceded the onset of psychotic symptoms, in contrast to controls

of the same age. We found significant correlations between variables of khat consumption and clinical scales (0.35 to 0.50; $p < 0.05$), and between the age of onset of khat chewing and symptom onset (0.70; $p <0.001$).

Evidence indicates a relationship between the consumption of khat and the onset of psychotic symptoms among the male population, whereby not the khat intake per se but rather early onset and excessive khat chewing seemed to be related to psychotic symptoms. The khat problem must be addressed beyond prohibition, given the widespread use and its role in Somali culture.

## 3.2 Background

The present study investigated the relationship between psychotic symptoms and the abuse of khat in the Horn of Africa. The leaves of the khat shrub (*catha edulis*) are traditionally chewed in Arab countries, the Horn of Africa and East Africa (Halbach, 1972) and recently this habit has spread to Western countries including the USA (Gegax, 2002). Due to improved transportation facilities, khat consumption has substantially increased during recent decades. This is reflected in the most recent issue of the World Drug Report: in 2001 five countries reported an increase in khat use and none a decrease; in 2002 an increase was reported in four, a decrease, again, in none (UNODC, 2004). (Kalix, 1996) estimates that about 6 million individual portions are consumed each day worldwide. During our field work in the city of Hargeisa, North-West Somalia (Somaliland), where khat use is not restricted by law, we observed that current ways of intake do not correspond to the documented traditional use in the region. The traditional way of consumption was socially highly regulated: adult males (more seldom females) would gather and chew khat together at a so-called ‘khat party’, usually on weekends and afternoons until the time of the evening prayer (Elmi, 1983; Kenndey *et al.*, 1980). Contrary to this formerly restricted use, current habits involve use by adolescents, chewing khat in tea-shops that operate day and night, early morning use, as well as “binging” and “speed runs” that may last for more than 24 hours. Our study was based on observations by social workers of collaborating non-governmental organizations and by our team during field studies on war-related trauma. It was shown that the widespread use of khat is related to the large number of individuals with visible signs of psychosis who are either homeless or kept in hiding, e.g. in physical chains, by family members who afraid to expose them to the general public.

The main psycho-active component of khat leaves is cathinone (S(-)alpha-aminopropiophenone; (Szendrei, 1980). Cathinone resembles amphetamine in chemical structure and affects the central and peripheral nervous system (Kalix, 1990) and behavior (Zelger *et al.*, 1980) (Woolverton & Johanson, 1984) similarly. Amphetamines and some of its derivatives have been shown to induce psychotic symptoms in experimental settings in humans (Bell, 1973) and animals (Robinson & Becker, 1986) and have been known to exacerbate psychotic states in psychiatric patients (Angrist *et al.*, 1980; Janowsky & Davis, 1976). Similarly, khat-induced psychotic states have been described in several case studies (Alem & Shibre, 1997; Jager & Sireling, 1994; Pantelis *et al.*, 1989; Yousef *et al.*, 1995). However, the number of group, community and population-based studies on khat use and psychiatric symptoms (Bhui *et al.*, 2003; Dhadphale & Omolo, 1988; Griffiths *et al.*, 1997) is still limited. Despite the ongoing scientific debate about amphetamine-induced psychosis it remains unclear whether the use of amphetamine-like substances including khat may actually *cause* a psychotic disorder in an otherwise healthy individual, or *trigger* the onset of schizophrenia in an individual with high vulnerability to the disease (Phillips & Johnson, 2001; Poole & Brabbins, 1996). The fact that presumed amphetamine psychoses do not fully remit within weeks of abstinence in a substantial percentage of individuals (Sato *et al.*, 1992) may also suggest that those individuals actually had a amphetamine-triggered schizophrenia. Increased drug use among psychotic patients may also come from an attempt to counteract nonspecific physical symptoms or side effects of neuroleptics (Mueser *et al.*, 1998).

The first goal of this study was to verify the impression of an unusually high prevalence of psychotic disorders in the city of Hargeisa via an epidemiological survey carried out in a representative sample of households. In addition, we wished to study the association between khat abuse and psychotic disorders. If khat abuse does induce psychotic disorders, a higher prevalence of psychotic diagnoses, mainly in men (as women rarely consume khat), was to be expected in Hargeisa compared to localities with less khat use. In addition, a case-control study served to examine whether individuals identified in the survey suffering from psychotic symptoms presented a pattern of khat consumption different from matched controls.

## 3.3 Methods

### Sample

In order to screen for households with mentally ill members, 612 households with 4,854 members were randomly selected as representative of the city of Hargeisa (approximately 400,000 inhabitants). For household selection the town was first subdivided into 30 sections of approximately equal populations. For this purpose we used the same sections as UNICEF in their assessment of vaccination coverage for children in October 2002, which were defined in a joint approach by UNICEF and the municipality of Hargeisa. A section had to be subdivided into square-shaped clusters if it was L-shaped, had a natural boundary within its limits (e.g. a steep hill) or had a much greater length than depth. A map for each section or cluster was produced using an aerial photograph. For random selection the geographical center of each cluster was determined and a random direction was chosen using a compass, a watch and a list of random numbers between 1 and 12 (a watch was oriented according to the compass, whereby 12 o'clock was adjusted to North; the random number defined the direction according to the hours on the face of the clock). Following the random direction until the border of the cluster was reached, all houses on the right side within a range of 15 meters were numbered. The first household to be approached was selected by a second set of random numbers. The next houses were selected by door-to-door distance until the predefined number was reached. Trained local staff interviewed the heads of the 612 households. If the head of household was not available, another adult member of the household was asked to answer to the questions. If no household member could be interviewed, the next house was selected according to the selection procedure.

The following question was used to determine whether a person severely disabled due to mental health problems resided in the household: "Are there any members of your household who currently have mental problems that are so severe that the person has been unable to provide income or has been unable to help in the household for at least four weeks?" This criterion was fulfilled for 169 (137 male, 32 female) cases. These individuals will be referred to as ‘positive screening cases’. A subsample of 52 ‘positive screening cases’ was then randomly selected and examined in a clinical interview. In this group there were 44 males and 8 females. These individuals will be referred to as ‘examined cases’.

For each ‘examined case’ a matched control, who did not meet the criteria for disability due to mental health problems, was identified. Controls were matched by gender, age, and educational level. These ‘case controls’ were subjected to the same clinical interview as the examined cases. Forty-nine of the 52 examined cases and one control were diagnosed with psychiatric or neurological disorders (on this basis we estimated a sensitivity of 0.98 and a specificity of 0.94 for the screening procedure). We included only those forty-three examined cases (82.7%) in the further analysis who – in addition to the impairment of function – showed as main manifestations of mental problems at least one very severe or two moderate positive psychotic symptoms in the absence of organic somatic damages that might explain them; from hereon these are termed ‘cases with psychotic symptoms’. The disorders of other examined cases were stroke (2), traumatic brain injury (1), mental retardation (2), and dementia (1). The case control with a positive diagnosis reported hallucinations with intact reality testing during khat intoxication and was replaced by a healthy individual. Socio-demographic characteristics for the two studied groups are summarized in Tables 3.1 and 3.2.

## Procedures and materials

All interviews were carried out in October and November 2002. Prior to the interview, participants were informed about the background of the study and the survey procedure. All participants signed a written informed consent, which was first read and explained to them (as most of the participants were illiterate). In the case of mentally challenged participants, background and procedure were also explained to the responsible caretakers whose written informed consent was a prerequisite for their participation. Interviews were approved by the local authorities and the National Demobilization Committee of Somaliland. Representatives of the different communities were informed and invited to observe the assessment in the field. Newspaper advertisements, daily radio programs and flyers informed the population about and helped them to understand the real purpose of the assessment (at first rumors had spread that the research team would provide free medication for mentally disturbed individuals and created unreal expectations). Consequently, the level of cooperation was extremely high. Out of 73 households approached under the supervision of the first author only three refused their participation. Therefore, we estimate that in total less than 5% of all households refused participation.

*Table 3.1: Socio-demographic characteristics of the sample of N = 4,854. For socio-demographic data, mean ± standard deviation and percentages and absolute numbers (in parenthesis) respectively are reported. P-values refer to differences between ex-combatants, civilian war survivors, and persons without any war experience.*

| | Whole group | Ex-combatants | Civilian war survivors | No war experience | p |
|---|---|---|---|---|---|
| Total Number | 4,854 | 250 | 2,667 | 1,937 | - |
| Male | 2,449 | 240 | 1,201 | 1,008 | |
| Female | 2,405 | 10 | 1,466 | 929 | < 0.001 |
| Age | 22.2±17.8 | 42.8±13.5 | 28.7±16.6 | 10.7±12.1 | < 0.001 |
| Age range | 0 – 102 | 12 - 102 | 0 - 101 | 0 - 90 | - |
| Years of formal education | 2.6±4.1 | 5.2±5.6 | 3.3±4.3 | 1.4±3.0 | < 0.001 |
| Economic situation of household* | 2.8±1.8 | 2.5±1.7 | 2.9±1.7 | 2.8±1.8 | 0.005 |
| Percentage of khat users in week before interview among men > 12 yrs | 31.3% (495 of 1,581) | 60.3% (144 of 239) | 28.1% (306 of 1,090) | 17.9% (45 of 252) | < 0.001 |
| Khat bundles/week before interview among khat chewing men > 12 yrs | 7.6±4.4 | 7.9±4.8 | 7.6±4.4 | 6.7±3.2 | 0.544 |
| 'Screening cases' among men > 12 yrs | 8.4% (133 of 1,581) | 15.9% (38 of 239) | 8.0% (87 of 1,090) | 3.2% (8 of 252) | < 0.001 |
| 'Screening cases' among women > 12 yrs | 1.9% (30 of 1,600) | 20% (1 of 5) | 1.6% (22 of 1,372) | 2.8% (7 of 248) | 0.066 |

* *The household economic situation was approximated as the sum of four significant assets (water tap, electrical power, TV set, car) and type of housing (hut = 1, house = 2, closed compound = 3). The mean of the two ratings is presented. For the combined rating Cronbach's Alpha = 0.78; correlation with income = 0.73, p < 0.001.*

*Table 3.2 - Socio-demographic characteristics of the 43 cases with psychotic symptoms and 43 'case controls.' Mean ± standard deviation and percentages and absolute numbers (in parenthesis) respectively are reported. P-values refer to group differences assessed by t-test/Wilcoxon test.*

| | **Patients with psychotic symptoms** | | | **Matched controls** | | | **Sig.** |
|---|---|---|---|---|---|---|---|
| | **total** | **male** | **female** | **total** | **male** | **female** | **p** |
| N | **43** | 38 | 5 | **43** | 38 | 5 | **1.0** |
| Age | **33.9±10.5** | 34.6±10.0 | 28.6±13.8 | **34.7±10.3** | 35.3±10.0 | 30.4±12.8 | **0.718** |
| Education (yrs in school) | **5.6±4.5** | 6.4±4.3 | 0.0 | **6.3±4.9** | 7.1±4.6 | 0.0 | **0.511** |
| Martial status (% married) | **16.3% (7)** | 18.4 % (7) | 0 % (0) | **44.2% (19)** | 50.0% (19) | 0% (0) | **0.005** |
| Employed or at school | **0% (0)** | 0% (0) | 0% (0) | **41.9% (18)** | 47.4% (18) | 0% (0) | **< 0.001** |

Local interviewers were recruited among NGO and hospital staff who already had experience in working with mentally disabled persons. They participated in a two-week training course, which involved teaching the basic psychiatric concepts (e.g. psychotic symptoms), interviewing skills, training on the screening-instrument and field work under close supervision of experts. After the end of the course, fourteen of the seventeen trainees were employed for the duration of the study. Five interviewer teams, each comprising one male and one female interviewer, and four local supervisors did the field work. The local supervisors received additional training on the random sampling method. During the first weeks of interviewing the first author closely supervised the teams in the field.

The screening interview assessed individual socio-demographic information, khat consumption and experiences in the civil war (subjects were grouped as either active war participants, civilian war survivors, or without any war experiences). Khat consumption (number of bundles/week) was assessed for the week prior to the interview. The household economic situation was approximated as the sum of four significant assets (water tap, electrical power, TV set, car) and type of housing (Table 3.1).

Clinical interviews were carried out by some of the authors (MO, MS, CC, BL), all trained in the assessment of psychotic disorders and PANSS rating. Socio-demographic information and war-history were detailed. A standard event list was used to quantify the number of traumatic event types a person had experienced; the list included 11 types of events: active combat experience, accident, natural disaster, witness murder or killing, rape, sexual molestation, physical assault, being kidnapped or captured, torture, other, or suffered shock because a close person had experienced a traumatic event. In a short semi-structured qualitative interview the main areas of psychological condition and functioning were assessed. Additionally, psychotic symptoms were assessed using the items of the Composite International Diagnostic Interview (CIDI), Section G (World Health Organization., 1997). The individual's age at which the family first noticed positive psychotic symptoms that prevailed over six months was taken as indication of the onset of a psychotic disorder. Khat consumption (average number of bundles/day) was assessed for the week before the interview and for the week prior to the onset of symptoms in examined cases. Case controls were asked about consumption in the week prior to the interview and for consumption at the age of symptom onset reported by his/her examined case-pair (Table 3.2). As many examined cases were not able to give valid information, the primary care taker and other family members were also interviewed.

Clinical interviews were administered in the English language with the help of trained local interpreters, who had participated in the same training course as the interviewers. After the interview, the interviewing psychologist rated the current psychopathology using the Positive and Negative Syndrome Scale, PANSS (S. R. Kay *et al*., 1987).

All items of the standardized interviews were translated from English into Af Somali by mixed teams of clinical experts and bilingual staff. Several steps of independent back-translations and corrections were necessary until a satisfactory translation was achieved. Content validity was assured by the involvement of clinical experts at all levels of the translation process. Also, interpreters were introduced to the concepts targeted by the respective questions.

## Data analysis

Differences between cases and controls were confirmed using chi$^2$-tests (or Fisher's exact tests), binomial testing, Student's t-test or Wilcoxon, and ANOVA or

Krsucal-Wallis test (all tests two-tailed). Univariate Analysis of Variance (ANOVA) was used to explore the effects of war-trauma on the khat intake. Means and standard deviations are reported.

## 3.4 Results

Of the sample of 4,584 inhabitants of Hargeisa the screening interview disclosed 169 positive screening cases (i.e. 3.5%). Positive screening cases were more often male than female (133 of 1,581 men, i.e. 8.4%, and 30 of 1,600 women above the age of twelve years, i.e. 1.9%; $p < 0.001$; Table 3.1). Khat chewing was more frequent among male positive than among negative screening cases above the age of 12 years: 46.6% of the 133 positive screening cases had chewed khat in the week before the interview in contrast to 29.9% of the 1,448 negative screening cases ($p < 0.001$). Consumers among positive screening cases had also chewed a greater amount of khat in the week preceding the interview (positive screening cases: 4.1 ± 6.3 bundles; negative screening cases: 2.2 ± 4.0 bundles; $p = 0.001$).

The proportion of positive screening cases was substantially higher among males above the age of 12 who had active war experience (ex-combatants) than in male civilian war survivors of the same age ($p < 0.001$, Table 3.1). The latter proportion was significantly higher than in men without any war experience ($p = 0.007$).

Psychotic symptoms meeting our criteria were determined for 83% (43) of the examined cases. Retrospective investigation suggested that the onset of psychotic signs occurred at the age of 23.4 ± 9.9 years (N = 38 men: 24.1 ± 9.8 years; N = 5 women: 18.4 ± 9.6 years; p = 0.230).

PANSS ratings of these 43 cases showed a substantially higher magnitude of current psychotic symptoms compared to a sample of 240 medicated schizophrenic patients (Stanley R. Kay, 1991) in the following subscales: Positive 27.1 ± 7.3, Negative 32.0 ± 8.9, Composite - 4.9 ± 10.6, General Psychopathology 52.7 ± 12.7, Anergia 16.6 ± 5.5, Thought Disturbance 16.4 ± 5.3, Activation 7.8 ± 3.0, Paranoia/Belligerance 10.8 ± 4.1, Depression 9.5 ± 3.9, and Supplemental Scale 17.4 ± 7.4. In further exploratory observations, we noticed a high tendency towards aggressive and hyperactive behavior. During interviews, most patients reported that they were in contact with a ghost (‘djin’), often associated with auditory, visual and somatosensory hallucinations.

Fifteen of the 43 cases with psychotic symptoms (35%) were under current medication at the time of assessment; another nine (21%) had received medication in the past. A variety of drugs had been given, ranging from neuroleptics (12 patients) to prometazine (6), benzodiazepines (3), tricyclic antidepressants (3), carbamazepine (1) and other unknown drugs (10).

Uncontrollable (disruptive, violent) behavior had led to restraint of cases with psychotic symptoms by chaining them to an object in 28 of the 38 men (i.e. 74%) and 3 of the 5 women (i.e. 60%) (p = 0.608). Additionally, 9 men (24%) and 3 women (60%) had been locked up to control their behavior (p = 0.589). On average, the 31 cases with psychotic symptoms who had ever been chained had spent 4.2 ± 5.2 years in chains (men: 4.5 ± 5.4 years; women: 1.8 ± 1.9 years; p = 0.410) and the 10 cases who had ever been locked up spent on average additional 5.2 ± 6.5 years restrained (men: 4.0 ± 6.6 years; women: 10.0 ± 4.2 years; p = 0.264).

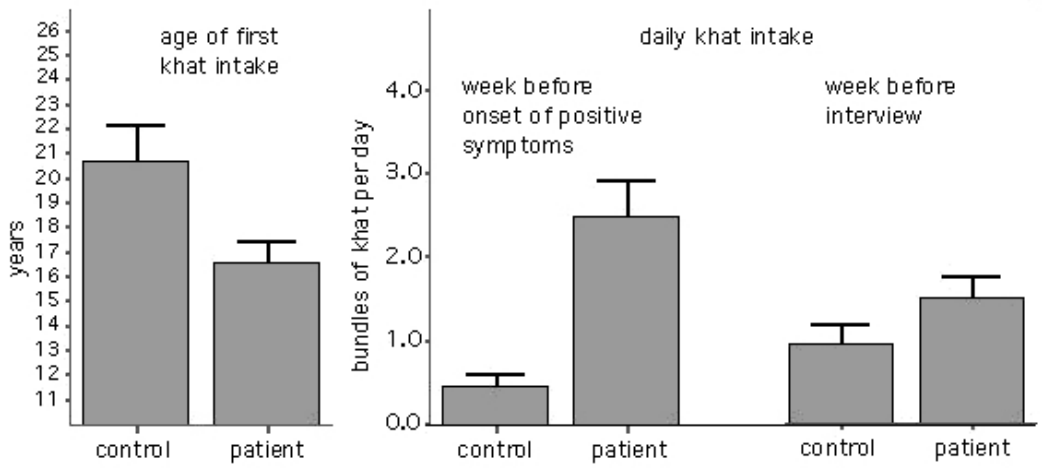
The proportion of khat user was higher among cases with psychotic symptoms than among matched controls: all except one of the 38 male psychotic cases, in contrast to 25 of the 38 male controls, had used khat ($p < 0.001$). In the cases with psychotic symptoms, regular khat consumption had started at an earlier age (16.6 ± 4.8 years) than among their matched controls (20.7 ± 7.0 years, $p = 0.010$; Figure 3.1). All except one case with psychotic symptoms (compared to 61% of controls, i.e. 14 of 23) had started to chew before the age of 23 years ($p = 0.004$). None of the women admitted to having ever chewed.

In the weeks preceding the onset of psychotic symptoms, cases with psychotic symptoms had chewed an average of 2.5 ± 2.0 bundles/day compared to 0.5 ± 0.6 bundles/day in controls ($p < 0.001$; Figure 3.1). Excessive khat intake (> two bundles/day) in this period was found in 78% of chewers among male cases with psychotic symptoms (i.e. 29 of 37) but in only 4% of chewers among controls (i.e. 1 of 25; $p < 0.001$). For the cases with psychotic symptoms, the age of onset of khat chewing correlated significantly with symptom onset ($r = 0.70$, $p < 0.001$). The lapse of time between first use of khat and onset of symptoms was greater than one year in 31 of the 38 male cases with psychotic symptoms (i.e. 82%); it varied around a mean of 8.6 ± 6.6 years (median 7 yrs). In the week before the interview 54% of the lifetime khat chewers among male cases with psychotic symptoms (i.e. 20 of 37) and 36% of the controls (i.e. 9 of 25) had chewed khat ($p = 0.162$). Furthermore, psychotic patients consumed an average of 1.5 ± 1.0 bundles/day, with controls consuming an average of 0.9 ± 0.7 ($p = 0.172$; Figure 3.1).

Khat use correlated with severity of symptoms: In cases with psychotic symptoms onset of khat use correlated significantly with higher scores on the PANSS subscales Negative Symptoms ($r = -0.36$, $p = 0.039$, $N = 34$), General

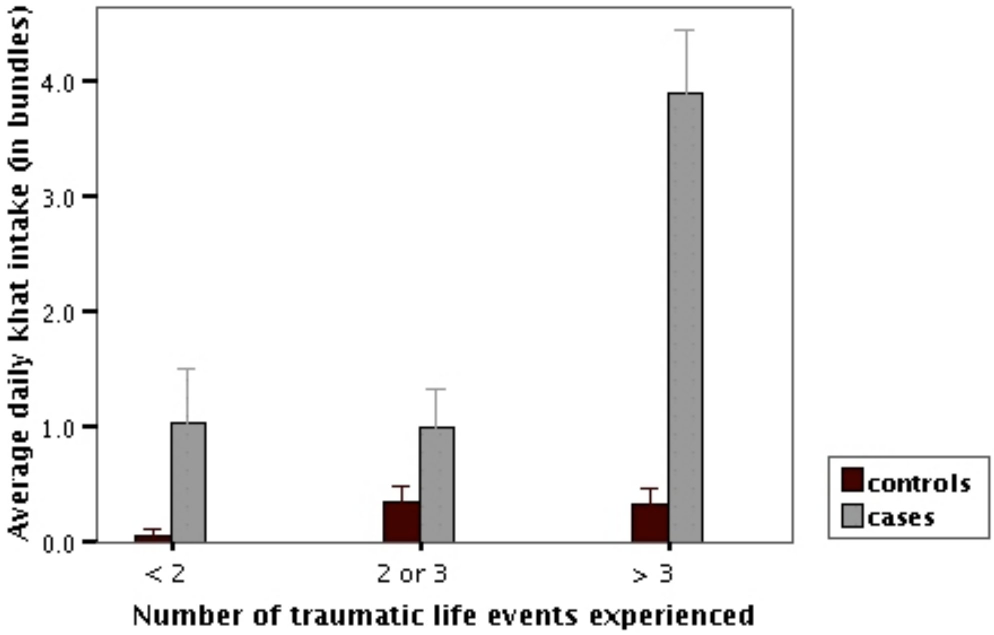
Psychopathology (r = - 0.44, p = 0.009; N = 34), Anergia (r = - 0.39, p = 0.022, N = 34) and Thought Disorder (r = - 0.42, p = 0.014, N = 34), while the amount of khat consumed prior to onset of psychotic symptoms correlated significantly with the subscale Paranoia/Belligerence (r = 0.49, p = 0.006, N = 30) and the Supplemental scale (r = 0.50, p = 0.005, N = 30). The amount of khat consumed in the week before the interview correlated with the PANSS subscale Anergia (r = - 0.35, p = 0.029, N = 38).

*Figure 3.1: Patterns of khat consumption. Left: age of first khat intake among lifetime chewers in patients with psychotic symptoms (35) and case controls (23); right: amount of khat use (in 'bundles' per day) in the week before the onset of first positive symptoms (25 cases with psychotic symptoms, 24 controls) and in the week before the clinical interview (16 cases with psychotic symptoms, 9 controls). Bars indicate mean and standard error.*




The number of traumatic event types experienced did not differ between cases with psychotic symptoms and matched controls (cases with psychotic symptoms: 3.1 ± 2.3 events; matched controls: 2.9 ± 2.4 events; p = 0.749). Also, the age when the first traumatic event was experienced did not differ between them (cases with psychotic symptoms: 20.2 ± 9.6 years; matched controls: 20.6 ± 9.2 years; $p = 0.853$). In order to estimate the relationship between number of experienced traumatic events and khat intake we used univariate ANOVA with khat intake before onset of psychotic symptoms (for controls at the age of symptom onset of matched pair) as dependent variable, and number of traumatic events in three categories (no or one event, two or three, four or more) and being a case or a control as independent variable. We found significant effects for the number of traumatic events (Sum of squares 36.6; df 2; $F = 17.028$; $p < 0.001$) and for the variable ‘case or control’ (Sum of squares 53.9; df 1; $F = 50.136$; p.< 0.001) and a significant effect of their interaction (Sum of squares 31.0; df 2; $F = 14.404$; $p < 0.001$) (total $R^2 = 0.620$). In Figure 3.2 the results are displayed graphically.

*Figure 3.2: Khat intake and traumatic experiences. Average daily khat intake in bundles (at the age when the case with psychotic symptoms showed onset of symptoms) according to number of traumatic life events. We divided the cases with psychotic symptoms and case controls into three groups according to the number of event types experienced as follows: none or one: 11 cases and 13 controls; two or three: 9 cases and 15 controls; more than three: 11 cases and 14 controls. Bars indicate mean and standard error.*




## 3.5 Discussion

The present study revealed a number of interesting and relevant findings. (1) In a representative subsample of male inhabitants of Hargeisa (older than 12 years) we found 8.4% severely disabled due to mental problems; of these, 83% had severe psychotic symptoms. Compared to the prevalence rates of psychotic disorders reported for male samples elsewhere (Jablensky *et al.*, 1992) this is higher than expected. Furthermore the gender ratio among the mostly psychotic positive screening cases was unusual (1 women to 7.7 men). (2) Khat abuse showed a significantly earlier onset and was more frequently excessive in male cases displaying psychotic symptoms than in matched controls. (3) There is a higher vulnerability to disability due to mental disorders in those groups of society who were directly involved in combat in the past. (4) Among the positive screening cases examined and their matched controls we found that khat intake before the onset of psychotic symptoms (respectively at the same age for matched controls) was higher when more traumatic events had previously been experienced.

These results are intriguing, as we may have detected only the very tip of the iceberg with our sub-optimal screening procedure, leaving less severe cases of mental and neurological disorders undiscovered.

The findings of the present study suggest that there is an association between khat consumption and psychosis; however the existence of a causative relationship and its direction between the two remains unclear. Furthermore, it seems that it is not the consumption of khat *per se* but rather specific patterns of it that are related to psychosis, especially early onset in life and the excessive intake (> two bundles per day). Both seem to be related to active participation in war, e.g. child ex-combatants used khat while fighting in order to counteract fear and enhance performance (UNICEF, 2003). Excessive khat consumption has already been reported to be associated with higher severity of psychiatric symptoms (Dhadphale & Omolo, 1988). Our data also suggest that there might be a moderating effect of the number of traumatic experiences on subsequent khat intake. This would be in line with the self-medication hypothesis.

Khat consumption might be related to the outbreak of psychosis in various ways. Considering psychoses as the result of genetic and acquired vulnerability and additional stress factors, the early onset of khat abuse may have substantially increased the risk in already vulnerable individuals. In animal studies, damage imposed on the developing brain, e.g. by drugs, increases the potential of amphetamine-like agents to change neuro-chemical systems and to induce psychotic-like behavior (Lipska *et al.*, 2002). In humans, drug abuse during puberty has been found to precede the onset of psychotic symptoms and prodromi (Farrell *et al.*, 2002) and to be related to poorer treatment outcome (Buhler *et al.*, 2002). Additional risk factors and particular stressors, such as war experiences, may contribute to an increased vulnerability. It is presently unclear, however, whether traumatic experiences act indirectly through higher drug consumption in traumatized men or whether they exert a direct effect on the brain, increasing the risk of developing psychosis. The temporarily higher khat abuse preceding first symptoms in cases with psychotic symptoms compared to case-controls may suggest that khat consumption is the primary agent, causing the onset of psychoses. This assumption is further strengthened by the inequality in the gender ratio, as women are generally denied access to the drug.

Moreover, khat consumption may affect the course of a psychotic disorder and the maintenance of symptoms. In contrast to the high khat consumption prior to the onset of psychotic symptoms, the amount of current khat consumption did not differ between cases with psychotic symptoms and controls and a significant number of patients did not have current access to the drug. Drug-effects on the course of illness may be attributed to sensitization (Yui *et al.*, 2002) or to lasting neurotoxic effects of prolonged stimulant intake (Robinson & Becker, 1986). To clarify the question of how continued khat consumption might affect the further development of psychotic symptoms, the number of relapses related to khat intake would be of tremendous importance. Our observation was that once a patient has developed severe psychotic symptoms he is restrained (e.g. chained) and kept away from the drug until symptoms remit. However, as soon as he is released the patient engages again in (often excessive) khat consumption until symptoms relapse and he is restrained again. Many patients had lived through this circle several times. In Western samples of amphetamine-induced psychosis, first relapses have mostly been studied (Yui et al., 2002). Furthermore, it seems plausible that the conditions under which cases with psychotic symptoms were frequently kept may have influenced the course of any psychopathological development.

Some methodological shortcomings of the study are related to the nature of field work in this specific post-conflict setting, which involved restricted freedom of movement due to the security situation and limited resources. However, although a perfect design is not possible in a rather complex field situation, the importance of such studies is evident from the fact that little or no information from post-war Somalia is available. First, we could not control whether our sample was comparable to the population from which it was drawn due to the lack of recent statistics in Somalia.

Second, the validity of our screening and clinical interview can be questioned because of various points, e.g. whether the descriptions of symptoms and disability might be adequate for the Somali culture, or whether factors such as interpretation or the interviewing of a whole family rather than a single patient might distort the information. In our approach we decided to use disability as a selection criterion and a descriptive rather than a normative approach to identify the reasons for it. Thus, we decided to use the more unspecific terms ‘cases with psychotic symptoms’ or ‘psychotic symptoms’ rather than ‘schizophrenia’ or ‘drug-induced psychosis’. However, the fact that our local interviewers found 123 of the 169 positive screening cases (72.8%) restrained, i.e. chained or locked up, and the overall high average PANSS scores of the examined cases, show that there are ‘hard’ criteria, which justify the use of the term ‘psychosis’ and validate our screening. Nevertheless, we recognize that with our method we must have failed to discover persons suffering from psychotic and other mental disorders (false positives). But assuming that this error is somehow the same for the whole sample, our finding that the group of society that engages most in khat chewing (males above the age of 12) most often suffers severe impairment due to mental disorders shows evidence that khat is related to mental health problems.

Thirdly, the fact that we could not choose our matched controls from the pool of negative screening cases – the resources that would have been necessary to (repeatedly) contact and arrange appointments with them exceeded our capacities – leads without any doubt to an overestimation of the specificity of our detection procedure.

Furthermore, the retrospective third-person assessment of the onset of psychotic signs, as well as the retrospective and subjective assessment of khat use, will have introduced some error variance in the data. However, we believe that especially in the Somali culture khat intake cannot be compared to any food intake, of which the retrospective assessment is problematic. In the Somali culture khat has a special significance, which also comes from existing traditional knowledge about its dangers. Therefore we suppose that retrospective assessment of khat intake is more valid than that of food intake. Also, the effects of social desirability might have affected both the detection of positive screening cases and the assessment of khat use. The fact that dozens of families approached the compound of our collaborating partner agencies in order to find help for their mentally ill members (often they brought them in chains to the compound) shows the great need for mental health services. Thus, the tendency to hide family members from our interviewer teams can be estimated as marginal. On the contrary, during the interviews our greater fear was that households would over-report the presence of mentally challenged family members. For this reason, we counted only those persons as positive screening cases when their existence in the household could be validated (e.g. by their physical presence). The assessment of khat consumption is another point where effects of social desirability can be assumed. Whereas the information given by examined cases could be validated by the information of family members, we were well aware of the danger that the matched controls might have under-reported their khat intake. In order to allow for this in the interview we spent much time and effort to identify the real khat intake (e.g. often we had to 'negotiate' about the answer to the khat questions – a habit inherent in Somali culture). Nevertheless, the high correlations validate the assessment procedures.

Also, the sample size was too small to answer some of the questions in detail, especially the small number of female examined cases. However, the results were nonetheless statistically very robust.

In sum, our design could not determine the existence of a causal relationship between khat and psychosis - this would have been too ambitious a goal. However, our main findings do not contradict the hypothesis that khat might cause psychosis.

Future research should focus on the question of causality. Unfortunately, the Horn of Africa is probably the region where stimulant abuse currently reaches highest levels on a world-wide scale. This circumstance offers a unique research opportunity for cross-sectional and repeated measurement studies, which would enable us better to understand the relationship between schizophrenia and drug effects and to fill the gap in knowledge related to khat use. At the same time, the alarmingly high prevalence of khat chewing among persons who suffer from psychotic symptoms in one of the countries of its highest use, and the magnitude of human suffering associated with it, demands the development of adequate community-based prevention and treatment interventions. The usefulness of standard procedures derived from developed countries and brought to the Horn of Africa must be viewed in a 'service-research attitude' (Saraceno & Barbui, 1997). We believe that khat abuse has become a tragic obstacle for the reconstruction of this war-torn society; consequently, there is an urgent need to address this mental health issue with means other than prohibition and regulation of the demand side through taxation, as khat is integral to the Somali culture.

## 3.6 Conclusion

Not khat intake per se but rather specific patterns of it are linked to the development of psychotic symptoms, like early onset in life, excessive chewing (> 2 bundles/day) and use as self-medication for war trauma related symptoms. Although we cannot establish a causal relationship between khat and psychosis, we find some evidence that the prevalence of psychotic disorders is increased among the male adult population of Hargeisa. Ex-combatants are the group in society who are most affected by severe mental disorders, among them we find the highest abuse of khat.

The way of khat use in Hargeisa is changing, indicated by e.g. the development of a group of heavy users who show consumption patterns similar to amphetamine addicts in Western countries. Measures of prevention and treatment of and further research on khat-related severe mental disorders have to be undertaken, however, taking into consideration that khat is an integral part of the Somali culture, which cannot simply be prohibited.

# 4. Psychotic disorder, khat abuse and aggressive behavior: a case report in Somalia[2]

[2] Odenwald, M. (submitted). Psychotic disorder, khat abuse and aggressive behavior: a case report in Somalia. BMC Psychiatry.

# 4.1 Abstract

The goal with this case vignette is to report one of these presumably frequent but undocumented cases, where khat abuse, mental disorder and serious behavioral problems are interacting. The current literature focuses on khat-induced psychotic disorders neglecting at large the adverse consequences of comorbid use on pre-existing disorders, especially related to aggression.

The case of a 32 year old Somali with a delusional disorder (ICD-10 F22.0) and comorbid khat abuse is presented who killed a man in the state of paranoid delusions and awaited for his trial assuming full liability for this crime. The exacerbation of the psychotic symptoms some months prior to this incident was accompanied by an increase of khat intake. In this period his life circled around delusional rumination and excessive khat chewing.

Comorbid khat abuse can lead to the deterioration of psychotic disorders, can facilitate aggressive acts and complicates treatment. The medical and legal system of the countries where khat use reaches highest levels are not fully prepared to deal with such cases. Research on the changes of khat use and on the development of adequate prevention and treatment measures is required.

# 4.2 Introduction

Comorbidity of psychoses and substance-use disorders is a frequently observed phenomenon in Western countries (Kavanagh *et al.*, 2002; Regier *et al.*, 1990). Information concerning this problem from developing countries is rare (B. Ahmad *et al.*, 2001).

Traditionally the leaves of the khat shrub are consumed in Arab countries and East Africa for their stimulating effects (Halbach, 1972). Mostly the fresh young leaves and tender shots of the plant are chewed, but its use as tea or dried power is also known (Baasher, 1980). Freshness of the plant material is crucial, as the stimulating properties vanish when the leaves wither (Geisshusler & Brenneisen, 1987). The main psychoactive substance is the alkaloid cathinone, which in chemical structure, central and peripheral effects closely resembles amphetamine (Kalix, 1992; Nencini & Ahmed, 1989). In recent decades, the cultivation of khat has seen an explosion-like boom, from a niche product to one of the mayor cash-crops for countries neighboring the Horn of Africa (Gebissa, 2004). On the consumer side we find equally drastic changes: khat chewing developed swiftly from a normatively regulated and socially institutionalized habit mostly practiced by adult males from specific ethnic and religious groups to a widespread phenomenon in the general population of these countries with features of informality, excessiveness and loss of traditional control (Carrier, 2005). Several case studies described khat-induced psychotic states, mostly among immigrants living in Western countries, with pronounced paranoid or grandiose delusions and frequent aggressive behaviors

(Pantelis *et al.*, 1989) including homicide (Alem & Shibre, 1997). Some authors believe that concerning information from countries with traditional khat use is sparse due to the unavailability of mental health services, which would detect or treat mental disorders (Luqman & Danowski, 1976). Recently, we reported that psychiatric patients in Somalia frequently have a history of excessive khat abuse (Odenwald *et al.*, 2005). This is confirmed by the experience of local NGOs in Somalia (e.g. General Assistance and Volunteer Organization, GAVO).

We report here the case of a prison inmate in North Western Somalia with a history of excessive khat abuse, who had killed a man in a state of paranoid delusions. Our goal with this case vignette is to report one of these presumably frequent but undocumented cases, where khat abuse, mental disorder and serious behavioral problems are interacting.

## 4.3 Methods

We based our report on a clinical interview, two separate family interviews, and an additional interview with the prison representatives including the responsible physician in 2003 and a follow-up interview in 2006. The interviews were conducted with the permission of Somaliland prison authorities. The patient and his family gave a written informed consent to the publication of this report. The interviews in 2003 were interpreted by a bilingual Somali medical doctor. 2006, a trained social worker served as interpreter.

## 4.4 Case Report

Mr. A. is a natural of North-East Somalia (Somaliland), 32 years of age, not married and owner of a business. At the time of the interview, he was detained in prison for three months, awaiting for his trial because of shooting one of his employees.

*Psychiatric findings*: During the interview A. was fully oriented and aware of his situation. His physical appearance was poor in hygiene and cleanliness, but conforming to the situation of detainees in Somaliland. His affect appeared flattened, psychomotor reactions were markedly reduced, his gaze numb. Indifference and lack of empathy, were quite obvious. His voice was low and monotonous, his replies to the interviewer's questions short and with low content. Thought disorders could not be noticed. Paranoid delusions were present, with no hallucinations, disorganized speech, catatonic or other behavioral symptoms noticeable. A. admitted the killing openly, but showed no sign of remorse or guilt, and stated that he would do it again. He was not under medication.

*Anamnestic information:* His development in childhood and adolescence was described as normal. He completed his formal education after the regular eight years. When war broke out in Northern Somalia in 1988, A. fled with his family to the countryside. The onset of khat chewing was described as normal in late adulthood, and regular consumption in normal quantities could be confirmed. In 2001, A. started to run a business, together with his sister. The victim belonged to his sub-tribe and had been working as his employee. In late 2002, at the age of 31 while staying for some months in another town to open another business, paranoid symptoms probably developed for the first time. He believed being sidelined, and pulled out of the first business suspecting his sister and his employee to be plotting against him. After some time, A. gave up this business and moved back. He then continued working with his sister and employee as if nothing had happened. Beginning in January 2003, A. increased his daily khat intake to up to six bundles ("mijin") per day. At about that time A. developed serious paranoid delusions. He was constantly ruminating that he lost his business share because of the plot against him. He felt threatened constantly and pursued by the local police, believing his employee to have informed the police about his (A.'s) plan to kill him. Thus, A. believed that the police was about to arrest him. He also believed his employee intended to kill him. At that time A. secretly bought a gun on the black market (AK 47 assault rifle). He avoided sleeping at night and restricted his rest hours to the time of the change of shift at the local police. At night he chewed khat by himself so as to stay awake. When going out to buy khat, he kept on moving restlessly and avoided staying more than 10 minutes in one place or showing up at the same place more than once. Marked negative symptoms were present during this period, such as the neglect of physical appearance and hygiene, anorexia, and withdrawal from social contacts. He was frequently in a state of agitation, being easily irritated. He was also often observed as absent minded and with a fixed gaze. At that time his family and friends began to believe he had a serious mental problem. However, during all this time no consultation of a medical doctor or traditional healer was sought. The night before the murder A chewed khat excessively and slept in the day. The following afternoon, he behaved strangely, e.g. changed his clothes three times in quick succession. A. reports that, in the early evening of that day, while chewing khat he had received a supernatural message from god telling him to kill his employee. It is not clear, whether this experience involved voice hallucinations. He went for his gun immediately and then straight to the hotel, where he found his employee and fired point blank. He then left the place calmly, carrying his gun, not caring about his being observed by many persons. He went back to his home to continue his remaining khat, with no plans to run away. The following morning, he was arrested at his house. We could not rule out a full abstinence from khat as prison inmates sporadically have access to the drug.

In 2006, Mr. A was contacted again. He had spent about 3 years in prison before his ‘jilib’ (extended family) paid the blood price to the family of the victim; then we was released. During the three years in prison he did not undergo any medical or psychiatric assessment nor did he receive any medical treatment. During the interview he was obviously suspicious but he allowed to be interviewed and signed the informed consent. A. was fully oriented and appeared well-dressed saying that he was starting a new business, an information which could be confirmed. No signs of emotional symptoms could be assessed, neither thought disorders, delusional ideations or hallucinations. A. still showed no sign of remorse. He was not under medication. He stated that he had stopped taking khat regularly because it does harm to him.

## 4.5 Discussion

We report here a case with a psychotic disorder and excessive khat abuse, who killed a man in a state of paranoid delusion. After arrest, he did not undergo any psychiatric assessment and there was no psychiatric record compiled for him. At the time of our first interview he awaited his trial assuming full responsibility for this crime.

Regarding diagnosis, we do not assume schizophrenia because A. did not exhibit clear schizophrenic symptoms and because he maintained normal social functioning up to a few months before the incident. The diagnostic and anamnestic information available appear to indicate a long-lasting delusional disorder (ICD-10 F22.0), but we cannot fully rule out a drug-induced psychotic disorder (ICD-10 F15.51). According to the physician of the custodian force cases like A.'s are quite frequent in Somaliland. This agrees with our own observations, although no statistical records are available, although, we believe that the degree of violence exhibited in this case is exceptional. A recent study (Banjaw *et al.*, 2005) has shown that cathinone and khat extract, indeed, increase the frequency of aggressive behaviors in an animal model of aggression (isolation-induced baseline aggression; (White *et al.*, 1991). In the light of this study, of our previous work in Somalia (Odenwald et al., 2005), and of anecdotal reports from neighboring countries (Alem & Shibre, 1997) we assume that khat-related behavioral problems must be a huge problem in the communities of these countries. For a clinician it is quite obvious that the uncontrolled and often unreflected use of khat in countries at the Horn of Africa considerably complicates treatment of comorbid psychiatric disorders.

The case reported here illustrates, in a nutshell, the problems related to khat abuse having emerged after the end of the civil war in Somalia society, including the legal system being unprepared to deal with such cases. These problems, like excessive juvenile use patterns, are conducive to mental disorders and interfere with their treatment. Solving these problems requires, among others, research on changing drug intake habits and on respective norms, on the interaction between regional drugs and mental disorders, and on culturally adequate prevention and intervention strategies, especially for the comorbid khat abuse.

# 5. Screening for Posttraumatic Stress Disorder among Somali ex-combatants: A validation study[3]

[3] Source: Odenwald, M., Lingenfelder, B., Schauer, M., Neuner, F., Rockstroh, B., Hinkel, H. & Elbert, T. (submitted). Screening for posttraumatic stress disorder among Somali ex-combatants: A validation study. Journal of Traumatic Stress.

## 5.1 Abstract

Many screening instruments for Posttraumatic Stress Disorder in post-conflict settings have limited validity.

We adapted the Posttraumatic Diagnostic Scale (PDS) in language and culturally to be used within the Somali community so that local interviewers could be trained to administer the scale. For validation purposes, a randomly selected group of 135 Somali ex-combatants was screened by trained local interviewers; of them, 64 were re-assessed by trained clinical psychologists using the Composite International Diagnostic Interview (CIDI).

The screening instrument showed a good internal consistency (Cronbach's $\alpha$ = .86), convergent validity to the CIDI (sensitivity = .90; specificity = .90) as well as concurrent validity: positive cases showed higher Self Report Questionnaire (SRQ-20) scores, higher prevalence of psychotic symptoms, and higher levels of the intake of the stimulant drug khat. Compared to a single cut-off score, the multi-criteria scoring, in keeping with the DSM-IV, produced more diagnostic specificity.

The results provide evidence that our screening instrument can be considered a culture-sensitive, reliable and valid method to detect PTSD.

## 5.2 Introduction

Many low-income countries are challenged by war, organized violence, and natural disasters with severe consequences for the mental health. Posttraumatic Stress

Disorder (PTSD) represents a common, if not the most frequent, mental health problem in community studies in post-conflict areas (Cardozo *et al.*, 2004; Karunakara *et al.*, 2004; Onyut *et al.*, 2005; Scholte *et al.*, 2004; Somasundaram & Sivayokan, 1994; Tang & Fox, 2001). Elevated PTSD rates are particularly common in vulnerable groups suffering from multiple or continuous trauma, such as former child soldiers or tortured refugees (Derluyn *et al.*, 2004; Van Ommeren *et al.*, 2001; Thabet & Vostanis, 1999). But the use of assessment tools in post-conflict regions is challenged by the lack of reliable and valid instruments (Keyes, 2000). Moreover, such instruments should not just be translated into local languages, but should also be culturally adapted to fit the group being targeted (Flaherty *et al.*, 1988). Coyne & Kagee (2000) warn that the use of instruments with unknown validity in post-conflict settings might lead to inaccurate information about the mental health situation and might even support unjustified decisions concerning the distribution of scarce resources. In their review of studies on mental health and trauma in refuges (Hollifield *et al.*, 2002) conclude that the instruments used in most studies have had limited or untested reliability and validity for the specific population being studied. One of the most frequently-used instrument for the assessment of PTSD symptoms in post-conflict areas is the Harvard Trauma Questionnaire (HTQ; Mollica *et al.*, 1992). Its reliability has proven adequate, but its validity for non-Western post-conflict settings could only be demonstrated to a limited extent (Mollica et al., 1992; Smith Fawzi *et al.*, 1997a; Smith Fawzi *et al.*, 1997b). Validation was based mainly on South-East Asian refugees who were treated in a single mental-health institution in the US. However, in a community sample in their country of origin the prevalence of PTSD was found to be much lower (Mollica *et al.*, 1993). As a result, the authors of the HTQ suggest that community-based studies should include a validation sub-study in order to define the appropriate population cut-off score (Smith Fawzi et al., 1997a) in order to avoid high numbers of misdiagnosed individuals - a recommendation which is usually neglected (Lopes Cardozo *et al.*, 2004; Lopes Cardozo *et al.*, 2000; Scholte et al., 2004). Another widely used instrument in post-conflict areas is the PTSD Checklist (PCL; Weathers *et al.*, 1994), which was used in an appropriate way in some studies (Thapa & Hauff, 2005).

Other assessment tools such as the Impact of Event Scale (IES; Horowitz *et al.*, 1979), the Davidson Trauma Scale (DTS; Davidson *et al.*, 1997), and the Posttraumatic Symptom Scale-10 (PTSS-10; Holen *et al.*, 1983) have also been used frequently, although reliability and validity of non-Western versions have been insufficiently tested (Eid *et al.*, 1999; Thulesius & Hakansson, 1999; Zilberg *et al.*, 1982; Chen *et al.*, 2001). Instruments developed for specific populations like Kurdish children (Ahmad *et al.*, 2000), or Turkish earthquake survivors (Basoglu *et al.*, 2001), have also only shown limited validity.

The present study aimed at the development of a short psycho-diagnostic, screening instrument to assess for PTSD in a specific post-conflict region, Somalia, which should account for the characteristics of the target population (e.g. high rate of illiteracy, low level of familiarity with questionnaires, Islamic background) and which can be administered by trained local interviewers in their native language. To develop this screening instrument, we translated and modified a widely used self-report instrument: the Posttraumatic Diagnostic Scale (PDS) into an 'assisted self-report' format (Somali-PDS). 'Assisted self report' means that the interviewer helps to fill in the questionnaire in a defined standard procedure but does not probe or further inquire as in a clinical interview. The PDS is a measure developed by Edna Foa (1995) for the purposes of diagnosing PTSD according to DSM-IV criteria.

Secondly, we aimed at determining convergent validity by comparing the results with DSM diagnoses based on expert interviews using the Composite International Diagnostic Interview (World Health Organization, 1997) and at determining concurrent validity by comparison with other measures of psychopathology and drug intake. Our third goal was to compare the accuracy of the original multi-criteria scoring method of the PDS with the a single cut-off-score based on symptom items only, which is the most frequently used scoring method in community-based screening studies (Cardozo et al., 2004).

## 5.3 Methods

### Study design

Participants of the screening interview were selected from a sample of 666 identified and electronically registered ex-combatants, all members of the armed forces in North-Western Somalia[4] who were participants of the Somaliland Pilot Demobilization and Reintegration Program (DRP). Out of this group, 195 people were randomly selected and asked to participate in a first interview, the screening for PTSD (from now on referred to as 'screening interview'). From this sample, 47 could not be tracked due to their nomadic life style and lack of permanent residence. In addition, one person had died, four had moved to another town or country, and two were imprisoned. The remaining 141 ex-combatants were contacted by project staff, informed about the intention and procedure of the assessment, and invited to take part in the screening interview. Four individuals refused to participate. Of the remaining

[4] This region corresponds to what had been the British protectorate Somaliland until 1960 and which unilaterally declared its independence in 1991 and established its own administration.

137 participants, 2 did not complete the screening interview (response rate 135 of 141, i.e. 95.7%). The remaining 135 subjects were interviewed by trained local assistants for symptoms of Posttraumatic Stress Disorder (PTSD) with the Somali-PDS. Additional topics of the screening interview comprised demographic and clinical data such as the consumption of the stimulant drug khat.

Following the screening interview, the first 64 interviewees were asked to participate in a follow-up assessment conducted 2 to 14 days later. Two of them did not complete this interview. This assessment included a structured clinical interview conducted by a team of international researchers and clinicians who specialize in trauma. Trained interpreters assisted with these interviews. This second interview will be referred to below as the 'validation interview'. All interviewers and interpreters of the second interview were blind with respect to the outcome of the screening interview.

## Subjects

Of the 135 participants of the screening interview, 133 were men and two were women. Ages ranged from 19 to 70 years. Participants were involved in three different detachments of the Somaliland armed forces: army, police, and custodian corps (prison wards)[5]. All participants were former members of the 'Somali National Movement' (SNM) and were receiving a monthly salary from the armed forces at the time of the study.

From this sample, 62 men and the 2 women were selected for the validation interview. This sample did not differ from the 71 ex-combatants who only participated in the screening interview with respect to age ($M$ = 34.0, $SD$ = 9.5 years vs. $M$ = 34.3, $SD$ = 10.2; t = 0.190, df = 132, p = .849), body mass index ($M$ = 19.2,

[5] After the end of the liberation war in 1991, the former members of the rebel army were detached to different branches of the new-built regular military forces.

*SD* = 2.6 vs. *M* = 19.2*, SD* = 3.0; t = -0,072, df = 129, p = .943), military branch (army: 51.6% vs. 43.7%, police: 25.0% vs. 32.4%, prison wards: 23.4% vs. 23.9%; $\chi^2$ = 1.084, df = 2, p = .582), or on the average amount of money spent per day on khat in the week preceding the screening interview (*M* = 1.04*, SD* = 1.66 US$ vs. *M* = 0.66*, SD* = 0.99 US$; t = -1.507, df = 108, p = .135). Importantly, the sum score of the Somali-PDS did not differ either (*M* = 11.0*, SD* = *M* = 9.9 vs. 10.3*, SD* = 9.2, t = -.456, df = 133, p = .649).

The validation interview revealed that the average age of the ex-combatants when they started to actively fight in the war was 18.6 years (range 11 to 32 years*; SD* = 5.3; n = 54). At the time of their first military operation 69% were 18 or younger, 43% were 16 years or younger and 30% were 15 or younger. Thus, a large fraction of the sample comprised former child soldiers. At the time of the validation interview, ex-combatants had an average of 5.2 years of formal education (*SD* = 4.2); 53% of them were married and their household included on average of 8.7 persons (*SD* = 5.1).

## Screening Interview

The screening interview assessed for symptoms of PTSD using a modified version of the Posttraumatic Stress Diagnostic Scale (PDS; Foa, 1995). The scale had been adapted to the Somali language, culture, and Islamic religion (Somali-PDS). The PDS is a widely used self-report instrument for the assessment of PTSD according to the DSM-IV with good psychometric properties and validity (Foa *et al.*, 1997; Griffin *et al.*, 2004; Sheeran & Zimmerman, 2002). According to Foa (1997), the instrument achieved a Cronbach’s Alpha of .92, rest-retest reliability of .83, and a kappa of .74 (compared to the SCID-PTSD module) in a sample of 248 treatment seeking individuals.  These results are similar to those derived from two samples of general psychiatric outpatients (Sheeran & Zimmerman, 2002) and of battered women (Griffin et al., 2004).

In the first part of the instrument, a list of potentially traumatic events is presented and the respondent is asked to mark those event types, which he or she experienced during his or her life. The participant is then asked to briefly describe the worst of these events and to tell whether or not her or she felt extreme anxiety or helplessness while experiencing the event.

In the second part, the 17 DSM symptoms are assessed with reference to this worst event. Participants are asked to rate the frequency of each symptom for the past four weeks on a 4-point scale (0 *not at all or only one time* to 3 *five or more time a week/almost always;* a symptom is counted if a score of 1 or higher is selected), and to indicate how long they have been experiencing these symptoms and how soon the symptoms began following the event. The next segment assesses difficulties in everyday functioning related to these symptoms. The scoring method established by Foa (1995) is based on DSM-IV criteria for PTSD and was applied in this study: A positive screening case must fulfill all seven criteria indicated in the DSM-IV. The screening interview included the assessment of demographic information (name, age, gender, military branch, khat consumption and average money spent daily on khat during the last week). At the Horn of Africa and the neighboring regions, khat is a traditionally consumed substance with amphetamine-like properties (Halbach, 1972; Kalix, 1996) which is legally traded in Somalia.

Because many of the participants were illiterate, the self-report scoring of the PDS was adapted to an 'assisted self-report'. All items and answer categories were read to respondents by the interviewer. The interviewers marked the answers on the form without further probing. If a respondent indicated that he or she did not understand the meaning of the item the interviewer repeated the exact wording. If the respondent was not able to provide an answer the interviewer assisted by offering an alternative wording of the item without actively inquiring or probing. Interviewers received extensive training on this procedure.

## Validation Interview

The validation interview used the Composite International Diagnostic Interview for the DSM-IV (CIDI; WHO, 1997). This included the PTSD module (section K), and 13 items of the schizophrenia module (section G; G1, G2, G4, G6, G10, G14, G17, G18, G19, G20, G21) – the latter because psychotic symptoms are frequently co-morbid in veterans with PTSD (Butler *et al.*, 1996) and their development was related to excessive khat chewing (Odenwald *et al.*, 2005). The CIDI has already been used in cross-cultural studies (Ormel *et al.*, 1994) and its excellent psychometric properties have been reported (Andrews & Peters, 1998; Reed *et al.*, 1997). The former DSM-III-R PTSD module has been criticized to be less sensitive to detect disorders (Peters *et al.*, 1996) and has been extensively modified to meet the DSM-IV criteria (World Health Organization, 1997). Other studies criticized the strict skipping rules (van Zelst *et al.*, 2003). Based on these criticisms clinicians in our study were instructed to ask and probe all items of the PTSD module and all selected items of the schizophrenia module. Psychotic symptoms were only included if the symptom was not related to dissociative phenomena or flashbacks.

In addition to PTSD and psychotic phenomena, symptoms of anxiety and depression were measured using the Self-Report Questionnaire-20 (SRQ-20; Harding *et al.*, 1983; Harding *et al.*, 1980). Items were read to the participant and the interviewer recorded the answers. The validity of answers to SRQ items were examined by probing questions (Kortmann, 1987).

In order to assess for exposure to traumatic events, a standard list which asked for 15 situations with high face validity for the Somali military context was used (‘yes-no’ format): fighting in combat (reported by 82%), witnessing combat (76%), kill or wound enemies in combat (48%), being confronted with dead bodies in combat (88%), experiencing a life threatening accident or explosion (35%), witnessing serious accident or explosion (53%), suffering an injury by weapon (56%), witness injury by weapon (83%), witnessing violent death of relative or friend (52%), witnessing murder not in combat (35%), experiencing severe beatings or torture (26%), witnessing beatings or torture (21%), experiencing violent confiscation of property by officials (32%), experiencing harassment by armed personnel (36%), experiencing imprisonment (62%). The internal consistency of this list was satisfactory (Cronbach’s $\alpha = .76$).

Socio-demographic information and physical symptoms in the preceding month (cough, diarrhoea, fever, hyperventilation, constipation, other; Cronbach’s $\alpha = .67$) were also assessed in the validation interview. Khat consumption was quantified by items which already showed to be valid in field studies (Odenwald et al., 2005). We assessed the money spent on khat last week and the average time spent on chewing khat per day because it is well documented that ex-combatants with PTSD abuse psychotropic drugs more frequently compared to the ones without PTSD (Kulka *et al.*, 1990). We also assessed the average number of cigarettes consumed per day as khat consumers usually smoke when chewing (Kebede, 2002). The average number of hours of sleep per day in the previous week was also assessed as patients with PTSD often have sleep difficulties (Clum *et al.*, 2001; Nishith *et al.*, 2001).

## Cultural adaptation and translation of the PDS

The translation of the PDS to Somali, as well as its cultural adaptation, were carried out by groups of local bilingual and international experts, all of whom had received education in trauma-related concepts. In group discussions and consultations with external specialists, attention was dedicated to culturally specific meanings of items and typical experiences in Somalia. As a result, items such as those concerning rape and sexual experiences were modified to meet cultural and religious requirements[6]. The process of translation included a back-translation, which was performed independently by professional translators. Mismatching items were subjected to extensive discussions and retranslations and were independently discussed with a second group of local staff. The process of back-translation occurred as many times as necessary until all items had a clear and correct meaning.

## Training of local interviewers

Six local interviewers underwent a 10-days training by international researchers and clinicians. The training included theoretical education and practical exercises. During the first two interviews, they were directly supervised by trainers. Subsequently, team supervision was continuously provided throughout the four weeks of the screening exercise. The interpreters participated in the same theoretical education as interviewers, and translated and discussed all items of the CIDI and the structured clinical interview with expert team members as part of their training.

During the training we confirmed that all of the six interviewers and two interpreters were psychologically stable and capable of carrying out the assessment,

[6] We could not ask directly about sexual abuse and violent sexual experience but had to design a hierarchical set of consecutive questions. Due to ethical constrictions we only assessed information concerning rape and did not inquire into sexual contacts and molestation during childhood. Each subsequent question was asked only if the answer to the question before was positive. First we asked whether a respondent ever had heard about rape, then whether he had witnessed a rape. The next question would have been whether he knew the victim, and lastly whether he himself was the victim.

as some of them had experienced life-threatening situations themselves in the past. We used group and individual support to help interviewers cope with what they heard during the interviews.

## Interview procedure

The screening interview lasted 20-40 minutes. All interviews took place in the Somalia Demobilization and Reintegration Program center. Prior to the screening interview, local interviewers read a standardized explanation of the procedure to the participants, answered remaining questions, and asked them to sign an informed consent form. An additional informed consent was obtained for the validation interview which was accomplished with the help of trained local interpreters and lasted approximately two hours.

## Data Analysis

Reliability of the Somali-PDS was evaluated using Cronbach's $\alpha$ (internal consistency). Convergent validity of the screening outcome was evaluated using kappa and coefficients of sensitivity and specificity. Receiver-operator curve (ROC) analysis was conducted to examine the diagnostic utility of the screening instrument compared to the CIDI (McFall & Treat, 1999). Group differences were confirmed by student's t-Test (or Wilcoxon's test when not applicable) and $Chi^2$ test (or when appropriate Fisher's test). The data was analyzed using SPSS, version 11 for Macintosh.

# 5.4 Results

## Screening reliability

For the sample of 135 participants, the internal consistency of the 17 symptom items of the Somali-PDS was high (Cronbach's $\alpha$ = .86). The corrected item total correlations for the 17 symptom items ranged between $r$ = .33 (Item 11: feeling emotionally numb) and $r$ = .61 (Item 4: feeling emotionally upset when reminded of the traumatic event), with a median of $r$ = .47. In contrast to the symptom list, the internal consistency of the ten items of the event scale of the Somali-PDS was moderate (Cronbach's $\alpha$ = .54). The (corrected) item total correlations ranged between $r$ = .12 (event 10: life-threatening illness) and $r$ = .41 (Event 8: imprisonment). The median was $r$ = .19.

## Convergent Validity

Table 5.1 summarizes the PTSD diagnosis based on the screening and the validation interviews, (62 subjects). The consistency of PTSD-diagnoses reached 90.3%, that is, by both interviews PTSD was diagnosed in nine subjects and in 47 it was not. For five subjects, the positive screening outcome was not confirmed by the validation interview (false positives). For one subject, the screening interview failed to correctly diagnose the PTSD. This confirmed a sensitivity of .90 and specificity of .90 ($\kappa$ = .69, $p < .001$) for the Somali-PDS. In three of the five subjects misdiagnosed as having PTSD in the screening interview, we found an overestimation of avoidance symptoms.

*Table 5.1: Comparison of the criteria for PTSD in the screening and validation interview. The two-way table shows the numbers of respondents with and without PTSD (rows; validation interview) and the positive and negative screening cases (columns).*

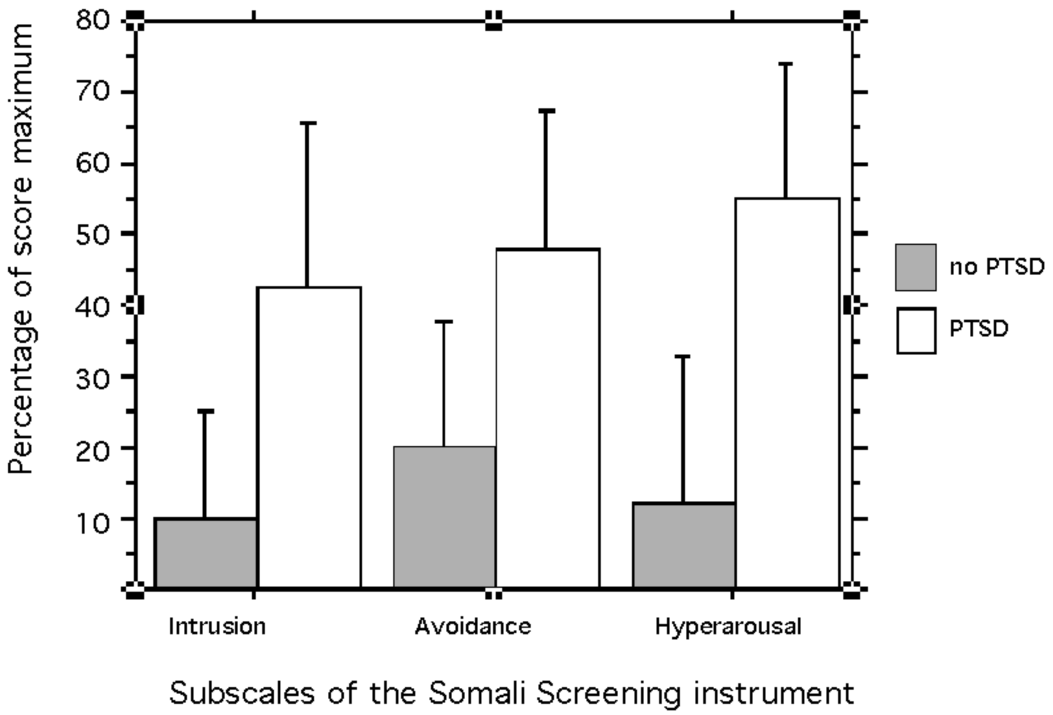
| | | Screening | | Sum |
|---|---|---|---|---|
| | | positive | negative | |
| **Diagnosis based on expert Interview** | **PTSD** | 9 | 1 | 10 |
| | **No PTSD** | 5 | 47 | 52 |
| | **Sum** | 14 | 48 | 62 |

*Sensitivity .90, Specificity .90, Kappa = .69 (p < .001)*
*Fischer's exact test: p < .001*

Respondents with PTSD in the validation interview ($n$ = 10) showed higher symptom scores in the screening instrument compared to ex-combatants without PTSD ($n$ = 52), with respect to the total symptom score as well as on the subscales level (see Figure 5.1; sum score: $M$ = 23.2, $SD$ = 10.0 vs. $M$ = 8.7, $SD$ = 8.0; $t$ = -5.059, df = 60 , $p$ < .001; intrusions: $M$ = 6.1, $SD$ = 4.4 vs. $M$ = 1.8, $SD$ = 2.6; $z$ = -3.269, $p$ = .001; avoidance: $M$ = 8.8, $SD$ = 4.8 vs. $M$ = 4.5, $SD$ = 4.2; $t$ = -2.926, df = 60, $p$ = .005; arousal: $M$ = 8.3, $SD$ = 3.5 vs. $M$ = 2.4, $SD$ = 3.0; $t$ = -5.452, df = 60, $p$ < .001; functioning: $M$ = 4.8, $SD$ = 2.5 vs. $M$ = 1.8, $SD$ = 2.1; $t$ = -4.0, df = 60, $p$ < .001). On an item level, the largest differences between subgroups were found for item 16 ('*being overly alert, for example, checking to see who is around you, always being suspicious about what is going on behind you, etc.*', $M$ = 2.10, $SD$ = 1.29 vs. $M$

= .56*, SD* = 1.13; *t* = -3.9, df = 60, *p* < .001) and item 2 (‘*having bad dreams or nightmares about the traumatic event’*: *M* = 1.20*, SD* = 1.32 vs. *M* = .65*, SD* = 1.10; *z* = -2.7; *p* = .006), in contrast to the smallest difference for item 6 (‘*trying not to think about, talk about or have feelings about the traumatic event’*, *M* = 1.50*, SD* = 1.18 vs. *M* = 1.29*, SD* = 1.45, *z* = -.805; *p* = .421).

*Figure 5.1: Group differences between respondents with and without PTSD according to the CIDI: Group differences in sub-scales of the screening instrument between ex-combatants with PTSD (N = 10; white bars) and without PTSD (N = 52; grey bars) in the clinical interview. Bars represent means of percentages of score maximum and standard deviation.*



## Concurrent validity of the screening method

Cases and non-cases of the screening interview differed with respect to non-PTSD symptoms as assessed in the validation interview (Table 5.2). Ex-combatants with positive screening outcome (PTSD) reported more anxiety and depression-related symptoms according to the SRQ-20, more psychotic symptoms (hallucinations and delusions according to the CIDI), more minor physical problems in the last month according to our symptom checklist and to sleep 126 minutes less per 24 hours. Furthermore, there was a tendency towards more traumatic experiences according to our event list, although they reported not having been longer involved in armed conflicts than their comrades with a negative screening outcome (no PTSD). On average, they spent 2 hours per day more on chewing khat, although the quantity consumed (measured by the monetary value of the consumed khat) and the number of cigarettes smoked were not significantly higher.

## Cut-off score

In most community-based screening studies, positive screening cases are usually defined by a single cut-off based on the sum score of symptom items only (Mollica et al., 1993). Here, we used the sum score of the 17 Somali-PDS symptoms items in order to create a cut-off score and assessed its utility against the CIDI PTSD diagnosis by means of an ROC analysis. As illustrated in Figure 5.2, the area under the curve (AUC) indicates a diagnostic accuracy better than chance equal to .874 ($p < .001$; SE = .062; CI 95% .752 to .996). Specificity and sensitivity vary clearly with the specific cut-off score chosen, with the highest magnitudes being achieved with a cut-off score of 13/14[7] (sensitivity = .90, specificity = .79).

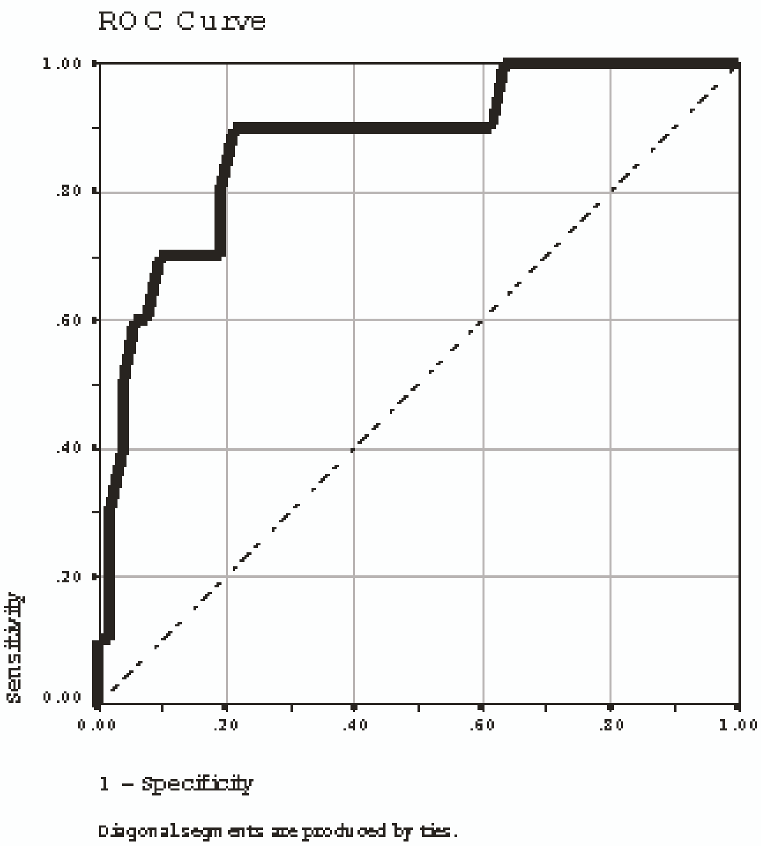
[7] Value ”13” and lower are counted as negative and value “14” and higher as positive.

*Table 5.2: Differences between positive (PTSD) and negative screening cases (without PTSD). Differences between these two groups on measures, which were assessed in the validation interview are shown. Means and standard deviations (in brackets) are reported.*

| | positive screening (14) | negative screening (48) | test statistic[1] (df) | p |
|---|---|---|---|---|
| SRQ-20 sum score | 9.07 (5.05) | 2.52 (4.11) | -5.010 (62) | < .001 |
| Psychotic symptoms | 57% (8) | 12% (6) | [6] | .001 |
| Number of traumatic events | 8.29 (3.00) | 6.54 (2.98) | -1.94 (62) | .057 |
| Years in armed conflict[2] | 5.4 (4.0) | 4.8 (4.6) | -.450 (59) | .655 |
| Sum of minor physical symptoms in last month | 1.71 (1.68) | .82 (1.21) | -2.24 (62) | .029 |
| Average hours of sleep per 24 h in previous week | 6.43 (2.95) | 8.54 (2.39) | 2.776 (62) | .007 |
| Money spent on khat in last week (US$)[3] | 7.38 (10.13) | 3.05 (5.80) | -1.31[7] | .191 |
| Average hours chewing khat per day in last week[3] | 5.54 (5.94) | 3.14 (2.46) | -2.14 (56) | .037 |
| Khat used in combat [4] | 85% (11) | 68% (27) | [6] | .305 |
| Average numbers of cigarettes per day in last week [5] | 7.14 (7.52) | 4.94 (6.94) | -1.027 (60) | .309 |

[1] student's t-test and $Chi^2$ were used; Wilcoxon was performed when variances were unequal; exact test according to Fisher-Yates was performed when expected frequency/cell was below 5
[2] different N: with PTSD 14, without PTSD 47
[3] different N: with PTSD 13, without PTSD 45
[4] different N: with PTSD 13, without PTSD 40
[5] different N: with PTSD 14, without PTSD 48
[6] exact test according to Fisher
[7] Wilcoxon's test

*Figure 5.2: Receiver-operator curve (ROC) showing sensitivity and 1-specificity of cut-off criteria based on the sum score of the screening instrument. Area under the curve = .874, SE = .062, p < .001. Sensitivity (.90) and specificity (.79) are highest with the cut-off criterion 13/14.*




## 5.5 Discussion

Extended screening of PTSD in countries affected by war and natural catastrophes is only feasible if local staff can be employed. The present study focused on the validity of a culturally adapted instrument for screening PTSD and trauma-related symptoms in Somali ex-combatants with a high rate of illiteracy.

The PDS was adjusted to meet these requirements as an 'assisted self report' instrument ('Somali-PDS'). In a sample of 135 interviewees Cronbach's Alpha reached .86. The comparison of PTSD diagnosis determined by the 'Somali-PDS' and by a standardized clinical interview (CIDI-K) in a sub-sample of 62 ex-combatants indicated a good convergent validity of the instrument (sensitivity = .90, specificity = .90). Additionally, the concurrent validity of the 'Somali-PDS' was supported by group differences in comorbid symptoms as assessed in the validation interview, e.g. more depressive and anxiety symptoms, more psychotic symptoms and more time per day spent on khat intake among ex-combatants with PTSD.

This results are in line with results of frequent depression and substance abuse are in PTSD (Breslau *et al.*, 2000; Kulka et al., 1990) - the latter possibly attributable to self-medication (Jacobsen *et al.*, 2001). Moreover, a higher rate of positive psychotic symptoms among individuals with PTSD was also found in other studies (Zimmerman & Mattia, 1999; Butler et al., 1996). The higher level of physical symptoms in individuals with PTSD is also in line with previous studies (Schnurr & Spiro, 1999; McFarlane *et al.*, 1994). We interpret this correspondence of our findings with the literature as a first support of the validity of our screening instrument. The comparison between two scoring methods (cut-off score based on symptom severity score vs. multiple DSM IV criteria) revealed equal sensitivity but higher specificity with the multiple DSM IV criteria. This, too, confirms the 'Somali PDS' as a valid diagnostic instrument and suggest that the adaptation of established diagnostic instruments to culturally specific needs and conditions is possible and can be done efficiently in field settings.

The present results also question the current practice in community-based assessments how to screen for PTSD on the basis of one single cut-off score, the more so, if it is derived from studies of clinical groups and applied to community settings without adaptation. However, the mandatory methodological requirement of defining cut-off scores for the specific community sample under investigation by conducting a pre-study might not always be feasible under emergency conditions. The alternative method of multiple criteria as described in the present study might produce more robust results without intensive pre-studies and, thus, might be more accurate and financially viable in post-conflict settings, although it might be associated with higher demands on the skills of local interviewers.

The present study disclosed severe abuse of the khat shrub. The interviewees' specification of their khat consumption did not match published reports about the traditional khat use (Halbach, 1972). For instance, many of the interviewees engaged in excessive chewing mode (similar to a 'speed run' in amphetamine addiction) and used additional benzodiazepines to dampen the stimulating effect of the drug. This suggests a group of heavy users who developed new patterns of consumption, which contrast to traditional use (Odenwald et al., 2005). Though the unusually high percentage of 57% psychotic symptoms among ex-combatants with PTSD might be explained by the small number in the PTSD group (12), the possibility that excessive khat consumption is related to it (Pantelis *et al.*, 1989) especially under certain conditions, like early onset of chewing in life (Odenwald et al., 2005), should be clarified in future research.

The present study emphasized the need to take into account and to respect local and cultural dimensions, whenever instruments developed in Western culture are used to assess psychological disorders in conflict-affected countries. For instance, the high rate of illiteracy was rarely considered. We found that concepts of 'trauma', originating from Western countries, had already invaded the Somali language and thinking. For instance, the term 'trauma' is frequently used in Somali colloquial language in order to explain the inadequate behaviors caused by severe mental disorder, but without any reference to culturally specific psychological phenomena[8]. Interestingly, ex-combatants who had experienced life-threatening events themselves easily understood the Western concept of PTSD in contrast to the society, because it matched their own experience.

Conclusions from the present study are limited by sample size, which was small with respect to the aim of a validation study; thus, we think further studies on the reliability and validity of the Somali-PDS are needed. Furthermore, sampling did not involve the whole of the target population of ex-combatants, but rather a selected group chosen to participate in the demobilization and reintegration program. The focus on ex-combatants might be questioned, as this group represents the two sides of being a victim of violence as well as a perpetrator. Civilian war survivors, who have only been victims in the past and are also suffering from war-related psychopathology, do constitute another relevant group for screening. Finally, in order to better understand the prevalence of war-related psychopathology in Somalia, the development of a more comprehensive measure of psychological problems would have been helpful. Future studies would benefit from this information, especially in relation to khat abuse, as it represents a unique feature.

[8] As, for example, the phenomenon of 'zar', by which psychological disturbances are explained by ghost possession and cured by traditional healers in ritual ceremonies (Tiilikainen, 2003)

## 5.6 Conclusions

Consequences of trauma do cause enormous suffering in many parts of the world, with post-war Somalia being currently one of the most tragic of cases. We believe that a scientific approach is helpful to reduce this suffering, e.g. if – as one possible first step - the validity and reliability of screening for PTSD in community settings in post-conflict/disaster regions can be improved by incorporating factors such as literacy and culture, while considering alternative scoring methods and the use of local interviewers. However, the fact that much of scientific knowledge is generated in the Western world, and cannot simply transferred to non-Western cultures, should not neglect the responsibility to disseminate and adapt the findings to the contexts where it is needed most. There is a strong need for an exchange between experts of all cultures involved and for a 'service delivery habit' (Saraceno & Barbui, 1997), with a strong evaluative component.

# 6. The Consumption of Khat and Other Drugs in Somali Combatants: A Cross-Sectional Study[9]

[9] Source: Odenwald, M., Hinkel, H., Schauer, E., Neuner, F., Schauer, M., Elbert, T.E. & Rockstroh, B. (submitted). The Consumption of Khat and Other Drugs in Somali Combatants: A Cross-Sectional Study. *PLoS* Medicine.

## 6.1 Abstract

The present study provides information about drug use among active security person-nel and militia in Somalia. Special focus has been put on regional differences between the northern and the southern part of the country, which are affected by 'failure of state' at different levels.

We conducted a cross-sectional study in seven regions, including 8,723 individuals approached by trained local interviewers. Of these respondents, 587 (6.3%) rejected or discontinued the interview and 12 were excluded for other reason. We assessed self-reported khat use and the interviewees' perception of khat, marijuana, psychoactive tablets (e.g. benzodiazepines), alcohol, solvents, and hemp seed use in military units. Forty-two percent of respondents reported khat use in the week before the interview. In southern and central Somalia the quantities were higher than in the north (Cohen's d = 0.70). Self-reported khat use and the perception of its use differed substantially. According to the perception of respondents, khat is the most frequently used drug (70% in previous week), followed by hashish (18%), psychoactive tablets (14%), alcohol (8%), solvents (3%) and hemp seeds (1%). Perceived use of khat differs little between northern and southern Somalia (d = 0.21), unlike the use of all other drugs ($0.41 \leq d \leq 1.62$), which reaches alarming levels in some regions of the south, especially for cannabis.

Our data support that drug use has qualitatively changed over the course of conflicts in southern Somalia as current patterns don't fit the traditional pattern of use. Drug-related problems in southern Somalia may have reached dimensions which have been unknown to the country.

## 6.2 Introduction

Little is currently known about the prevalence of drug use by former combatants and about the influence of lack of state power in (post-) conflict regions on the use of drugs. Here we report the first epidemiological data on khat and other drug use among active armed forces and militia personnel in Somalia. In Somalia, decades of civil war have given rise to a vacuum of state power (Gros, 1996) and in some regions, law is not enforced. For the understanding of the political situation of current Somalia, it is essential to acknowledge that the Somali society is clan-based, with six major clan-families and some minority groups. In early 1991, the autocratic rule of the former president Siyad Barre, who increasingly had relied on his closely related sub-clans, was ended by the victory of several allied clan-based armed groups. However, they split off later in rivalry over power and resources and produced the disordered situation which lasts until today (Menkhaus, 2003). The political situation after 2003 offered new hope to effectively re-establish a central government and to end the armed conflict (Terlinden, 2006).

In many countries, after the end of an armed conflict, a huge number of former refugees and internally displaced people (IDP) as well as ex-combatants, need to get reintegrated socially and economically into society (Kigma, 2000). In this process, ex-combatants were frequently found to have difficulties in readjusting, e.g. occupational or marital problems (Mogapi, 2004; Prigerson *et al.*, 2001). Substance abuse and dependence have been conceptualized as risk factors for readjustment to civilian life (Fontana & Rosenheck, 2005; Rosenheck & Fontana, 1994; Savarese *et al.*, 2001; Savoca & Rosenheck, 2000). Especially ex-combatants with a high trauma load or with Posttraumatic Stress Disorder (PTSD) were frequently found to have high consumption levels of alcohol and other substances (Kulka *et al*., 1990; McFall *et al*., 1992; Okulate & Jones, 2006; Shipherd *et al*., 2005). Current knowledge supports the self-medication hypothesis, i.e. drugs are consumed to suppress war-related traumatic memories, improve sleep, or ameliorate depressive symptoms (Brady *et al*., 2004; Calhoun *et al*., 2000; Chilcoat & Breslau, 1998; Jacobsen *et al*., 2001). Thus, in recent years psychiatric services for ex-combatants developed more integrated models of care, including the treatment of substance abuse (Ouimette *et al*., 2003; Sloan & Rowe, 1998). However, most studies on substance use, readjustment and treatment of drug-related problems of former combatants have been conducted in western countries. Information from African post-conflict regions are sparse, especially information related to the prevalence of abuse, the type of drugs consumed and the relationship between drug use and other psychiatric conditions and readjustment measures. This lack of information seriously hampers the efforts made by reintegration programs in many resource-poor post-conflict countries because unrecognized drug abuse might lead to failure of reintegration in a substantial number of cases. Additionally, drug abuse might lead to further social problems (e.g. increased criminality (Collier, 1994) or lower returns for the whole national economy. Wide-spread drug abuse might even affect the peace-building process as a whole (Kingma, 2000), e.g. when many ex-combatants turn to drug trafficking or banditry (UNODC, 1999).

The main drug of abuse in Somalia is khat (UNODC, 2004). The leaves of the khat shrub are traditionally consumed in parts of Africa and Arab countries because of their stimulating properties (Halbach, 1972; Numan, 2004). Recently, khat use has spreat to Western countries, where it is practiced by immigrant groups (Gegax, 2002; Toennes & Kauert, 2004). The chemically instable alkaloid cathinone, S(-)alpha-aminopropiophenone, which is only prevalent in the fresh plant material, is the main psycho-active agent (Szendrei, 1980). Numerous laboratory studies confirmed that cathinone resembles amphetamine in chemical structure and affects the central and peripheral nervous system (Kalix, 1990) and behavior similarly (Woolverton & Johanson, 1984; Zelger *et al.*, 1980; for a review see Kalix, 1991; Nencini & Ahmed, 1989). Khat use has been related to numerous somatic and psychiatric health sequelae (Al-Habori, 2005; Al-Hebshi & Skaug, 2005). In the last cross-sectional assessment of khat-intake, Elmi (1983) reported the introduction of the khat habit in the southern part of the country not until the 1960s, in contrast to the north, where it is has a long-standing tradition. In the northern part of the country 64% of adult males regularly consumed khat compared to 21% in the south. More recent data from the neighboring countries indicate that khat chewing is frequently accompanied by alcohol drinking, smoking hashish and intake of benzodiazepines (Omolo & Dhadphale, 1987; Selassie & Gebre, 1996; Zein, 1988). We recently reported a cross-sectional study in north-western Somalia (Somaliland; Odenwald *et al.*, 2005) showing that self-reported khat use was more frequent and excessive among male ex-combatants (60%) than in adult male civilian war survivors (28%) and in males without war experience (18%; $p < 0.001$). In recent years, the cultivation and trade of cannabis and other illicit drugs became a growing problem in southern Somalia, but there are only limited data available (UNODC, 2002).

Here we report data concerning self-reported khat use among active security personnel and militia in Somalia, and some problematic use patterns (e.g. solitary and excessive use). In a preparatory project for a demobilization program[10], we gathered

[10] Committee 2 of the Somali National Peace and Reconciliation conference in Mbagthi, Kenya, supported a preparatory assessment in which the here reported data were collected. The assessment was

data on the respondents' perceptions of the prevalence of six different types of drug use in their units. We were especially interested to determine how many of the potential future participants of demobilization and reintegration activities use khat, which drugs are the most frequently consumed ones according to the perception of respondents and whether there are differences between northern and southern Somalia.

## 6.3 Methods

### Design, Sampling and Participants

Seven regions of Somalia were selected for interviews, including major population centers and rural areas: In the north of Somalia, we included North-West Somalia (Somaliland[11]) and Puntland. Both regions do have a strong state like power in terms of regional administrations. In central Somalia Hiran was chosen, in southern Somalia we selected Bay, Mogadishu and Kismaayo. Mogadishu was divided into two parts according to the "green line" which divided the town between main factions. In central and southern Somalia the territory is divided into a large number of smaller and bigger factions who do not allow a central government to exert power (Menkhaus, 2003). On the level of each region, interviews were conducted with all collaborating factions. Collaboration required a minimum of one unit to be completely assessed. Of the major factions all but one participated in the research project. In Somaliland, due to the involvement in a different project, a census-like

---

financed by the European commission and implemented on the ground by German Technical Cooperation (GTZ) with the help of local NGOs.

[11] Self declared independent but not internationally recognized Republic of Somaliland.

assessment (registration) was conducted. We aimed to assess a minimum of 600 respondents in order to detect small differences between regions (with Alpha = 0.001 and Beta = 0.2) and to be able to get representative samples.

Interviews were conducted from August until December 2003. The interviewers visited a compound used by the respective militia or units to conduct the individual interviews. They chose a private place, e.g. a separate room, to conduct the interviews. As participation in the assessment was ordered by superiors, we estimated a nearly 100% participation rate. However, due to information policy of collaborating factions we did not know the actual size of units. According to the observation of interviewers, the motivation of the individual unit members for participation was high[12].

A total of 8,723 militiamen and security staff were approached. Of these participants, 587 dropped out after being informed about the purpose of the study (empty sheet returned) or during the interview (6.7%). Another 12 were excluded because their interviewers did not fulfill minimal standards (a minimum of 10 interviews per interviewer was required), resulting in 8,124 (93.1%) interviews entering statistical analysis. We reached close to 50% of armed staff in Somaliland and about 8% of the total estimated number of armed personnel in the rest of Somalia[13]. Of them, 4,070 belonged to regional authorities in Somaliland and Puntland and 2.290 to other factions. Another 1,090 were members of freelance and clan-based militia, 481 members of sharia court militias and 78 members of business militias.

[12] Despite the fact that they were accurately informed about the study, and that their participation would not have any effect on the participation in a future program, they were still hoping that they would increase the chance to be selected by participating in the assessment.
[13] recent planning documents of international organizations, like UN or GTZ and of the the SPRC vary around figures of 53,000 excluding Somaliland (est. 17,600)

## Interviewers, Training and Supervision

Interviewers were staff of local NGOs with interviewing experience (N = 38). Prior to data collection, a 14 days' training was conducted, containing clinical concepts and research design, role plays and field exercises. A team member of Somali origin and international staff kept in touch with the interviewers throughout the assessment phase by GSM and satellite phones, radio and field visits. Close contact to the forces and militias' command and an intense awareness campaign by local press, radio and TV prepared the ground. No security incident was reported over the whole assessment. After the assessment local NGOs handed in the questionnaires and assisted data entry.

## Instrument

The questionnaire was designed as a standardized instrument to gather relevant individual information of active militiamen and security personnel in order to prepare for disarmament, demobilization and reintegration activities. Questions and closed answers were developed in English language by an interdisciplinary team, consisting of Somali medical and non-medical staff and international experts on demobilization and mental health from different organizations. In this group, all items were extensively discussed on cultural adequacy, translated and, then, independently back-translated by professional translators. In case of mismatch of the back-translation in semantic content, the item was revised and again, independently back-translated. The translation-back-translation circle was repeated as often as necessary until the semantic content of the Somali wording was adequate.

The results of the socio-demographic part of the interview are presented in Table 6.1.

*Table 6.1: Socio-demographic information on 8,124 active armed forces and militia staff in seven regions of Somalia.*

| | Corrected Total[1] | Somaliland (3,903) | Puntland (854) | Hiran (696) | Bay (604) | Mogadishu North (654) | Mogadishu South (814) | Kismaayo (599) | p (test statistic) |
|---|---|---|---|---|---|---|---|---|---|
| Age [2] | 34.5 (4.9) | 41.3 (12.6) | 37.1 (12.8) | 39.6 (12.5) | 30.5 (9.2) | 29.1 (9.3) | 30.3 (8.7) | 34.1 (12.6) | < .001 (211.7)[3] |
| % male | 93.3 (5.8) | 82.8 | 89.9 | 97.7 | 97.5 | 96.3 | 98.5 | 90.5 | < .001 (370.2)[4] |
| % married or widowed | 63.3 (10.8) | 73.4 | 76.8 | 71.0 | 63.1 | 52.0 | 49.1 | 57.9 | < .001 (597.0)[4] |
| Number of dependants [2] | 5.9 (2.0) | 6.8 (5.6) | 9.2 (6.1) | 7.2 (5.5) | 4.8 (5.1) | 3.4 (4.5) | 4.3 (4.9) | 5.5 (5.5) | < .001 (127.4)[3] |
| % primary education completed | 41.1 (13.5) | 49.2 | 38.8 | 34.1 | 32.4 | 22.1 | 48.4 | 63.0 | < .001 (335.0)[4] |
| % any vocational training | 22.0 (13.6) | 24.7 | 44.5 | 17.7 | 7.1 | 12.7 | 12.4 | 35.2 | < .001 (460.5)[4] |
| % with combat experience | 75.0 (22.3) | 48.4 | 82.1 | 84.1 | 100.0 | 70.2 | 96.9 | 43.1 | < .001 (1516.0)[4] |
| Age of first combat[2] | 22.3 (2.0) | 24.8 (9.6) | 23.5 (8.7) | 24.2 (9.2) | 21.6 (6.7) | 20.0 (7.9) | 19.8 (6.2) | 22.0 (7.6) | < .001 (49.9)[3] |
| Years in combat[2] | 1.8 (0.7) | 2.4 (2.5) | 2.7 (3.4) | 0.8 (0.9) | 1.7 (2.8) | 1.8 (3.2) | 1.0 (1.3) | 2.3 (3.8) | < .001 (41.0)[3] |

[1] Expected Value (Standard Error of the Mean)
[2] Mean (Standard Deviation)
[3] ANOVA, df = 6
[4] 2 x 7 $Chi^2$, df = 6

Types of narcotic substances to be assessed were defined in a prior assessment among the 45 participants of the interview training (some of them weren't interviewers later). As a result, the following six types of narcotic drug consumption were assessed in the main study: (a) chewing khat, (b) smoking 'hashish', (c) ingesting psychoactive 'tablets' (not prescribed but taken in order to be 'high', e.g. 'diazepam' pills), (d) drinking alcohol, (e) inhaling solvents (like petrol or glue) and (f) eating 'bangi' seeds (hemp seeds). Khat turned out to be by far the number one drug in the opinion of the interviewers. Thus, we assessed its individual use and the consumed amount for the period of the week before the interview by means of self-report. Self-report of individual drug intake was found to be a reliable and valid measure in western countries (Brener *et al.*, 2003), which can be related to other risk behaviors (Dunn *et al.*, 2003). In order to facilitate honest answers, we first asked respondents what type of khat they would usually take, the Ethiopian type ("Herari") or Kenyan type ("Miraa"): "What kind of khat do you usually chew?" Then we asked for the number of traded units 'ready to consume' ('bundles') they had consumed in the previous week: "How many bundles of khat have you consumed in the last week?" We judged an average consumption of more than two bundles a day as being 'excessive' as this margin was found to be the threshold that separated psychiatric patients from normal individuals (Dhadphale & Omolo, 1988). We also inquired typical signs associated with excessive chewing: a) sleepless nights due to continued khat intake, which occurs frequently in heavy chewers because of its stimulating effects and b) consumption in solitary setting, which was described as a frequent intake habit of 'problem chewers' (Pantelis *et al.*, 1989), and which is in contrast to the traditional 'social' setting (khat party).

In some parts of the country, the consumption of drugs like alcohol can involve draconic punishment; therefore, we assessed consumption of all other types of drugs by asking for perception of its use. First, we assessed the respondents' opinion about the existence of the six types of drugs defined above: "Are you aware of the following drug-taking habits in your locality?" Then, we asked to estimate the percentage of his/her unit members who had consumed these drugs in the week before the interview (perception of use): "In your opinion, what percentage of people in your (force/militia) unit have used the following drugs in the last week?" In western settings, the perception of drug use of peers has a high predictive value for the self-reported drug use (Perkins *et al.*, 2005). The validity of the items concerning socio-demographic information and self-reported khat use was demonstrated in our previous work (e.g. Odenwald et al., 2005). Using the same methodology and procedure in a previous study with ex-combatants (Odenwald *et al.*, submitted), the same local interviewers who assisted in the current study had assessed quantitative information on khat use. A second, clinical interview by trained international experts with the help of trained interpreters was conducted in 47 subjects, about one to four weeks later in order to evaluate the first interview. Given that both interviews assessed drug use information with reference to different weeks the correlation between the quantitative information on khat use was high ($r = .69$, $p < .001$) and the correspondence of the categorical information was satisfactory ($kappa = .47$, $p = .001$).

## Approval and ethics

The Cease Fire, Disarmament and Demobilization Committee (Committee 2) of the Somali Peace and Reconciliation Conference (SPRC) in Mbaghati, Nairobi, the National Demobilization Committee (NDC) in Hargeisa, the Somalia Unit of the European Commission (Nairobi), the German Agency for Technical Cooperation, International Services (GTZ IS; Nairobi) approved the assessment. All participants were informed before the interview about purpose and method of the interview, about confidentiality and about the possibility to discontinue the interview at any time without negative consequences. Interviews were only conducted after respondents had given verbal consent. We accepted oral consent because of the high rate of illiteracy.

## Statistical analysis

Data was analyzed with SPSS 11.0 for Macintosh. We report proportions in percent and for continuous variables means and standard deviations. In order to correct for unequal numbers of interviewees in different regions we calculated the Expected Value (E(x´)) and Standard Error of the Mean (SE(x´)) as statistics for the total sample. In that way we also calculated proportions of the total sample. Differences between regions were tested using ANOVA, t-test, $Chi^2$ test and Kruskal Wallis tests. In order to determine the effect size for $Chi^2$ tests we calculated Cohen's w (Cohen, 1977, 1988) which can have a maximum value of 1 in our case (2 x 7 categories). For mean differences between northern Somalia on the one hand and central and southern Somalia on the other we computed the standardized effects size d (Cohen, 1977, 1988) using the pooled standard deviation (Lipsey & Wilson, 2001). For proportion differences between north and south/central Somalia we computed odds ratios and their confidence intervals for alpha 0.05 (Lipsey & Wilson, 2001). We do not report p values of correlation coefficients as they are not informative with our very high N (e.g., for $r > 0.04$ $p < 0.001$).

## 6.4 Results

In all Somalia, 42% of respondents reported khat intake in the week previous to the interview (Table 6.2), with highest levels in Bay and southern part of Mogadishu (69% and 61%). There is a clear difference between northern and southern/central Somalia, which produces a medium effect size (Cohen's w = 0.34). This picture is reflected by the results of excessive khat use and related patterns: consumption of more than two 'bundles' per day in the previous week was more frequent in central and southern Somalia (w = 0.37), as well as reporting more than one sleepless night due to khat chewing in the week previous to the interview (w = 0.30), and habitual consumption in a solitary setting (w = 0.18). The self-reported quantitative information about individual khat chewing in the week before the interview goes along with this result (Table 6.3): khat chewing respondents reported that they have consumed on average 10.1 'bundles' (SD = 6.2) and had 2.0 sleepless nights (SD = 0.9) due to chewing khat in the last week. Again, the differences between northern and southern/central Somalia were evident, with higher numbers in the south and center (Cohen's d = 0.70 and 0.90). Figure 6.1 displays graphically the differences between the north on the one hand and central/southern Somalia on the other.

*Table 6.2: Qualitative information about chewing khat and associated features in active armed forces and militia staff in seven regions of Somalia.*

| Percentage of | Corrected Total[3] | Somali-land (3,903) | Punt-land (854) | Hiran (696) | Bay (604) | Mog. North (654) | Mog. South (814) | Kismaayo (599) | p (Chi$^2$)[4] | Cohen's W[5] | Odds ratio North- South (CI 95%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Khat chewers [1] | 42.0 (20.8) | 29.7 | 10.5 | 26.6 | 69.4 | 47.7 | 61.4 | 48.6 | <.001 (930.7) | 0.34 | 2.9 (2.6 – 3.2) |
| > 2 bundles/ day[1] | 10.4 (11.1) | 1.3 | 0.2 | 2.0 | 6.0 | 12.4 | 26.7 | 24.2 | <.001 (1114.0) | 0.37 | 16.0 (11.9 – 21.5) |
| > 1 sleep-less night [1, 2] | 51.8 (22.6) | 13.6 | 25.6 | 68.6 | 57.5 | 63.8 | 69.4 | 64.3 | <.001 (755.6) | 0.30 | 10.9 (9.0 – 13.1) |
| chewing in solitary setting [2] | 7.7 (5.1) | 3.1 | 2.8 | 3.3 | 11.9 | 11.2 | 6.1 | 15.2 | <.001 (253.3) | 0.18 | 3.2 (2.6 – 3.9) |

[1] in the week previous to the interview
[2] only among chewers
[3] Expected Value (Standard Error of the Mean)
[4] 2 x 7 Chi$^2$, df = 6
[5] according to Cohen (1977): "small" w = 0.1, "medium" w = 0.3, "large" w = 0.5

*Table 6.3: Quantitative information about khat consumption in the week previous to the interview in seven regions of Somalia.*

| | Corrected Total[4] | Somaliland (3,903) | Puntland (854) | Hiran (696) | Bay (604) | Mog. North (654) | Mog. South (814) | Kism. (599) | p (F)[5] | Cohen's d North-South |
|---|---|---|---|---|---|---|---|---|---|---|
| Khat bundles 1, 2, 3, 4 | 10.1 (6.2) | 5.9 (6.5) | 3.4 (5.4) | 6.3 (6.7) | 7.6 (6.1) | 10.8 (11.1) | 15.9 (13.5) | 20.8 (18.4) | <.001 (130.4) | 0.70 |
| Sleepless nights due to khat 1, 2, 3, 4 | 2.0 (0.9) | 0.7 (1.8) | 1.0 (1.8) | 3.0 (2.2) | 2.0 2.1) | 2.6 (2.3) | 2.7 (2.0) | 2.0 (1.5) | <.001 (108.5) | 0.90 |

1 Mean (Standard Deviation)
2 only chewers included (total 2,955; Somaliland 1,158; Puntland 90; Hiran 185; Bay 419; Mogadishu North 312; Mogadishu South 500; Kismaayo 291)
3 in week before the interview
4 Expected Value (Standard error)
5 One way ANOVA, df = 6

Tables 6.4 and 6.5 highlight the opinion of militia/security personnel in Somalia about the existence of different types of drug consumption and the perceived proportions of consumers within units. On average, 97% of respondents believe that khat is consumed in their locality, without much variation between regions; Cohen's w for the difference between regions is consequently small (0.1). Smoking hashish is the second most frequently reported type: 59% of respondents believe that it exists in their localities, followed by intake of tablets (54%), drinking alcohol (41%), sniffing inhalants (25%) and eating bangi seeds (13%). There are marked differences on the regional level with medium to large effect sizes ($0.37 \leq w \leq 0.64$). The odds-ratios document clearly that all drug use including khat is believed to be less frequent in the two northern regions compared to the five regions of central and southern Somalia ($2.0 \leq OR \leq 19.0$).

*Table 6.4: Proportion of respondents who believe that the respective drug is consumed in their localities; we report proportions of 'yes' answers in the seven regions and a corrected total proportion.*

| Are you aware of the following drug-taking habits in your locality? | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| % yes answers | Corrected Total[1] | Somaliland (3,903) | Puntland (854) | Hiran (696) | Bay (604) | Mogadishu North (654) | Mogadishu South (814) | Kismaayo (599) | p ($Chi^2$)[2] | Cohen's w[3] | Odds ratio North-South (CI 95%) |
| Chew khat | 97.2 (2.3) | 95.2 | 97.3 | 99.1 | 99.2 | 93.1 | 98.5 | 98.2 | <.001 (83.1) | 0.10 | 2.0 (1.5 – 2.6) |
| Smoke hashish | 59.2 (31.2) | 15.3 | 18.3 | 76.1 | 89.7 | 60.7 | 63.8 | 90.8 | <.001 (3105.6) | 0.62 | 16.2 (14.5 – 18.1) |
| Take tablets | 53.8 (30.9) | 9.2 | 16.6 | 68.5 | 87.3 | 50.9 | 59.3 | 85.1 | <.001 (3288.3) | 0.64 | 19.0 (16.9 – 21.3) |
| Drink alcohol | 41.3 (24.0) | 17.1 | 16.7 | 32.0 | 78.3 | 34.1 | 42.4 | 68.8 | <.001 (1527.3) | 0.43 | 4.8 (4.3 – 5.3) |
| Inhale drugs | 24.8 (16.5) | 6.6 | 16.4 | 16.2 | 56.3 | 23.1 | 18.9 | 36.1 | <.001 (1139.4) | 0.37 | 4.4 (3.8 – 5.0) |
| Eat bangi seeds | 13.4 (17.1) | 0.5 | 6.0 | 8.0 | 50.7 | 5.8 | 6.8 | 15.7 | <.001 (1925.0) | 0.49 | 12.6 (9.8 – 16.2) |

[1] Expected Value (Standard Error of the Mean)
[2] 2 x 7 $Chi^2$, df = 6
[3] according to Cohen (1977): "small" w = 0.1, "medium" w = 0.3, "large" w = 0.5

The estimated percentages of drug consumers among armed personnel (Table 6.5) showed similar results. Respondents reported that on average 69.5% of their comrades chewed khat in the week before the interview. In this respect, again, there is a small difference between north and south (Cohen's d = 0.21). On average, respondents estimated that hashish was consumed by 18.2%, tablets by 14.4%, alcohol by 8.2%, inhalants by 3% and bangi seeds by 1% in the previous week. However, we find that the estimated proportion of consumers of all drugs other than khat is higher in central and southern Somalia ($0.41 \leq d \leq 1.62$). Clearest are the differences related to smoking hashish, which was reported for a third or more of unit members in two areas of southern Somalia (Kismaayo and Bay) in contrast to one percent or less in the two regions of northern Somalia. Figure 6.2 reports these differences between the northern part of Somalia and the central and southern regions.

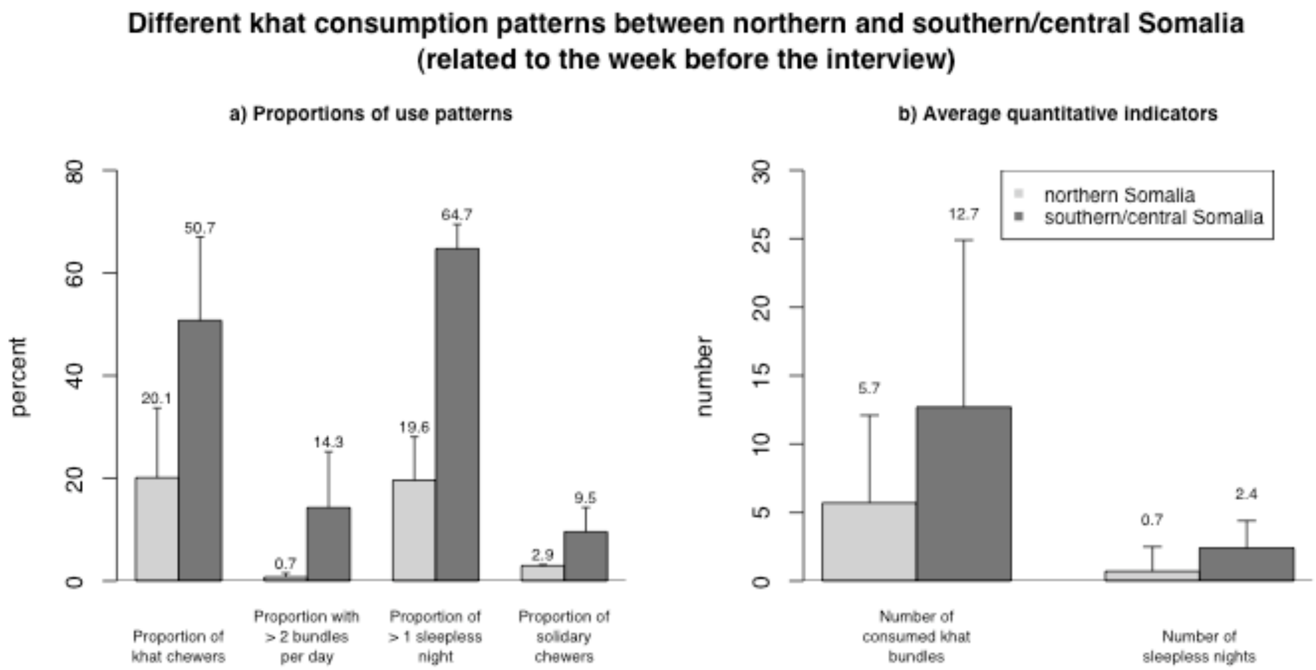
We calculated the correlations between the perceived proportions of unit members who would take the different types of drugs. The perceived proportion of khat consumers is not strongly associated with consumers of other drugs ($0.08 \leq r \leq 0.22$). However, the perceived proportion of hashish consumers is substantially correlated with those of tablet consumers ($r = 0.76$) and alcohol drinkers ($r = 0.54$).

*Table 6.5: Estimated percentages of consumers of six types of drugs in armed forces and militia units in Somalia. We report mean and standard deviation and for the total sample, expected value of mean percentage and standard error.*

| In your opinion, what percentage of people in your (military/militia) unit has used the following drugs (in the last week)? | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Corrected Total[1] | Somali-land (3,903) | Punt-land (854) | Hiran (696) | Bay (604) | Mog. North (654) | Mog. South (814) | Kis-maayo (599) | p (F)[3] | Cohen's d North-South |
| Khat[2] | 69.5 (7.8) | 71.7 (24.1) | 60.5 (23.6) | 63.5 (20.5) | 80.7 (19.4) | 61.4 (29.5) | 72.8 (15.8) | 75.8 (16.7) | < .001 (84.4) | 0.21 |
| Hashish[2] | 18.2 (14.4) | 1.0 (4.7) | 0.5 (2.7) | 15.7 (18.2) | 38.1 (23.8) | 20.8 (24.2) | 18.4 (22.1) | 33.2 (26.2) | < .001 (984.4) | 1.62 |
| Tablets[2] | 14.4 (10.9) | 0.7 (5.1) | 0.6 (3.1) | 13.4 (16.9) | 30.2 (23.7) | 16.1 (22.0) | 17.7 (20.2) | 22.6 (21.1) | < .001 (704.4) | 1.39 |
| Alcohol[2] | 8.2 (7.0) | 1.7 (7.1) | 0.6 (3.1) | 2.8 (8.1) | 19.8 (20.3) | 11.7 (21.3) | 8.3 (15.3) | 12.8 (14.5) | < .001 (326.8) | 0.85 |
| Inhalants[2] | 3.0 (3.1) | 0.2 (2.4) | 0.2 (1.3) | 1.9 (6.5) | 9.2 (13.8) | 3.7 (10.2) | 2.3 (7.0) | 3.3 (6.9) | < .001 (213.0) | 0.64 |
| Bangi seeds[2] | 1.0 (1.5) | 0.0 (0.3) | 0.1 (0.9) | 0.9 (4.7) | 4.4 (8.0) | 0.5 (4.5) | 0.7 (3.8) | 0.4 (1.7) | < .001 (168.9) | 0.41 |

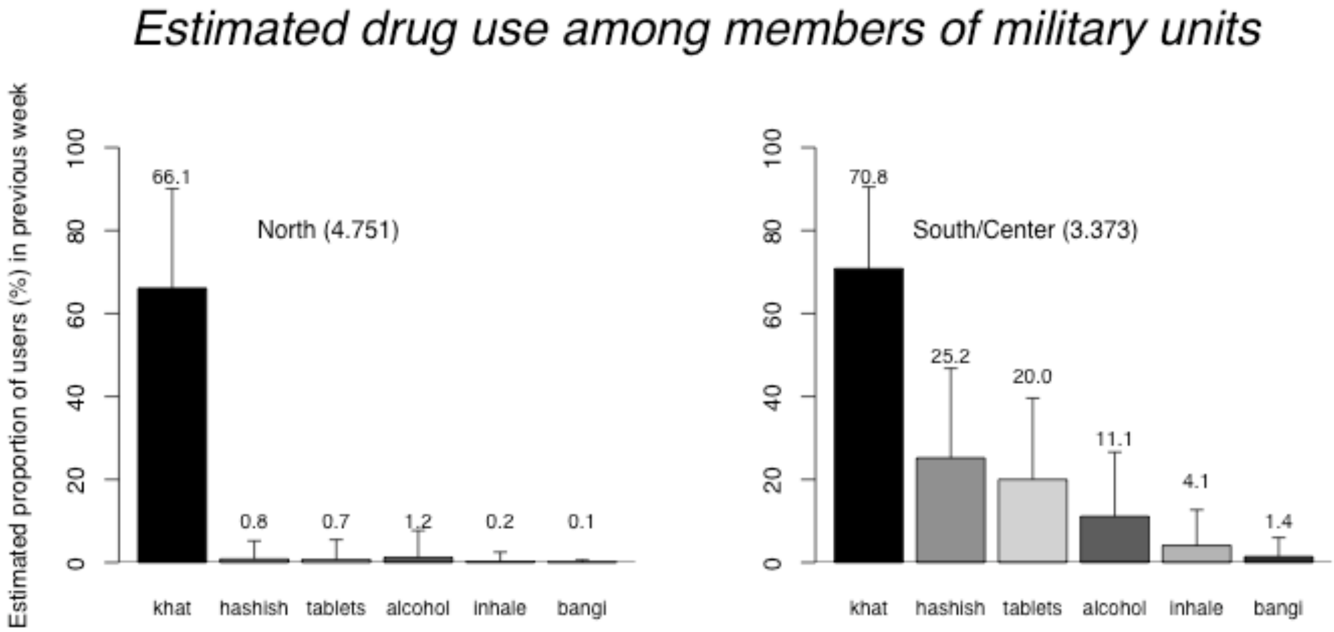
[1] Expected value (Standard Error of the Mean)
[2] Mean (Standard Deviation)
[3] One way ANOVA, df = 6

*Figure 6.1: Comparison of information on self-report information on drug use of 4,751 respondents in northern and 3.373 in southern/central Somalia. Left: Percentage of khat users (week before the interview) and proportion of respondents reporting signs of excessive use (> 2 bundles/day, > one sleepless night/week, chewing alone); error bars correspond to the Standard Error of the Mean. Right: Average of the quantity of khat (bundles) consumed by 1,248 users in the north and 1,707 in the south and number of sleepless nights due to khat chewing in the week prior to the interview; error bars correspond to Standard Deviations.*




The perceived proportion of alcohol drinkers correlates with the one of tablet users (r = 0.56) and inhalers (r = 0.50). The perceived proportion of bangi seed consumers is associated with the one of inhalers (r = 0.54).

*Figure 6.2: Respondents' perceptions of how many of their unit members consumed six types of drugs in the past week (percentages), in northern Somalia (Somaliland and Puntland) and central and southern Somalia (Hiran, Bay, Mogadishu and Kismaayo). We report Expected Values, error bars correspond to the pooled Standard Deviation.*




## 6.5 Discussion

Our assessment of 8,124 active armed forces and militia personnel in Somalia revealed that khat chewing is very frequent. While the prevalence based on self-report data goes up to 69% in one region of southern Somalia, we found an overall prevalence of 42%. However, the assessed behaviors associated with problematic khat chewing show that severe addiction has to be be expected in a substantial part of them: more than one sleepless night due to khat chewing in the last week has been reported by 52% and solitary consumption by 8%. Our results are in line with the observation that khat is the most frequently consumed psycho-active drug among the general population all over Somalia (Elmi, 1983). Nevertheless, other drugs are also consumed, especially hashish, psycho-active pills (like benzodiazepines), and alcohol. The regional differences of drug intake are remarkable: in southern Somalia we found a higher self-reported quantity of khat intake and the unanimous perception of higher consumption levels of all types of other drugs. The impression arises that the drug problems among militia members and other armed staff and in the south of Somalia exceed the level of the north - the contrary was found in the last epidemiological study (Elmi, 1983), which – however – relied on a sample of the general population. We speculate that drug abuse in southern Somalia might have also increased within the general population. This is supported by an increased drug production and trafficking in southern Somalia (UNODC, 2002), by the widespread availability of drugs in combination with high levels of unemployment, especially among the young, and by the overall trend in sub-Saharan Africa (UNODC, 1999).

There are manifold reasons that would explain why drug use among militia personnel in southern and central Somalia is higher than in the north. The different levels of state power and law enforcement are obvious and this is in line with the hypothesis that not-existing state power might be a risk factor for uncontrolled drug use. Missing state power might facilitate the unrestrained production, importation, distribution and consumption of drugs in southern and central Somalia. In the militia groups, drugs like hashish and benzodiazepines might be easily available and disciplinary consequences might be missing. Factors that facilitate the use by militiamen in southern and central Somalia are manifold. The Kenyan khat production areas are within the reach of small airplanes. There, the khat trade is firmly in the hands of Somali middlemen. It is well known that factions are involved in the khat business as means of income generation (Grosse-Kettler, 2004). Furthermore, factions the control airstrips and roads and might charge tolls in the form of a share of the transported khat. Some authors even speculate, based on observations in the field and anecdotal reports, that in some militia groups khat is part of the salary (Grosse-Kettler, 2004). Additionally, there are concerns that in the fertile regions of southern Somalia, notably the valleys of the Shabelle and Juba rivers, the plantation of marihuana is increasing (UNODC, 2002), leading to a higher availability on the local markets. These thoughts find some support by our finding that in Kismayo, the economic center next to the lower Juba valley, the highest levels of perceived hashish use were reported in militia units. Furthermore, drug use in the unstable southern and central regions might be influenced by the ongoing armed conflict, in the sense that militiamen who might be exposed to a high degree of violence might tend to use drugs as means of coping with it. This result is in line with studies on increased drug use by western ex-combatants who are either affected by Posttraumatic Stress Disorder (PTSD ; Brady et al., 2004) or were exposed to high levels of war-zone stress (Kulka et al., 1990).

In our study we find evidence that drug use in Somalia has not just changed quantitatively but also qualitatively: data on perceived drug use document the consumption of formerly not accepted or existing substances, like benzodiazepines or alcohol, and imply that the formerly unknown poly-drug use seems to exist in militia units; e.g. according to the estimates of our respondents, in units where bangi seeds are consumed, the probability is above 86% that all other drugs are consumed, too. Although we know the perceived peer alcohol use contains a bias towards overestimation (Kypri & Langley, 2003; Lewis & Neighbors, 2004; Perkins et al., 2005) and our findings need to be replicated by studies relying on self-report, clinical interviews and objective test methods, we think that our data strongly support the hypothesis that, in Somalia, a group of heavy abusers has developed who may suffer from severe forms of drug dependence and related problems (Bersani *et al.*, 2002; Blows *et al.*, 2005). Unsystematic observations during our field work in Somalia and published studies from neighboring Ethiopia, showing e.g. the combined use of khat and other drugs (Selassie & Gebre, 1996), support this hypothesis. This result calls for attention because of the related dangers for the reintegration of former combatants into civilian society (Fontana & Rosenheck, 2005; Rosenheck & Fontana, 1994) and the implications for future demobilization programs.

Like shown in western settings, data on self-reported drug consumption and perceived consumption do not match (Perkins et al., 2005). According to our experiences in a preparatory study (Odenwald et al., submitted), answer tendencies play a mayor role in self-reported khat use. The wording of the respective questions has an enormous effect on answers, e.g. asking directly, whether a respondent would chew khat, almost 100% of respondents answered ‘no’, which was in clear contrast to our daily observation with the same group of respondents. An indirect question style like employed in this study, however, produced answers with more face validity. Still, we believe that this way of self-report produces under-estimations of real figures. We observed that many respondents answered they had stopped chewing khat one week or one month ago and thus failed to report khat use in the week preceding the interview. Many respondents obviously had a strong wish to quit their khat consumption, which was contrasted by frequent relapses. On the other hand, we cannot rule out that social desirability played an important role in underreporting, especially because of the respondents' fear of denied program access, in case of drug intake. Especially self-reported khat use might have been affected by underreporting or non-reporting due to social desirability, in contrast to the perceived use by unit members. As opposed to such effects, one might argue over-sampling of drug using individuals in southern and central Somalia might have occurred. However, our strategy to interview one complete unit may have circumvented such effects. This is strengthened by the correspondence of both, coefficients on khat use prevalence based on self-report and on the perceived consumption within the units: both showed a small to moderate north-south difference in the same direction. In general, the prevalence of 42% self-reported khat intake might represent an under-estimation of real numbers. In a previous study in Northern Somalia, 60% of ex-combatants reported that they had used khat in the week before the interview (Odenwald et al., 2005).

Our study has some limitations. Because of the information policy of collaborating factions we do not know the actual number of armed personnel in the included units. But due to the fact that all unit members were ordered to see our interviewers and the low rate of drop out after being provided with information on the study and during the course of the interview (6.3%), due to large numbers, due to inclusion of all factions but one and because of the high motivation to participate in the assessment, we argue that we managed to achieve a representative sample. This is further strengthened by the substantial variation we have in our data showing that our sample isn't a highly selected homogeneous subgroup. Secondly, due to security reasons and other restrictions, we had no possibility to supervise and support interviewers on a daily basis during the assessment. In turn, the fact that several hundred respondents admitted that alcohol intake in their locality supports that they answered honestly. Still, the possibility that respondents under-reported actual drug consumption has to be considered. Another point of criticism might be our methods to quantitatively assess khat consumption. Numerous qualities of khat with different contents of psycho-active agents are known (Al-Motarreb *et al.*, 2002). Furthermore, studies showed that the 'miraa'-type khat which is consumed in southern Somalia has probably a higher cathinone content (Geisshusler & Brenneisen, 1987) than other khat-types. We argue, like other researchers (Mion & Oberti, 1998; Patel *et al.*, 2005), that the assessment of traded units is a viable compromise in absence of other quantitative methods applicable under field conditions.

Future research should, on the one hand, target the changes of drug intake patterns in Somalia, determine the actual prevalence and consequences of intake of different drugs. On the other hand also changes of underlying regulative social norms and protective mechanisms in society, like the traditional knowledge on the dangers of khat should be investigated. We fear that the alarmingly high increases of drug intake in other countries of Africa (UNODC, 1999) find their parallel among active Somali fighters and have already produced a drug problem of a formerly unknown quality to this country - at least in some geographical parts and social groups. A future demobilization program should be prepared to meet this challenge (Mogapi, 2004). The fact that many of the unit members are former child soldiers and have probably been exposed to combat and drugs during adolescence warrants additional attention because they might be especially affected by Posttraumatic Stress Disorder and other psychiatric disorders (Odenwald et al., 2005). In the field of therapy of addiction, much research was done in western countries, but it is unclear to what extent measures and therapeutic programs can be transferred to settings like Somalia (Saraceno & Barbui, 1997). Rather, research has to be undertaken in order to develop adequate tools, incorporating the relevant cultural and religious aspects as well as the mental health status in the population. In the specific case of khat, prohibition, like it was attempted in the past (Elmi *et al.*, 1987), is not a feasible solution as recreational khat use is deeply rooted in the local culture. We suggest that regulation mechanisms inherent to the Somali culture have to be strengthened and awareness of the dangers to the consumers' health has to be raised.

7. **Can khat chewing become a key factor for the development of long-lasting psychotic disorders like schizophrenia?**

A proposed answer is outlined below. In my point of view, under certain conditions khat use can actually *cause* schizophrenia.

Psychotic disorders of the schizophrenia spectrum may develop in two ways: the first considers psychosis as a consequence of genetic vulnerability and the effects of environmental stressors, e.g. stimulant use and/or traumatic stress, that might serve as triggering events (Norman & Malla, 1993). For genetically vulnerable individuals, relatively small doses of khat might be sufficient to trigger psychotic symptoms, in contrast to most users who report no such effects at normal consumption levels. In this mode, khat is rather the *trigger* than the *cause* of schizophrenia.

A second mode considers ‘acquired vulnerability’ or the ‘two hit’ model of schizophrenia (Impagnatiello *et al.*, 1998). In this second mode, khat can be considered the *cause* of schizophrenia. With cause, I mean, that khat contributes to the acquisition of *vulnerability* for schizophrenia *and*, at a later stage, it serves as a *trigger* for the behavioral expression of this vulnerability. Under certain conditons, especially at a very young age when the developing brain is sensitive to drug effects (Koch, 2000; Lipska & Weinberger, 2003), chronic khat use alone or in combination with other factors (e.g. stress) might induce long-lasting neuro-physiological changes (‘first hit’), which affect the regulation of the dopaminergic systems and lead to a dopaminergic hyperresponsiveness to certain stimuli (e.g. stimulant drugs or stress), similar to what is known about amphetamin-induced ’behavioral sensitization’ (Kalivas & Stewart, 1991). These changes correspond to an acquired sensitization of dopamingeric mesolimbic projections; ‘endogenous sensitization’ of this system was seen as the neurophysiological substrate of vulnerability for schizophrenia (Laruelle, 2003). I propose that several consecutive processes are responsible for these neurophysiological changes and their deleterious behavioral consequences: the early onset of khat use in life, tolerance development *and* sensitization to psychotomimetic effects (see outlined below). After the sensitization stage is reached, i.e. vulnerability has been acquired, the final step to schizophrenia ('second hit') comprises frequent relapses of khat-induced psychotic episodes upon continued khat intake or when exposed to stress (Yui et al., 2002) until a clinically relevant symptom level is maintained independent of khat use.

## Four steps of how khat chewing causes schizophrenia

### *Early onset of khat chewing*

The onset of khat abuse at a very young age, i.e. before brain maturation has ended, comprises the first step of the acquisition of vulnerability for schizophrenia. As outlined above, the immature brain seems to be especially vulnerable to the exposure of drugs (Koch, 2000; Lipska & Weinberger, 2003; Schneider *et al.*, 2004). This hypothesis is further supported by the findings that drug use among later schizophrenic patients starts early in life (Hambrecht & Hafner, 1996; Odenwald *et al.*, 2005), or even increases the risk for the development of this disorder (Henquet *et al.*, 2005; Zammit et al., 2002). At the Horn of Africa the exposure to khat can start very early in life, e.g. in the breast milk of lactating mothers (Eriksson *et al.*, 1991) or because the traditional regulating mechanisms disappear leading to an onset of consumption in late childhood and early adolescence (Odenwald, in press). Thus, in this region, we find an unique situation concerning the early exposure to central stimulants in life.

### *Increase of the consumed quantity*

Under certain conditions, the khat user learns to effectively mastigate higher and higher quantities of khat leaves, and will be at risk to develop tolerance and a 'binge'-like consumption pattern. One of these conditions could be the existence of stress-related psychiatric symptoms, including posttraumatic stress symptoms, when the individual is motivated for self-medication. A large number of laboratory studies showed that exposure to stress and increased levels of glucocorticoids lead to more frequent self-administration of stimulants (Koob & Le Moal, 2005). This hypothesis is supported by the results presented above that respondents with partial PTSD consumed higher quantities of khat (see Chapter 6) and that individuals with PTSD spend more time in khat sessions (see Chapter 5). In this context, withdrawal symptoms, intense dysphoria after the end of a chewing session and the development of psychological dependence including 'craving' further motivate them to continue to use khat (see Chapter 1 for the the discussion on the existence of khat-related withdrawal and tolerance). The dynamic of this vicious circle leads to the consumption of increased amounts of khat and can explain why we observed astonishingly high khat use in some individuals. In another study, I will show that a quarter of khat users with partial Posttraumatic Stress Disorder (pPTSD) consumed more than 24 bundles in the week before our interviews (Odenwald *et al.*, in prep.). Tolerance development might be a key factor why some severely addicted khat users show a binge-like consumption pattern that resembles the 'speed runs' of amphetamine addicts, i.e. to chew several days in a row and finally to cut down the stimulation with benzodiazepins.

### *Sensitization of psychotomimentic effects of khat*

The triggering of psychotic symptoms can be understood as a function of both the dose of amphetamine over time and the individual vulnerability (George F. Koop, personal communication, 2006). Amphetamine-related psychotic symptoms can either be induced through the consumption of single high doses or through a 'slow burn', i.e. the consumption of low amounts over a prolonged period of time (Koob & Le Moal, 2005; Machiyama, 1992). This is important, as the dose of cathinone, which can be consumed by a trained user, is still much lower than doses of injected or orally administered amphetamine. In khat-related 'slow burn', a high blood level of cathinone is maintained, e.g. by continuous chewing over several days in a row. This is in line with results on psychotic symptoms being more frequent in the group of those respondents who consumed the largest quantity of khat in the week before the interview (Odenwald et al., in prep.; Patel et al., 2005). Sensitization will continuously lower the threshold for cathinone to elicit psychotic symptoms similar to what is known for amphetamine (Kalivas & Stewart, 1991; Koob & Le Moal, 2005). This process will lead to psychotic symptoms with increasingly lower amounts of cathinone, a process similar to what has been reported for relapse in methamphetamine psychosis (Yui et al., 2002). Thus, I propose that once a subject has already experienced khat-induced psychotic symptoms, they tend to reoccur at lower khat doses than previously.

### *Chronic khat-induced symptoms become a schizophrenia-like disorder*

After a sensititization for the psychotomiomentic effects of khat has been reached, psychotic symptoms will be induced at continuously lower levels of khat. The clinical picture will continuously become worse and and worse and symptoms will need more time to remit after cessation. In this period, psychotic states will reach the severity of a clinical disorder. Upon continued khat intake and with increasing number of such episodes the severity of such episodes will increase and the impairment of every-day functioning level will become worse. Repeated episodes of clinically relevant khat-induced psychosis are merely the exception but the rule among this group of patients, as illustrated in the review above (Chapter 2). Frequent or long-lasting episodes of khat-induced psychotic symptoms might finally lead to a condition of incomplete remission over longer periods. Continued khat intake or exposure to stress at this stage will *trigger* a long-lasting psychotic disorder independend of any further khat use, i.e. what has previously been a khat-induced psychotic disorder becomes a disorder of the schizophrenia spectrum like it has been shown for severe amphetamine users (Flaum & Schultz, 1996; Machiyama, 1992; Sato et al., 1992). This is supported by the Japanese experience during the epidemia of methamphetamine use after 1945 when a large number of patients developed long-lasting psychotic disorders independent of the drug (Sato et al., 1992).

## The influence of the specific Somali context

The specific social and cultural context in Somalia might facilitate the transition from temporary khat-induced psychotic states to chronic psychotic disorders. There are various reasons why the consumption of the drug might be maintained despite of the presence of psychotic symptoms.

First, many traditional healers in Somalia ‘prescribe’ khat to alleviate psychotic symptoms, based on beliefs of spirit possession. In this framework, acute psychotic symptoms like grandiose and bizarre delusions, agitation, thought and speech incoherence are attributed to the presence of a supernatural being taking over the command of the patient's body. In order to soothe the spirit and prevent further harm to the patient, the family is adviced to offer khat to him.

Secondly, interpersonal dynamic in the families often leads to poor treatment compliance and objection to health advices. In the Somali clan system, the 'jilib' is a unit of several closely related families, who assume responsibility for the social conduct of each of its members. In case a relative kills a member of another 'jilib' they have to pay the blood price. Individuals who develop a psychotic episode often face drastic preventive measures from their relatives, who are afraid of misbehavior and, thus, compensation payment. Evidence on behavioral consequences of amphetamines confirms the potential to promote aggressive outbreaks related to paranoid delusions (Ellinwood, 1971). Moreover, aggression is also considered a typical symptom of a psychosis related to amphetamine withdrawal (Askevold, 1959, cited after Koob & Le Moal, 2005). This may be true for khat-induced psychotic states as well (see Chapter 2, Alem & Shibre, 1997). A very recent laboratory study confirmed the many anecdotal reports that excessive khat use is related to aggression (Banjaw et al., 2005). The most frequent preventive measure employed by Somali 'jilibs' is the chaining of the psychotic person against his will at home until the symptoms remit, as shown in our household survey (Chapter 3). These measures, in turn, lead to a high risk to continue khat chewing. Chaining a relative usually causes a lot of aggression, mistrust and arguments within families. As soon as patients are freed from their chains they run away. In town, they will meet khat sellers and chewers everywhere and khat can be easily obtained – especially during collective ‘ijabane’ chews. In addition, being chained against one’s own will doubtlessly lead to stigmatization. The drug might offer a cheap escape from this unbearable situation. Furthermore, the patient finds social contacts and support within the group of other heavily addicted khat chewers.

## Hypotheses derived from this model

From this model, a number of testable hypotheses can be derived for future research:

- The prevalence of disorders of the schizophrenia spectrum is increased in the general population of Somalia compared to other countries, especially among men, who engage more in excessive khat chewing than women. First evidence in favor of this hypothesis was reported in Chapter 3; however, it needs to be confirmed by larger epidemiological studies.
- Age of onset of khat use and lifetime excessiveness of khat abuse are risk factors for schizophrenic disorders. The risk to develop a disorder of the schizophrenia spectrum increases as a function of the number of previous khat-induced psychotic episodes of clinical relevance and of the duration of previous khat-induced psychotic symptoms. Khat use among schizophrenic patients can lead to symptom exacerbation or relapse.
- There are several subgroups of patients with schizophrenia-like symptoms in Somalia: those with schizophrenia-spectrum disorders as such, those with transient khat-induced psychotic states, which will remit fast upon cessation, and finally those who have developed a chronic state with incomplete remission of khat-induced psychotic symptoms. They can be separated by repeated assessments of the remission of symptoms, e.g. in a treatment study in the Somali community, by prospective or

retrospective assessments of their khat abuse and psychiatric histories or by studying genetic factors.

- Subjects with previous khat-induced psychotic states of clinical relevance need less khat to induce another subsequent episode (sensitization). This can be studied in animal models but also using drug screening upon admission to psychiatric wards in hospitals, where the same patients are re-admitted for many consecutive times due to khat-induced psychotic states.
- The remission from a khat-induced psychotic state depends on the number of previous psychotic episodes. Patients with more episodes will need a longer period of abstinence to fully remit. Besides animal models, the hospital setting in Somalia would allow to prospectively study this hypothesis.
- In the Somali community, physical restriction as means of management of psychotic disorders leads to continued khat abuse by the patients and poorer long-term outcome of psychotic disorders in comparison to other ways of management. This can be studied in a longitudinal assessment in the course of a randomized controlled trial in the community (treatment as usual, i.e. physical restriction, vs. psychoeducation with neuroleptic therapy) or by experimental variation of physical restriction.
- Posttraumatic Stress Disorder leads to the consumption of higher quantities of khat because the drug is used for self-medication of numbing and re-experiencing symptoms. This hypothesis has found first support in the study reported in Chapter 5.
- Khat users can train themselves to consume large quantities of the drug. This is on the one hand achieved through a more and more efficient oral extraction of cathinone as well as through increasing time spent for khat chewing (‘binge’). This occurs in a

subgroup of khat users, in the course of the development of severe addiction and, especially, tolerance development. This hypothesis can be tested in cross-sectional studies of khat users assessing retrospectively their abuse history, in longitudinal studies with khat users or in animal studies in the laboratory.

# 8. Summary and conclusions

The production and consumption of khat leaves, a traditional stimulant drug originating from the countries around the Horn of Africa and the Arab Peninsula, has been growing enormously during the last century, especially fast after 1970. Since then, modern means of transport were available for the distribution of the perishable good to markets outside the regions of its production. Today, khat is an important cash crop and economic factor for several national economies. Millions of people economically depend on khat. At the same time, the understanding of newly developed consumption patterns, distinct from the former traditional use, and their health consequences are neither well studied nor understood.

In Chapter 2 I reviewed and critically discussed the currently available literature concerning the association between khat use and psychosis. My main point is that most studies had severe methodological shortcomings and did not address the most important research questions, e.g. the direction of relationship remains unclear in the studies showing an association between khat use and psychiatric symptoms. On the other hand, there is sufficient evidence to say that excessive khat use can induce short-lived psychotic states, which remit normally within two weeks upon cessation. Whether khat use is in any way related to schizophrenia spectrum disorders, e.g. by exacerbating symptoms, triggering single episodes or increasing the vulnerability, has not been topic of any scientific study.

In Chapter 3, I describe a study targeting this very issue, whether khat use is somehow related to schizophrenia spectrum disorders. In a cross-sectional household survey in Hargeisa, the capital of Somaliland (North-Western Somalia) we identified 169 cases with long-lasting functioning impairment due to mental disorders among our sample of 4.854 subjects. The prevalence of this condition was highest among the former combatants (5% of the total sample), with about 16%, compared to civilian war survivors (8%) and others without any war experiences (3%). We randomly selected 54 of these cases, assessed their mental health using a structured clinical interview and compared them to healthy matched controls. Our results show that 83% (43) of these cases suffered from a long-lasting psychotic disorder of the schizophrenia spectrum. The rest of them was diagnosed with stroke, traumatic brain injury, dementia and mental retardation; only one person showed no diagnosable disorder. In a following case-control study with the 43 psychotic patients we found that their khat use at the time of psychosis onset was significantly higher than the consumption of the matched controls at the same age. Excessive khat use preceded the onset of the disorder in 78% of the psychotic cases in comparison to 4% at the same age among the controls. Additionally, psychotic patients had started to use khat four years earlier in their lives as the healthy controls, on mean at the age of 17. Based on these results we concluded that early onset and excessive use of khat might be risk factors for the development of psychotic disorders of the schizophrenia spectrum.

In Chapter 4, I report a case study of one patient with a long-lasting psychotic disorder and a comorbid khat abuse. His symptoms worsened while he, in parallel, increased his khat intake; in the course of deterioration of paranoid delusions he finally committed a murder and was imprisoned. This case probably illustrates the most neglected side of the psychiatric problems related to khat: this is *not* the striking picture of a khat-induced psychosis but the often silent effect of khat chewing on pre-existing disorders. This aspect of khat chewing has never been addressed by a scientific study.

This case study also provides insight into the local juridical practice: while he was imprisoned for three months no psychiatric evaluation had taken place nor treatment was considered. He was treated as a normal prisoner as if there was no psychiatric condition involved.

In Chapter 5, I report a study, which aimed at the development of a reliable and valid psycho-diagnostic instrument to assess Posttraumatic Stress Disorder (PTSD) in Somali language and which can be applied by trained, local interviewers. In an intensive translation and adaption process we developed a Somali version of the Posttraumatic Stress Diagnostic Scale (Foa, 1995), which showed good reliability and validity in a sample of 135 randomly chosen ex-combatants. We found that ex-combatants with PTSD reported a longer average duration of khat sessions in the previous week. They also exhibited more frequently productive psychotic symptoms. Important in this context, we confirmed our previous hypothesis that attempts to self-medicate posttraumatic symptoms promote khat use and might – in this way - contribute to the development of khat-induced psychotic symptoms.

The previously reported work served as preparatory study for a large epidemiological assessment of more than 8.000 active and former combatants in Somalia, as described in Chapter 6. This study was conducted in the context of a preparatory project for an international disarmament, demobilization and reintegration program. With the help of the previously validated items, we found that drug use patterns markedly differed between northern and southern Somalia: the one-week prevalence as well as the amount of khat use and the estimated use of five other drugs (hashish, psychoactive tablets, alcohol, solvents and hemp seeds) were clearly higher in southern Somalia. This study clearly illustrates that the reintegration of former combatants will be a challenge in Somalia, as a large number of participants will have drug-related problems.

In Chapter 7, I presented a model for the assumed relationship between khat use and schizophrenia spectrum disorders which is based on the findings reported above. The new thing in this model is the claim that khat use can *cause* schizophrenia. Central in this model are two consecutive processes: the increase of khat consumption and the development of acquired vulnerability to schizophrenia through multiple khat-induced psychotic states. Schizophrenia as such can be triggered through continuous khat use after this stage has been reached. This model can be used for future studies in order to be more focussed on the very important open questions.

In the five studies I presented, different aspects of the interaction between khat use and psychiatric disorders as well as the broader economic and societal context were elaborated. Although these studies only represent a small step towards a complete understanding of the whole picture, some conclusions can be derived from this work:

1. The reported findings showed that khat use is widely prevalent in nowadays Somalia. In the cross-sectional study (Chapter 3) it was confirmed that in the week before the interview 31% of male adolescents and adults had chewed khat. The highest level (60%) was found in the group of ex-combatants. The average khat chewer in Hargeisa spent approx. 1 US$ per day on khat. This figure is intriguing in a country where the national GNP per capita reached in 2001 only 200 US$ (UNDP, 2001a). Thus, khat chewing must be seen as an important economic factor in the development of Somalia.

2. The findings confirm that khat and drug use patterns in Somalia have changed profoundly, as current use does not correspond to the traditional use. We found a higher khat quantity per individual chewer, more frequent sessions, longer session and the parallel consumption of other drugs. Furthermore, we found that users start early in life without a formal initiation. Today, khat use has probably new functions beyond the traditional ones, i.e. because of recreational, religious, medical and alterness-related reasons. In Somalia, among these new functions is self-medication of psychiatric symptoms. Elsewhere in East Africa, a new youth culture emerged in which khat chewing is considered to be cool (Carrier, 2005).
3. Especially in southern Somalia, where khat was in the beginning of the 80ies a smaller problem compared to the north of the country (Elmi, 1983), the situation might have changed. Our data are in favor with the hypothesis that the consumption of different drugs, including khat, is today a larger problem in the southern part of the country than in the northern part. The finding that cannabis was used most intensively in the study sites that are close to the fertile river beds of the Shabelle and Juba river, is in line with speculations that nowadays cannabis might be produced on the land of the former banana plantations in this region.
4. Khat use is related to posttraumatic stress, and our findings are in line with the theory of self-medication, i.e. khat is used to ameliorate typical numbing symptoms and suppress trauma-related memories (Breslau *et al.*, 1995; Chilcoat & Breslau, 1998), as well as with the hypothesis that khat use acts as a risk factor for the exposure to traumatic events (Brady *et al.*, 2004). This is of special importance in a

country where large parts of the population has been exposed to the violence of war.

5. Khat use is associated in many ways with the development and course of psychotic disorders, but a simple causal relationship cannot be established. Our data are in line with the hypothesis that excessive use and early onset in life are risk factors for the development of psychotic disorders. On the other hand, khat use also leads to a more severe course of psychotic disorders as illustrated by the case report who committed a murder in a paranoid state.
6. It is necessary to further addresss khat in scientific studies, as many important open questions related to the development of the past decades remain open. This should be of concern for many different disciplines, from economics to medicine. Especially the relationship between khat use and psychotic disorders urgently needs to be further studied and better understood because it might have enormous implications for the public health and the general development of the country.

# 9. Zusammenfassung und Schlussfolgerungen

Im Laufe des vergangenen Jahrhunderts gab es einen enormen Anstieg der Produktion und des Konsums von Khatblättern, einem traditionallen Rauschmittel, das hauptsächlich in den Ländern um das Horn von Afrika und der Arabischen Halbinsel bekannt ist. Diese Veränderungen fanden insbesondere nach 1970 statt, nachdem zunehmend moderne Transportmittel eingesetzt wurden, um internationale Märkte mit dem leicht verderblichen Produkt zu beliefern. Für einige Volkswirtschaften ist Khat heute ein wichtiger Devisenbringer und Wirtschaftsfaktor, und Millionen Menschen sind ökonomisch davon abhängig. Die im Zuge dieser Entwicklung entstandenen Konsummuster, die sich stark von traditionellem Konsum unterscheiden, als auch deren Gesundheitsfolgen sind schlecht untersucht und noch nicht verstanden.

Warum die Untersuchung des Khatkonsum und seiner Folgen gerechtfertigt ist, wurde in der Einleitung dargestellt. Im Übersichtsartikel in Kapitel 2 wurde die gegenwärtig verfügbare Literatur, die sich mit dem Zusammenhang zwischen Khat und psychotischen Störungen befasst, dargestellt und kritisch diskutiert. Hauptaussage ist dabei, dass die meisten Studien methodische Probleme hatten und die wichtigsten Forschungsfragen noch gar nicht bearbeitet wurden. Beispielsweise blieb die Richtung des Zusammenhangs zwischen Khatkonsum und psychischen Störungen unklar. Jedoch gibt es auch klare Ergebnisse, z.B. dass exzessiver Khatkonsum kurzdauernde psychotische Störungen auslösen kann, die bei Abstinenz normalerweise innerhalb von zwei Wochen remittieren. Es wurde allerdings noch nie untersucht, ob und inwieweit Khatkonsum und Störungen aus dem Schizophreniespektrum interagieren, z.B. ob es zu einer Symptomverschlechterung kommen kann, ob einzelene Episoden ausgelöst werden können oder ob gar die Vulnerabilität dadurch erhöht werden kann.

In Kapitel 3 beschreibe ich eine Studie, die genau das zum Ziel hatte, ob nämlich Khatkonsum und Störungen aus dem Schizophreniespektrum irgendwie miteinander verbunden sind. In einer repräsentativen Stichprobe von 4.854 Personen in Hargeisa, der Hauptstadt Somalilands (Nordwest Somalia), konnten wir 169 Fälle mit langdauernden Funktionsproblemen aufgrund von psychischen Störungen identifizieren. Die Prävalenz dieser Funktionsprobleme war mit 16% am höchsten unter ehemaligen Kombattanten (5% der Gesamtstichprobe) im Vergleich zu zivilen Bürgerkriegsüberlebenden (8%) und Personen ohne jegliche Kriegserfahrung (3%). Aus allen Fällen wurden 54 zufällig ausgewählt und einem zweiten, klinischen Interview zur Diagnose ihrer psychischen Störungen unterzogen. Unsere Ergebnisse zeigen, dass 83% (43) von ihnen eine langdauernde psychotische Störung aus dem Schizophreniespektrum hatten. Der Rest hatte entweder einen Schlaganfall oder ein Schädel-Hirn-Trauma erlitten, war an einer Demenz erkrankt oder litt an geistiger Behinderung; es gab nur eine einzige Person ohne eine diagnostizierbare Störung. In einer sich anschließenden Fall-Kontrollstudie mit den 43 psychotischen Patienten konnten wir zeigen, dass deren Khatkonsum zur Zeit des Störungsausbruchs signifikant erhöht war. In 78% der Fälle ging exzessiver Khatgebrauch dem Beginn der Psychose voraus. Im Vergleich dazu hatten 4% der Kontrollpersonen im gleichen Alter exzessiv Khat konsumierten. Außerdem hatten psychotische Patienten den Khatkonsum im Durchschnitt vier Jahre früher begonnen, nämlich durchschnittlich im Alter von 17. Aufgrund dieser Ergebnisse schlossen wir, dass ein früher Beginn des Khatkonsums im Jugendalter und der exzessive Gebrauch Risikofaktoren für die Entwicklung einer Störung aus dem Schizophreniespektrum sein könnten.

In Kapitel 4 berichtete ich den Fall eines Patienten mit einer langandauernden psychotischen Störung und komorbidem Khatkonsum. Während er seinen Khatkonsum erhöhte, wurde er zusehends paranoider. Schließlich beging er einen Mord im Zuge der fortschreitenden paranoiden Wahnentwicklung. Dieser Fall zeigt eine vernachlässigte Seite der Khatproblematik: die Auswirkung des Khatkonsums auf vorbestehende psychiatrische Störungen. Dieser Aspekt wurde bislang nicht in wissenschaftlichen Studien thematisiert. Dieser Fall erlaubt außerdem einen Einblick in die lokale Praxis der Rechtsprechung und des Strafvollzugs: Während der gesamten Haft wurde keine psychiatrische Begutachtung oder Behandlung in die Wege geleitet. Der Patient wurde im Verfahren und in der Haft so behandelt als sei keine psychiatrische Störung vorhanden.

In Kapitel 5 wurde die Entwicklung eines reliablen und validen psychodiagnostischen Instruments für die Erhebung der Posttraumatischen Belastungsstörung (PTSD) in somalischer Sprache vorgestellt, das speziell von trainierten lokalen Interviewern angewendet werden kann. In einem Übersetzungs- und Anpassungsprozess wurde die somalische Version der Posttrautmatic Diagnostic Scale (Foa, 1995) entwickelt. An einer randomisierten Stichprobe von 135 ehemaligen Kombattanten wurde dieses Instrument gestestet und erreichte dabei gute Realibilitäts- und Validitätskennwerte. Außerdem zeigte ich in dieser Studie, dass Ex-Kombatanten mit PTSD in der vorangegangenen Woche länger Khat konsumiert hatten. Sie waren außerdem häufiger von produktiv-psychotischen Symptomen betroffen. Wir konnten damit unsere Hypothese unterstützen, dass Selbstmedikationsversuche von posttraumatischen Symptomen mit Khat zur Entwicklung von khat-induzierten psychotischen Symptomen beitragen können.

Die in Kapitel 5 berichtete Studie diente zur Vorbereitung einer großen epidemiologischen Erhebung von mehr als 8.000 aktiven und ehemaligen Kombatanten in ganz Somalia, die in Kapitel 6 beschrieben wird. Diese Studie wurde im Rahmen der Vorbereitung auf ein internationales Entwaffnungs-, Demobilisierungs- und Reintegrationsprojekt durchgeführt. Mit den validierten Items konnten wir zeigen, dass sich die Drogenkonsummuster zwischen den Norden und dem Süden Somalias deutlich unterscheiden. Die Einwochenprävalenz von Khatkonsum, die individuell konsumierte Menge und der in der eigenen Einheit wahrgenommene Gebrauch fünf anderer Drogen (Cannabis, Psychopharmaka, Alkohol, Lösungsmittel und Hanfsamen) waren klar höher in Südsomalia. Diese Studie zeigt, dass die Reintegration ehemaliger Kombatanten in Somalia eine Herausforderung sein wird, weil viele von ihnen Drogenprobleme haben.

In Kapitel 7 stellte ich ein Modell für den Zusammenhang zwischen Khatkonsum und Störungen des Schizophreniespektrums vor, das auf den zuvor dargestellten Ergebnissen meiner Forschungen fußt. Ich postuliere, dass Khatgebrauch Schizophrenie *verursachen* kann. Dabei sind drei aufeinander folgende Prozesse von zentraler Bedeutung: der frühe Beginn des Konsums, die Steigerung der individuell konsumierten Khatmenge und das *Erwerben* einer Vulnerabilität für Schizophrenie durch wiederholte khatinduzierte, psychotische Zustände. Die Schizophrenie selbst kann durch fortgesetzten Khatgebrauch ausgelöst werden, wenn dieses Stadium erst erreicht ist. Mit diesem Modell will ich dazu beizutragen, dass zukünftige Forschungsarbeiten in diesem Bereich besser als bisher auf die wichtigen noch offenen Fragen eingehen.

Diese Studien stellen zwar nur einen kleinen Schritt hinsichtlich des angestrebten umfassenden Erkenntnisgewinns dar, doch erlauben sie einige Schlussfolgerungen:

1. Im heutigen Somalia ist Khatkonsum weit verbeitet. Im Laufe einer Woche hatten 31% der männlichen Jugendlichen und Erwachsenen Khat gekaut, wobei die Gruppe der Exkombattanten mit 60% die höchsten Werte erreichte. Der durchschnittliche Khatkonsument in Hargeisa gibt demzufolge pro Tag etwa 1 US$ für die Droge aus - eine erschreckend hohe Zahl in einem Land, das im Jahr 2001 ein Bruttosozialprodukt von 200 US$ pro Kopf hatte (UNDP, 2001). Khatkonsum muss daher als ein wichtiger ökonomischer Faktor für die ganze Entwicklung des Landes gesehen werden.
2. Die Ergebnisse bestätigen, dass sich Khat- und Drogenkonsummuster in Somalia tiefgreifend verändert haben, weil gegenwärtige Konsummuster klar von traditionellem Gebrauch abweichen. Wir fanden größere individuell konsumierte Mengen, häufigere und längere Sessionen und die komorbide Einnahme von anderen Drogen. Außerdem beginnt der Khatkonsum sehr früh im Leben. Während Khatkonsum im traditionellen Setting mit der Suche nach Erholung, religiösen, medizinischen Gründen oder Aufmerksamkeitssteigerung in Zusammenhang gebracht wurde, gibt es heute wahrscheinlich neue Funktionen. Darunter fällt in Somalia auch die Selbstmedikation psychiatrischer Symptome; an anderen Orten Ostafrikas entstand eine Jugendkulur, in der Khatkonsum als *cool* gilt.
3. Besonders im Süden Somalias, wo Khat Anfang der 80er Jahre im Vergleich zum Norden ein marginales Problem war (Elmi, 1983), hat sich die Situation drastisch verändert. Unsere Daten stützen die Hypothese, dass der Konsum verschiedener

Drogen, einschließlich Khat, heute im Süden ein größeres Problem ist als im Norden. Das Ergebnis, dass Cannabis am intensivsten in den Untersuchungsorten konsumiert wurde, die in der Nähe der fruchtbaren Flußtäler des Shabelle und Juba lagen, deckt sich mit Spekulationen, dass auf dem Land der noch aus Kolonialzeiten stammenden Bananenplantagen heute auch Cannabis angebaut wird.

4. Khatkonsum tritt häufig bei posttraumatischem Stress auf, und unsere Ergebnisse stützen sowohl die Selbstmedikationstheorie, d.h. dass Khat eingenommen wird, um die typischen emotionalen Taubheitsgefühle abzumildern (Breslau *et al.*, 1995; Chilcoat & Breslau, 1998), als auch die Hypothese, dass Khatkonsum ein Risikofaktor für das Erleben eines Traumas ist (Brady *et al.*, 2004). Das ist von besonderer Bedeutung in einem Land, in dem große Bevölkerungsteile Krieg und Gewalt erlebt haben.
5. Khatkonsum ist in vielerlei Hinsicht mit der Entwicklung und dem Verlauf von psychotischen Störungen verbunden, wenngleich eine simple Kausalbeziehung nicht nachgewiesen werden kann. Unsere Daten stützen die Hypothese, dass exzessiver Konsum und früher Beginn im Leben Risikofaktoren für die Entwicklung einer psychotischen Störung sind. Außerdem führt Khatkonsum auch zu einem ungünstigen Verlauf von psychotischen Störungen.
6. Khat muss in weiteren wissenschaftlichen Studien untersucht werden, weil viele der wichtigen Fragen, die aus den Entwicklungen der letzten Jahrzehnte resultieren, noch offen bleiben. Das gilt für verschiedene wissenschaftliche Disziplinen, von Wirtschaftswissenschaften zu Medizin. Besonders der Zusammenhang zwischen Khatkonsum und psychotischen Störungen muss dringend weiter untersucht und

besser verstanden werden, weil sich hieraus nicht nur bedeutsame Implikationen für den Gesundheitssektor sondern auch für die Gesamtentwicklung des Landes ergeben.

# 10. Author's Contribution

## Chapter 2, Review Article:

Published in Sucht, Dec. 2006

MO was the only author.

The author expresses his appreciation to Peter Hansen, Danish Institute for Development Studies (DIIS), and to Elisabeth Schauer, Victims' Voice Foundation (VIVO), who provided useful comments on an earlier draft ofthe manuscript.

## Chapter 3, Cross-Sectional Study:

Published in BMC Medicine, Feb. 2005

Co-authors: Neuner, F., Schauer, M., Elbert, T., Catani, C., Lingenfelder, B., Hinkel, H., Häfner, H. & Rockstroh, B.

Development of the study design and selection of instruments were accomplished by MO, FN, TE, MS, BR and HeH. MS, TE and MO performed pilot studies. Training and supervision of local interviewers was provided by MO, HaH, FN and BL. Clinical interviews were conducted by MO, MS, CC and BL. Statistical analysis was performed by MO and TE. The article was composed and revised by MO, TE, BR, FN and HeH.

We would like to thank Mrs. Christine Klaschik, University of Konstanz, and Dr. Rebecca Horn, Jesuit Relief Service, for their participation in the data collection and training of the interviewers. The first author espresses deep gratitude towards Zeinab Aden, Helga Scholl, Rashiid Brown Shomari, Mesfin Tesmegen and Mustafa Abdi from GTZ IS for their help to implement the research project.

The study was supported by the Deutsche Forschungsgemeinschaft (DFG) and the German Technical Cooperation (GTZ).

## Chapter 4, Case-Report:

Submitted to BMC Psychiatry

MO was the only author.

The author would like to thank Dr. Hans Watzl, Dr. Frank Neuner and Dr. Thomas Elbert from Konstanz University and Mr. Tilman Kluttig, Center for Psychiatry Reichenau, for their useful comments on this manuscript and its previous versions. I also would like to express my gratitude to Dr. Adam Giama who assisted with the interviews, to Birke

Lingenfelder and Dr. Wolfgang Peschel for their help to maintain the contact to the patient and to Dr. Maik Schluroff who helped me to improve the language of the manuscript.

## Chapter 5, Development of the Somali PDS:

Submitted to Journal of Traumatic Stress
MO was responsible for: Development of the study design and selection of instruments, training and supervision of local interviewers, conducting clinical interviews, performing the statistical analysis, composition and revision of the article.
Co-authors: Lingenfelder, B., Schauer, M., Neuner, F., Rockstroh, B., Hinkel, H. & Elbert. T.
The authors express gratitude towards Brigitt Hotz, Zeinab Aden, Helga Scholl, Rashiid Brown Shomari, Mesfin Tesmegen and Mustafa Abdi from GTZ IS for their help to implement the research project.

## Chapter 6, Drug Abuse among Somali Combatants:

Submitted to PLOS Medicine
MO was responsible for: Development of the study design and development of instruments, performing a pilot study, training of local interviewers, supporting the data entry, performing the statistical analysis, composition and revision of the article.
Co-authors: Hinkel, H., Schauer, E., Neuner, F., Schauer, M., Elbert, T. & Rockstroh, B.
The authors would like to thanks Brigitt Hotz, Zeinab Aden, Helga Scholl, Rashiid Brown Shomari, Mesfin Tesmegen and Mustafa Abdi from GTZ IS for their help to implement the research project.

# 11. Own publications

## Journal articles, book chapters, books, reports

Odenwald, M., Schauer, M., Neuner, F., Lingenfelder, B., Horn, R., Catani, C.et al. (2002). *War-trauma, khat abuse and psychosis: Mental health in the demobilization and reintegration program Somaliland*. Nairobi: German Technical Cooperation International Services (GTZ IS). pdf: http://www.delken.cec.eu.int/en/publications/war%20trauma%20khat%20and%20psychosis%20vivo%20report.pdf

Odenwald, M., Neuner, F., Schauer, M., Elbert, T., Catani, C., Lingenfelder, B., Hinkel, H., Häfner, H. & Rockstroh, B. (2005). Khat use as risk factor for psychotic disorders: A cross-sectional and case-control study in Somalia. *BMC Med, 3*(1), 5.

Odenwald, M. (in press). Chronischer Khatkonsum und psychotische Störungen: Ein Literaturüberblick und Ausblick. *Sucht*.

Odenwald, M., Schmitt, T., Neuner, F, Ruf, M. & Schauer, M. (in press). Aussageverhalten von traumatisierten Flüchtlingen: Eine Untersuchung zum Vorbringen des eigenen Verfolgungsschicksals im Rahmen des Asylverfahrens. *Zeitschrift für Politische Psychologie*.

Odenwald, M., VanDuijl, M & Schmitt, T. (in press). Disorders of possession and dissociation in the intercultural clinical practice. In: K. Bhui & D. Bughra (eds.) *Culture and Mental Health: A comprehensive textbook*. Oxford: Hodder Arnold.

Odenwald, M., Hinkel, H., Schauer, E., Neuner, F., Schauer, M., Elbert, T. & Rockstroh, B. (under review). Self-reported khat use and opinion about drug consumption among active military personnel in Somalia: a cross-sectional study. *PLOS Medicine*.

Odenwald, M., Lingenfelder, B., Schauer, M., Neuner, F., Rockstroh, B., Hinkel, H. & Elbert. T. (submitted). Screening for Posttraumatic Stress Disorder among Somali ex-combatants: A validation study.

Odenwald, M. (submitted). Psychotic disorder, khat abuse and aggressive behavior: a case report in Somalia.

Odenwald, M., Hinkel, H., Schauer, E., Neuner, F., Schauer, M., Elbert, T. & Rockstroh, B. (submitted). The effects of khat and posttraumatis stress on psychotic symptoms.

Douglas, I., Gleichmann, C., Odenwald, M., Steenken, K. & Wilkinson, A. (2003). *Disarmament, Demobilization and Reintegration: a practical field and classroom guide*. Eschborn: GTZ, NODEFIC, PPC, SNDC.

Gäbel, U., Ruf, M., Schauer, M., Odenwald, M. & Neuner, F. (2006). Prävalenz der Posttraumatischen Belastungsstörung (PTSD) und Möglichkeiten der Ermittlung in der Asylverfahrenspraxis. *Zeitschrift für Klinische Psychologie und Psychotherapie, 35*(1), 12-20.

Onyut, L.P., Neuner, F., Schauer, E., Ertl, V., Odenwald, M., Schauer, M., Elbert, T. (2004). The Nakivale Camp Mental Health Project: Building local competency for psychological assistance to traumatised refugees. *Intervention,* 2 (2), 90-107.

Onyut LP, Neuner F, Schauer E, Ertl, V., Odenwald, M., Schauer, M. & Elbert, T. (2005). Narrative Exposure Therapy as a treatment for child war survivors with posttraumatic stress disorder: two case reports and a pilot study in an African refugee settlement. *BMC Psychiatry*, 5 (1): 7.

Ray, W., Odenwald, M., Neuner, F., Schauer, M. Ruf, M., Rockstroh, B. & Elbert, T. (in press). Decoupeling neural networks from reality: dissociative experiences in torture victims are reflected in abnormal brain waves in left frontal cortex. *Psychological Science*.

Schauer, E., Neuner, F., Elbert, T., Ertl, V., Onyut, L.O., Odenwald, M. & Schauer, M. (2004). Narrative Exposure Therapy in children: a case study. *Intervention*, 2 (1), 18–32.

Schauer, M., Elbert, T, Gotthardt, S., Rockstroh, B., Odenwald, M. & Neuner, F. (2006). Wiedererfahrung durch Psychotherapie modifiziert Geist und Gehirn. *Verhaltenstherapie*, 16, 96-103.

## Conference contributions

Odenwald, M. (2002). Way of coping with trauma leads to further victimization: Combat trauma and substance abuse in members of a former liberation movement. Oral presentation at the *11th International Conference of the TraumaNetwork*, June. Wiesbaden, Germany.

Odenwald, M. & Elbert, T. (2003). Combat trauma, substance abuse and psychotic disorders among Somali ex-combatants. Oral presentation at the *European Conference on Traumatic Stress (ECOTS)* of the European Society for Traumatic Stresss Studies , May. Berlin, Germany.

Odenwald, M. (2004). Trauma und Traumafolgen in internationalen Krisengebieten: Sind westliche Konzepte brauchbar? Organization and moderation of a panel at the *Annual Conference of the Deutschsprachigen Gesellschaft für Psychotraumatologie (DeGPT), Sept* 3- 5. Vienna, Austria.

Odenwald, M. (2004). Wo suchen Menschen bei schweren psychischen Störungen Hilfe in Somaliland. Oral presentation at the *Annual Conference of the Deutschsprachigen Gesellschaft für Psychotraumatologie (DeGPT), Sept* 3-5. Vienna, Austria.

Odenwald, M. (2004). The consumption of narcotic drugs in post-conflict settings – consequences for civil society and reintegration of ex-combatants. Presentation at the Conference of the Volkswagen Foundation *Violence, its Impact and Coping Strategies*, Sept 26 – Oct 1. Mweya, Uganda.

Odenwald, M. (2004). The chewing of khat leaves and psychotic disorders at the Horn of Africa. Oral presentation at the 47th International Conference of the ICAA, *Visions for the Future: Empowerment, Integration, Interaction*, Oct 31 – Nov 5. Venice, Italy.

Odenwald, M., Schauer, E & Hinkel, H. (2005). War-related trauma, drug-consumption and paranoid Ssmptoms among Somali ex-combatants. Oral presentation at the *European Conference of Traumatic Stress (ECOTS)* of the European Society for Traumatic Stresss Studies, June 18-21. Stockholm, Sweden.

Odenwald, M., Neuner, F., Elbert, T., Schauer, M. & Rockstroh, B. (2005). Excessive chewing of khat leaves and high prevalence of mental illness in Somalia. Oral presentation at the *World Congress of Psychiatry* of the World Psychiatric Association, Sept 10-15. Cairo, Egypt.

Odenwald, M., Catani, C., Schauer, E. , Kohiladevy M., Neuner, F., Ruf, M., Schauer, M., Elbert, T., Somasundaram, D., Onyut, P.L., Gotthardt, S. & Rockstroh, B. (2005) Posttraumatic Stress Disorder among Tsunami-affected children of former war-zone in Northern Sri Lanka. Poster presentation at the *World Congress of Psychiatry* of the World Psychiatric Association, Sept 10-15. Cairo, Egypt.

Odenwald, M. (2006). European Open Forum of the European Refugee Fund, EU Office of the Red Cross Reception, Austrian Red Cross *Reception and Health Care of Asylum Seekers*, Jan 26 – 28. Vienna, Austria.

# 12. Maps and Figures

# 13. References

ACMD. (2005). Khat (qat): Assessment of risk to individual and communities in the UK. In Advisory Council on the Misuse of Drugs (ACMD) (Ed.). London: British Home Office.

Adugna, F., Jira, C., & Molla, T. (1994). Khat chewing among Agaro secondary school students, Agaro, southwestern Ethiopia. *Ethiop Med J, 32*(3), 161-166.

Ahmad, B., Mufti, K. A., & Farooq, S. (2001). Psychiatric comorbidity in substance abuse (opioids). *J Pak Med Assoc, 51*(5), 183-186.

Ahmad, A., Sundelin-Wahlsten, V., Sofi, M. A., Qahar, J. A., & von Knorring, A. L. (2000). Reliability and validity of a child-specific cross-cultural instrument for assessing posttraumatic stress disorder. *Eur Child Adolesc Psychiatry, 9*(4), 285-294.

Ahmed, A. G., & Salib, E. (1998). The khat users: A study of khat chewing in Liverpool's Somali men. *Med Sci Law, 38*(2), 165-169.

AKUF. (2003). Kriege Archiv: Somalia. Hamburg: Arbeitsgemeinschaft Kriegsursachenforschung der Universität Hamburg.

Al-Ghdaian, A. A. (1983). *Khat in the shari'ah (islamic law)*. Paper presented at the International conference on Khat: The health and socio-economic aspects of Khat use, Antananaribo, Madagascar.

Al-Habori, M. (2005). The potential adverse effects of habitual use of catha edulis (khat). *Expert Opin Drug Saf, 4*(6), 1145-1154.

Al-Hebshi, N. N., & Skaug, N. (2005). Khat (catha edulis)-an updated review. *Addict Biol, 10*(4), 299-307.

Al-Motarreb, A., Baker, K., & Broadley, K. J. (2002). Khat: Pharmacological and medical aspects and its social use in Yemen. *Phytother Res, 16*(5), 403-413.

Alem, A., Kebede, D., & Kullgren, G. (1999). The prevalence and socio-demographic correlates of khat chewing in Butajira, Ethiopia. *Acta Psychiatr Scand Suppl, 397*, 84-91.

Alem, A., & Shibre, T. (1997). Khat induced psychosis and its medico-legal implication: A case report. *Ethiop Med J, 35*(2), 137-139.

Alexander, B. K., Coambs, R. B., & Hadaway, P. F. (1978). The effect of housing and gender on morphine self-administration in rats. *Psychopharmacology (Berl), 58*(2), 175-179.

Ali, A. A., Al-Sharabi, A. K., Aguirre, J. M., & Nahas, R. (2004). A study of 342 oral keratotic white lesions induced by qat chewing among 2500 Yemeni. *J Oral Pathol Med, 33*(6), 368-372.

Alkan, M. L., & Ali, A. A. (2001). Report of a medical mission to Somaliland, 2001. *Rural Remote Health, 1*(1), 87.

Andreasson, S., Allebeck, P., Engstrom, A., & Rydberg, U. (1987). Cannabis and schizophrenia. A longitudinal study of swedish conscripts. *Lancet, 2*(8574), 1483-1486.

Andrews, G., & Peters, L. (1998). The psychometric properties of the composite international diagnostic interview. *Soc Psychiatry Psychiatr Epidemiol, 33*(2), 80-88.

Angrist, B., Rotrosen, J., & Gershon, S. (1980). Differential effects of amphetamine and neuroleptics on negative vs. Positive symptoms in schizophrenia. *Psychopharmacology (Berl), 72*(1), 17-19.

Anthony, J. C., Warner, L. A., & Kesseler, R. C. (1994). Comparative epidemiology of dependence on tobacco, alcohol, controlled substances, and inhalants: Basic findings from the national comorbidity survey. *Experimental and Clinical Psychopharmacology, 2*, 244-268.

Arseneault, L., Cannon, M., Witton, J., & Murray, R. (2004). Cannabis as a potential causal factor in schizophrenia. In D. Castle & R. Murray (Eds.), *Marihuana and madness: Psychiatry and neurobiology*. Cambridge: Cambridge University Press.

Awas, M., Kebede, D., & Alem, A. (1999). Major mental disorders in Butajira, southern Ethiopia. *Acta Psychiatr Scand Suppl, 397*, 56-64.

Baasher, T. A. (1980). The use of khat: A stimulant with regional distribution. In G. Edwards & A. Arif (Eds.), *Drug problems in the socio-cultural context* (pp. 86-93). Geneva: WHO.

Balint, G. A., Ghebrekidan, H., & Balint, E. E. (1991). Catha edulis, an international socio-medical problem with considerable pharmacological implications. *East Afr Med J, 68*(7), 555-561.

Banjaw, M. Y., Miczek, K., & Schmidt, W. J. (2005). Repeated catha edulis oral administration enhances the baseline aggressive behavior in isolated rats. *J Neural Transm*.

Barre, S. (1983, Oct 24-28, 1983). *Inaugural speech of h.E. President of sdr*. Paper presented at the Report of the WHO inter-country meeting on the health, social and economic aspects of khat, Mogadishu.

Basoglu, M., Salcioglu, E., Livanou, M., Ozeren, M., Aker, T., Kilic, C., et al. (2001). A study of the validity of a screening instrument for traumatic stress in earthquake survivors in Turkey. *J Trauma Stress, 14*(3), 491-509.

Beck, A. T., & Steer, R. A. (1987). *Beck Depression Inventory*. San Antonio: The Psychological Corporation.

Beckerleg, S. (2006). What harm? Kenyan and Ugandan perspectives on khat., *African Affairs*: Oxford University Press, Royal African Society.

Belew, M., Kebede, D., Kassaye, M., & Enquoselassie, F. (2000). The magnitude of khat use and its association with health, nutrition and socio-economic status. *Ethiop Med J, 38*(1), 11-26.

Bell, D. S. (1973). The experimental reproduction of amphetamine psychosis. *Arch Gen Psychiatry, 29*(1), 35-40.

Bersani, G., Orlandi, V., Kotzalidis, G. D., & Pancheri, P. (2002). Cannabis and schizophrenia: Impact on onset, course, psychopathology and outcomes. *Eur Arch Psychiatry Clin Neurosci, 252*(2), 86-92.

Bhui, K., Abdi, A., Abdi, M., Pereira, S., Dualeh, M., Robertson, D., et al. (2003). Traumatic events, migration characteristics and psychiatric symptoms among Somali refugees--preliminary communication. *Soc Psychiatry Psychiatr Epidemiol, 38*(1), 35-43.

Bhui, K., Audini, B., Singh, S., Duffett, R., & Bhugra, D. (2006). Representation of asylum seekers and refugees among psychiatric inpatients in London. *Psychiatr Serv, 57*(2), 270-272.

Blows, S., Ivers, R. Q., Connor, J., Ameratunga, S., Woodward, M., & Norton, R. (2005). Marijuana use and car crash injury. *Addiction, 100*(5), 605-611.

Brady, K. T., Back, S. E., & Coffey, S. F. (2004). Substance abuse and posttraumatic stress disorder. *Current Directions in Psychological Science, 13*(5), 206-209.

Brener, N. D., Billy, J. O., & Grady, W. R. (2003). Assessment of factors affecting the validity of self-reported health-risk behavior among adolescents: Evidence from the scientific literature. *J Adolesc Health, 33*(6), 436-457.

Bremner, J. D., Southwick, S. M., Darnell, A., & Charney, D. S. (1996). Chronic PTSD in Vietnam combat veterans: Course of illness and substance abuse. *Am J Psychiatry, 153*(3), 369-375.

Brenneisen, R., Fisch, H. U., Koelbing, U., Geisshusler, S., & Kalix, P. (1990). Amphetamine-like effects in humans of the khat alkaloid cathinone. *Br J Clin Pharmacol, 30*(6), 825-828.

Brenneisen, R., Geisshusler, S., & Schorno, X. (1986). Metabolism of cathinone to (-)-norephedrine and (-)-norpseudoephedrine. *J Pharm Pharmacol, 38*(4), 298-300.

Breslau, N., Davis, G. C., & Andreski, P. (1995). Risk factors for PTSD-related traumatic events: A prospective analysis. *Am J Psychiatry, 152*(4), 529-535.

Breslau, N., Davis, G. C., Peterson, E. L., & Schultz, L. R. (2000). A second look at comorbidity in victims of trauma: The posttraumatic stress disorder-major depression connection. *Biol Psychiatry, 48*(9), 902-909.

Brown, J. L., & Pollitt, E. (1996). Malnutrition, poverty and intellectual development. *Sci Am, 274*(2), 38-43.

Buhler, B., Hambrecht, M., Loffler, W., an der Heiden, W., & Hafner, H. (2002). Precipitation and determination of the onset and course of schizophrenia by substance abuse--a retrospective and prospective study of 232 population-based first illness episodes. *Schizophr Res, 54*(3), 243-251.

Butler, R. W., Mueser, K. T., Sprock, J., & Braff, D. L. (1996). Positive symptoms of psychosis in posttraumatic stress disorder. *Biol Psychiatry, 39*(10), 839-844.

Calcagnetti, D. J., & Schechter, M. D. (1992). Increases in the locomotor activity of rats after intracerebral administration of cathinone. *Brain Res Bull, 29*(6), 843-846.

Calhoun, P. S., Sampson, W. S., Bosworth, H. B., Feldman, M. E., Kirby, A. C., Hertzberg, M. A., et al. (2000). Drug use and validity of substance use self-reports in veterans seeking help for posttraumatic stress disorder. *J Consult Clin Psychol, 68*(5), 923-927.

Cardozo, B. L., Bilukha, O. O., Crawford, C. A., Shaikh, I., Wolfe, M. I., Gerber, M. L., et al. (2004). Mental health, social functioning, and disability in postwar Afghanistan. *Jama, 292*(5), 575-584.

Carothers, J. C. (1945). Miraa (catha edulis) as a cause of psychosis. *The East African Medical Journal, 22*, 4-6.

Carrier, N. (2005). 'miraa is cool': The cultural importance of miraa (khat) for Tigania and Igembe youth in Kenya. *Journal of African Cultural Studies, 17*(2), 201-218.

Carvalho, F. (2003). The toxicological potential of khat. *J Ethnopharmacol, 87*(1), 1-2.

Chen, C. H., Lin, S. K., Tang, H. S., Shen, W. W., & Lu, M. L. (2001). The Chinese version of the Davidson trauma scale: A practice test for validation. *Psychiatry Clin Neurosci, 55*(5), 493-499.

Chilcoat, H. D., & Breslau, N. (1998a). Posttraumatic stress disorder and drug disorders: Testing causal pathways. *Arch Gen Psychiatry, 55*(10), 913-917.

Chilcoat, H. D., & Breslau, N. (1998b). Investigations of causal pathways between PTSD and drug use disorders. *Addict Behav, 23*(6), 827-840.
Clum, G. A., Nishith, P., & Resick, P. A. (2001). Trauma-related sleep disturbance and self-reported physical health symptoms in treatment-seeking female rape victims. *J Nerv Ment Dis, 189*(9), 618-622.
Cohen, J. (1977). *Statistical power analysis for the behavioral sciences* (revised ed.). New York: Academic Press.
Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd edition ed.). Hillsdale, N.J.: Erlbaum.
Collier, P. (1994). Demobilization and insecurity: A study in the economics of the transition from war to peace. *Journal of International Development, 6*(3), 343-351.
Connell, P. H. (1958). *Amphetamine psychosis*. London, New York: Oxford University Press.
Coyne, J. C., & Kagee, A. (2000). Mental health among Bosnian refugees. *Jama, 283*(1), 55.
Critchlow, S., & Seifert, R. (1987). Khat-induced paranoid psychosis. *Br J Psychiatry, 150*, 247-249.
CSA (2004). The 2004 national statistics. Retrieved 02/03/2006, 2006, from http://www.statsethiopia.org/text_files/2004_national_statistics.htm
CVS Consultants, & Migrant and Refugee Communities Forum. (1999). *A shattered world: The mental health needs of refugees and newly arrived communities*. London: CVS Consultants.
Date, J., Tanida, N., & Hobara, T. (2004). Qat chewing and pesticides: A study of adverse health effects in people of the mountainous areas of Yemen. *Int J Environ Health Res, 14*(6), 405-414.
Davidson, J. R., Book, S. W., Colket, J. T., Tupler, L. A., Roth, S., David, D., et al. (1997). Assessment of a new self-rating scale for post-traumatic stress disorder. *Psychol Med, 27*(1), 153-160.
Derluyn, I., Broekaert, E., Schuyten, G., & De Temmerman, E. (2004). Post-traumatic stress in former Ugandan child soldiers. *Lancet, 363*(9412), 861-863.
Derogatis, L. R. (1977). *SCL-90 administration, scoring and procedure manual*. Baltimore: John Hopkins University Press.
Derogatis, L. R., & Melisaratos, N. (1983). The Brief Symptom Inventory: An introductory report. *Psychol Med, 13*(3), 595-605.
Deslandes, P. N., Pache, D. M., & Sewell, R. D. (2002). Drug dependence: Neuropharmacology and management. *J Pharm Pharmacol, 54*(7), 885-895.
Dhadphale, M., & Mengech, A. (1987). Letter to the editor. *Br. J. Psychiatry, 150*, 876.
Dhadphale, M., Mengech, A., & Chege, S. W. (1981). Miraa (catha edulis) as a cause of psychosis. *East Afr Med J, 58*(2), 130-135.
Dhadphale, M., & Omolo, O. E. (1988). Psychiatric morbidity among khat chewers. *East Afr Med J, 65*(6), 355-359.
Dohrenwend, B. P., Shrout, P. E., Egri, G., & Mendelsohn, F. S. (1980). Nonspecific psychological distress and other dimensions of psychopathology. Measures for use in the general population. *Arch Gen Psychiatry, 37*(11), 1229-1236.

Dunn, M. S., Bartee, R. T., & Perko, M. A. (2003). Self-reported alcohol use and sexual behaviors of adolescents. *Psychol Rep, 92*(1), 339-348.

Flaherty, J. A., Gaviria, F. M., Pathak, D., Mitchell, T., Wintrob, R., Richman, J. A., et al. (1988). Developing instruments for cross-cultural psychiatric research. *J Nerv Ment Dis, 176*(5), 257-263.

Eddy, N. B., Halbach, H., Isbell, H., & Seevers, M. H. (1965). Drug dependence: Its significance and characteristics. *Bull World Health Organ, 32*(5), 721-733.

Eid, J., Thayer, J. F., & Johnsen, B. H. (1999). Measuring post-traumatic stress: A psychometric evaluation of symptom--and coping questionnaires based on a Norwegian sample. *Scand J Psychol, 40*(2), 101-108.

Ellinwood, E. H., Jr. (1971). Assault and homicide associated with amphetamine abuse. *Am J Psychiatry, 127*(9), 1170-1175.

El-Kader, A. (1983). *The Shariah's position on khat*. Paper presented at the International Conference on Khat: The health and socio-economic aspects of khat use, Antananaribo, Madagascar.

Elmi, A. S. (1983). The chewing of khat in Somalia. *J Ethnopharmacol, 8*(2), 163-176.

Elmi, A. S., Ahmed, Y. H., & Samatar, M. S. (1987). Experience in the control of khat-chewing in Somalia. *Bull Narc, 39*(2), 51-57.

Eriksson, M., Ghani, N. A., & Kristiansson, B. (1991). Khat-chewing during pregnancy-effect upon the off-spring and some characteristics of the chewers. *East Afr Med J, 68*(2), 106-111.

FAO. (2001). FAO/WFP crop and food supply assessment mission to Ethiopia - 9 January 2001. Special reports and alerts (GIEWS). Retrieved 02/03/2006, 2006, from http://www.fao.org/documents/show_cdr.asp?url_file=//DOCREP/004/X9320E/X9320E00.HTM

Farrell, M., Boys, A., Bebbington, P., Brugha, T., Coid, J., Jenkins, R., et al. (2002). Psychosis and drug dependence: Results from a national survey of prisoners. *Br J Psychiatry, 181*, 393-398.

Feyisa, T., & Aune, J. (2003). Khat expansion in the Ethiopian highlands. Effects on the farming system in Habro district. *Mountain Research and Development, 23*(2), 186-190.

Flaum, M., & Schultz, S. K. (1996). When does amphetamine-induced psychosis become schizophrenia? *Am J Psychiatry, 153*(6), 812-815.

Foa, E. B. (1995). *Posttraumatic Stress Diagnostic Scale*. Minneapolis, USA: National Computer Systems.

Foa, E. B., Cashman, L., Jaycox, L., & Perry, K. (1997). The validation of a self-report measure of posttraumatic stress disorder: The Posttraumatic Diagnostic Scale. *Psychological Assessment, 9*(4), 445-451.

Fontana, A., & Rosenheck, R. (2005). The role of war-zone trauma and PTSD in the etiology of antisocial behavior. *J Nerv Ment Dis, 193*(3), 203-209.

Fountain, J., McQuade, C., Peters, E., Anitha, S., Crompton, N., Roy, A., et al. (2004). *Drug-related interventions for refugees and asylum seekers: A pilot study amongst Somali and Turkish communities in London*. Lancaster: University of Lancashire, Faculty of Health, Centre for Ethnicity and Health.

Gebissa, E. (2004). *Leaf of Allah: Khat & agricultural transformation in Harerge, Ethiopia 1875-1991*. Oxford, Athens: James Currey, Ohio University Press.

Gegax, T. T. (2002). Meet the khat-heads. *Newsweek, 140*(14), 35.

Geisshusler, S., & Brenneisen, R. (1987). The content of psychoactive phenylpropyl and phenylpentenyl khatamines in catha edulis forsk. Of different origin. *J Ethnopharmacol, 19*(3), 269-277.

Giannini, A. J., & Castellani, S. (1982). A manic-like psychosis due to khat (catha edulis forsk.). *J Toxicol Clin Toxicol, 19*(5), 455-459.

Giannini, A. J., Burge, H., Shaheen, J. M., & Price, W. A. (1986). Khat: Another drug of abuse? *J Psychoactive Drugs, 18*(2), 155-158.

Goldberg, D. P., & Hillier, V. F. (1979). A scaled version of the General Health Questionnaire. *Psychol Med, 9*(1), 139-145.

Gosnell, B. A., Yracheta, J. M., Bell, S. M., & Lane, K. E. (1996). Intravenous self-administration of cathinone by rats. *Behav Pharmacol, 7*(6), 526-531.

Gossop, M., Darke, S., Griffiths, P., Hando, J., Powis, B., Hall, W., et al. (1995). The Severity of Dependence Scale (SDS): Psychometric properties of the SDS in English and Australian samples of heroin, cocaine and amphetamine users. *Addiction, 90*(5), 607-614.

Goudie, A. J., & Newton, T. (1985). The puzzle of drug-induced conditioned taste aversion: Comparative studies with cathinone and amphetamine. *Psychopharmacology (Berl), 87*(3), 328-333.

Gough, S. P., & Cookson, I. B. (1984). Khat-induced schizophreniform psychosis in UK. *The Lancet, 25*(2), 455.

Griffin, M. G., Uhlmansiek, M. H., Resick, P. A., & Mechanic, M. B. (2004). Comparison of the Posttraumatic Stress Disorder Scale versus the Clinician-Administered Posttraumatic Stress Disorder Scale in domestic violence survivors. *J Trauma Stress, 17*(6), 497-503.

Griffiths, P. (1998). Qat use in London: A study of qat use among a sample of Somalis living in London. In C. D. P. Unit (Ed.) (Vol. Paper 26). London: Home Office.

Griffiths, P., Gossop, M., Wickenden, S., Dunworth, J., Harris, K., & Lloyd, C. (1997). A transcultural pattern of drug use: Qat (khat) in the UK. *Br J Psychiatry, 170*, 281-284.

Gros, J. (1996). Towards a taxonomy of failed states in the new world order: Decaying Somalia, Liberia, Rwanda and Haiti. *Third World Quaterly, 17*(3), 455-472.

Grosse-Kettler, S. (2004). *External actors in stateless Somalia* (Vol. 39). Bonn, Germany: Bonn International Center for Conversion.

Granek, M., Shalev, A., & Weingarten, A. M. (1988). Khat-induced hypnagogic hallucinations. *Acta Psychiatr Scand, 78*(4), 458-461.

Geisshusler, S., & Brenneisen, R. (1987). The content of psychoactive phenylpropyl and phenylpentenyl khatamines in catha edulis forsk. Of different origin. *J Ethnopharmacol, 19*(3), 269-277.

Hadaway, P. F., Alexander, B. K., Coambs, R. B., & Beyerstein, B. (1979). The effect of housing and gender on preference for morphine-sucrose solutions in rats. *Psychopharmacology (Berl), 66*(1), 87-91.

Hafner, H. (2001). *Das Rätsel Schizophrenie: Eine Krankheit wird entschlüsselt, 2nd edition*. Munique: Beck.

Hafner, H., Maurer, K., Loffler, W., an der Heiden, W., Munk-Jorgensen, P., Hambrecht, M., et al. (1998). The ABC schizophrenia study: A preliminary overview of the results. *Soc Psychiatry Psychiatr Epidemiol, 33*(8), 380-386.

Hafner, H., Riecher-Rossler, A., Hambrecht, M., Maurer, K., Meissner, S., Schmidtke, A., et al. (1992). IRAOS: An instrument for the assessment of onset and early course of schizophrenia. *Schizophr Res, 6*(3), 209-223.

Halbach, H. (1972). Medical aspects of the chewing of khat leaves. *Bull World Health Organ, 47*(1), 21-29.

Hambrecht, M., & Hafner, H. (1992). [are sex differences in schizophrenia stable on a transnational basis?]. *Schweiz Arch Neurol Psychiatr, 143*(6), 525-540.

Hambrecht, M., & Hafner, H. (1996). Substance abuse and the onset of schizophrenia. *Biol Psychiatry, 40*(11), 1155-1163.

Hambrecht, M., & Hafner, H. (2000). Cannabis, vulnerability, and the onset of schizophrenia: An epidemiological perspective. *Aust N Z J Psychiatry, 34*(3), 468-475.

Harding, T. W., Climent, C. E., Diop, M., Giel, R., Ibrahim, H. H., Murthy, R. S., et al. (1983). The WHO collaborative study on strategies for extending mental health care, II: The development of new research methods. *Am J Psychiatry, 140*(11), 1474-1480.

Harding, T. W., de Arango, M. V., Baltazar, J., Climent, C. E., Ibrahim, H. H., Ladrido-Ignacio, L., et al. (1980). Mental disorders in primary health care: A study of their frequency and diagnosis in four developing countries. *Psychol Med, 10*(2), 231-241.

Hassan, N. A., Gunaid, A. A., Abdo-Rabbo, A. A., Abdel-Kader, Z. Y., al-Mansoob, M. A., Awad, A. Y., et al. (2000). The effect of qat chewing on blood pressure and heart rate in healthy volunteers. *Trop Doct, 30*(2), 107-108.

Hassan, N. A., Gunaid, A. A., El-Khally, F. M., & Murray-Lyon, I. M. (2002). The effect of chewing khat leaves on human mood. *Saudi Med J, 23*(7), 850-853.

Henquet, C., Krabbendam, L., Spauwen, J., Kaplan, C., Lieb, R., Wittchen, H. U., et al. (2005). Prospective cohort study of cannabis use, predisposition for psychosis, and psychotic symptoms in young people. *BMJ, 330*(7481), 11.

Holen, A., Sund, A., & Weisaeth, L. (1983). *The Alexander Lielland disaster March 27th 1980: Psychological reactions among the survivors*. Oslo: Division of Disaster Psychiatry, University of Oslo.

Hollifield, M., Warner, T. D., Lian, N., Krakow, B., Jenkins, J. H., Kesler, J., et al. (2002). Measuring trauma and health status in refugees: A critical review. *Jama, 288*(5), 611-621.

Holtmann, M., Becker, K., Hartmann, M., & Schmidt, M. H. (2002). [is there a temporal correlation between substance abuse and psychosis in adolescents?]. *Z Kinder Jugendpsychiatr Psychother, 30*(2), 97-103.

Horowitz, M., Wilner, N., & Alvarez, W. (1979). Impact of Event Scale: A measure of subjective stress. *Psychosom Med, 41*(3), 209-218.

Impagnatiello, F., Guidotti, A. R., Pesold, C., Dwivedi, Y., Caruncho, H., Pisu, M. G., et al. (1998). A decrease of reelin expression as a putative vulnerability factor in schizophrenia. *Proc Natl Acad Sci U S A, 95*(26), 15718-15723.

Jablensky, A., Sartorius, N., Ernberg, G., Anker, M., Korten, A., Cooper, J. E., et al. (1992). Schizophrenia: Manifestations, incidence and course in different cultures. A World Health Organization ten-country study. *Psychol Med Monogr Suppl, 20*, 1-97.

Jablensky, A., Sartorius, N., Cooper, J. E., Anker, M., Korten, A., & Bertelsen, A. (1994). Culture and schizophrenia. Criticisms of WHO studies are answered. *Br J Psychiatry, 165*(4), 434-436.

Jablensky, A., Sartorius, N., Ernberg, G., Anker, M., Korten, A., Cooper, J. E., et al. (1992). Schizophrenia: Manifestations, incidence and course in different cultures. A World Health Organization ten-country study. *Psychol Med Monogr Suppl, 20*, 1-97.

Jacobsen, L. K., Southwick, S. M., & Kosten, T. R. (2001). Substance use disorders in patients with posttraumatic stress disorder: A review of the literature. *Am J Psychiatry, 158*(8), 1184-1190.

Jager, A. D., & Sireling, L. (1994). Natural history of khat psychosis. *Aust N Z J Psychiatry, 28*(2), 331-332.

Janowsky, D. S., & Davis, J. M. (1976). Methylphenidate, dextroamphetamine, and levamfetamine. Effects on schizophrenic symptoms. *Arch Gen Psychiatry, 33*(3), 304-308.

Johanson, C. E., & Schuster, C. R. (1981). A comparison of the behavioral effects of l- and dl-cathinone and d-amphetamine. *J Pharmacol Exp Ther, 219*(2), 355-362.

Kalivas, P. W., & Stewart, J. (1991). Dopamine transmission in the initiation and expression of drug- and stress-induced sensitization of motor activity. *Brain Res Brain Res Rev, 16*(3), 223-244.

Kalix, P. (1987). Khat: Scientific knowledge and policy issues. *Br J Addict, 82*(1), 47-53.

Kalix, P. (1990). Pharmacological properties of the stimulant khat. *Pharmacol Ther, 48*(3), 397-416.

Kalix, P. (1991). The pharmacology of psychoactive alkaloids from ephedra and catha. *J Ethnopharmacol, 32*(1-3), 201-208.

Kalix, P. (1992). Cathinone, a natural amphetamine. *Pharmacol Toxicol, 70*(2), 77-86.

Kalix, P. (1996). Catha edulis, a plant that has amphetamine effects. *Pharm World Sci, 18*(2), 69-73.

Karunakara, U. K., Neuner, F., Schauer, M., Singh, K., Hill, K., Elbert, T., et al. (2004). Traumatic events and symptoms of post-traumatic stress disorder amongst Sudanese nationals, refugees and Ugandans in the west Nile. *Afr Health Sci, 4*(2), 83-93.

Kassaye, M., Sherief, H., Fissehaye, G., & Teklu, T. (1999). Drug use among high school students in Addis Ababa and Butajira. *Ethiop J Health Dev, 13*(2), 101-106.

Kavanagh, D. J., McGrath, J., Saunders, J. B., Dore, G., & Clark, D. (2002). Substance misuse in patients with schizophrenia: Epidemiology and management. *Drugs, 62*(5), 743-755.

Kay, S. R. (1991). *Positive and negative syndromes in schizophrenia: Assessment and research*. New York: Brunner/Mazel.

Kay, S. R., Fiszbein, A., & Opler, L. A. (1987). The Positive and Negative Syndrome Scale (PANSS) for schizophrenia. *Schizophr Bull, 13*(2), 261-276.

Keane, T. M., Gerardi, R. J., Lyons, J. A., & Wolfe, J. (1988). The interrelationship of substance abuse and posttraumatic stress disorder. Epidemiological and clinical considerations. *Recent Dev Alcohol, 6*, 27-48.

Kebede, D., Alem, A., Mitike, G., Enquselassie, F., Berhane, F., Abebe, Y., et al. (2005). Khat and alcohol use and risky sex behaviour among in-school and out-of-school youth in Ethiopia. *BMC Public Health, 5*, 109.

Kebede, Y. (2002). Cigarette smoking and khat chewing among college students in north west Ethiopia. *Ethiop J Health Dev, 16*(1), 7-17.

Kennedy, J. G., Teague, J., & Fairbanks, L. (1980). Qat use in north Yemen and the problem of addiction: A study in medical anthropology. *Cult Med Psychiatry, 4*(4), 311-344.

Kennedy, J. G., Teague, J., Rokaw, W., & Cooney, E. (1983). A medical evaluation of the use of qat in north Yemen. *Soc Sci Med, 17*(12), 783-793.

Kennedy, J. K. (1987). *The flower of paradise: The institutionalized use of the drug qat in north Yemen*. Boston: D. Reidel Publishing Company.

Keyes, E. F. (2000). Mental health status in refugees: An integrative review of current research. *Issues Ment Health Nurs, 21*(4), 397-410.

Kigma, K. (2000). Introduction. In K. Kigma (Ed.), *Demobilization in sub-Saharan Africa: The development and security impacts*. New York: St. Martin's Press, Inc.

Kingma, K. (2000). Post-war societies. In N. Pauwels (Ed.), *War force to work force: Global perspectives on demobilization and reintegration*. Baden-Baden: Nomos.

Koch, M. (2000). Can animal models help to understand human diseases? Commentary on Swerdlow et al., 'animal models of deficient sensorimotor gating: What we know, what we think we know, and what we hope to know soon'. *Behav Pharmacol, 11*(3-4), 205-207.

Koob, G. F., & Le Moal, M. (2005). *Neurobiology of addiction*. New York: Elsevier.

Kortmann, F. (1987). Problems in communication in transcultural psychiatry. The self reporting questionnaire in Ethiopia. *Acta Psychiatr Scand, 75*(6), 563-570.

Krikorian, A. D. (1983). *Khat and its use: An historical perspective*. Paper presented at the International Conference on Khat: The health and socio-economic aspects of khat use, Antananaribo, Madagaskar.

Kristiansson, B., Abdul Ghani, N., Eriksson, M., Garle, M., & Qirbi, A. (1987). Use of khat in lactating women: A pilot study on breast-milk secretion. *J Ethnopharmacol, 21*(1), 85-90.

Kulka, R. A., Schlenger, W. E., Fairbank, J. A., Hough, Jordan, Marmar, et al. (1990). *Trauma and the Vietnam war generation: Report of findings from the national Vietnam Veterans Readjustment Study*. New York: Brunner/Mazel.

Kypri, K., & Langley, J. D. (2003). Perceived social norms and their relation to university student drinking. *J Stud Alcohol, 64*(6), 829-834.

Laruelle, M. (2003). Dopamine transmission in the schizophrenic brain. In S. R. Hirsch & D. Weinberger (Eds.), *Schizophrenia* (2nd ed., pp. 365-387). Oxford: Blackwell.

Laruelle, M., Iyer, R. N., al-Tikriti, M. S., Zea-Ponce, Y., Malison, R., Zoghbi, S. S., et al. (1997). Microdialysis and SPECT measurements of amphetamine-induced dopamine release in nonhuman primates. *Synapse, 25*(1), 1-14.

Lemessa, D. (2001). *Khat (catha edulis): Botany, distribution, cultivation, usage and economics in Ethiopia*. Addis Ababa: UN-Emergencies Unit for Ethiopia.

Lewis, M. A., & Neighbors, C. (2004). Gender-specific misperceptions of college student drinking norms. *Psychol Addict Behav, 18*(4), 334-339.

Lieberman, J. A., Kane, J. M., & Alvir, J. (1987). Provocative tests with psychostimulant drugs in schizophrenia. *Psychopharmacology (Berl), 91*(4), 415-433.

Lipsey, M. W., & Wilson, D. B. (2001). *Practical meta-analysis* (Vol. 49). London: Sage.

Lipska, B. K., Halim, N. D., Segal, P. N., & Weinberger, D. R. (2002). Effects of reversible inactivation of the neonatal ventral hippocampus on behavior in the adult rat. *J Neurosci, 22*(7), 2835-2842.

Lipska, B. K., Swerdlow, N. R., Geyer, M. A., Jaskiw, G. E., Braff, D. L., & Weinberger, D. R. (1995). Neonatal excitotoxic hippocampal damage in rats causes post-pubertal changes in prepulse inhibition of startle and its disruption by apomorphine. *Psychopharmacology (Berl), 122*(1), 35-43.

Lipska, B. K., & Weinberger, D. R. (2003). Animal models of schizophrenia. In S. R. Hirsch & D. R. Weinberger (Eds.), *Schizophrenia* (pp. 388-402). Oxford: Blackwell.

Litman, A., Levav, I., Saltz-Rennert, H., & Maoz, B. (1986). The use of khat. An epidemiological study in two Yemenite villages in Israel. *Cult Med Psychiatry, 10*(4), 389-396.

Lopez, A., Mathers, C., Ezzati, M., Jamison, D., & Murray, C. (2006). *Global Burden of Disease and risk factors*. Washington: Oxford University Press and The World Bank.

Lopes Cardozo, B., Talley, L., Burton, A., & Crawford, C. (2004). Karenni refugees living in Thai-Burmese border camps: Traumatic experiences, mental health outcomes, and social functioning. *Soc Sci Med, 58*(12), 2637-2644.

Lopes Cardozo, B., Vergara, A., Agani, F., & Gotway, C. A. (2000). Mental health, social functioning, and attitudes of Kosovar Albanians following the war in Kosovo. *Jama, 284*(5), 569-577.

Luqman, W., & Danowski, T. S. (1976). The use of khat (catha edulis) in Yemen. Social and medical observations. *Ann Intern Med, 85*(2), 246-249.

Machiyama, Y. (1992). Chronic methamphetamine intoxication model of schizophrenia in animals. *Schizophr Bull, 18*(1), 107-113.

Maitai, C. K. (1996). *Catha edulis (miraa): A detailed review focusing on its chemistry, health implication, economic, legal, social, cultural, religious, moral aspects and its cultivation*. Nairobi: National Council for Science and Technology.

Manton, K. G., Korten, A., Woodbury, M. A., Anker, M., & Jablensky, A. (1994). Symptom profiles of psychiatric disorders based on graded disease classes: An illustration using data from the WHO international pilot study of schizophrenia. *Psychol Med, 24*(1), 133-144.

Masciarelli, A. (2002). Flying in Mogadishu's daily fix. Retrieved 02/09/2006, 2006, from http://news.bbc.co.uk/2/hi/africa/2018967.stm

McFall, M. E., Mackay, P. W., & Donovan, D. M. (1992). Combat-related posttraumatic stress disorder and severity of substance abuse in Vietnam veterans. *J Stud Alcohol, 53*(4), 357-363.

McFall, R. M., & Treat, T. A. (1999). Quantifying the information value of clinical assessments with signal detection theory. *Annu Rev Psychol, 50*, 215-241.

McFarlane, A. C., Atchison, M., Rafalowicz, E., & Papay, P. (1994). Physical symptoms in post-traumatic stress disorder. *J Psychosom Res, 38*(7), 715-726.

McGue, M., & Gottesman, II. (1991). The genetic epidemiology of schizophrenia and the design of linkage studies. *Eur Arch Psychiatry Clin Neurosci, 240*(3), 174-181.

McKee, C. M. (1987). Medical and social aspects of qat in Yemen: A review. *J R Soc Med, 80*(12), 762-765.

McLaren, P. (1987). Khat psychosis. *Br J Psychiatry, 150*, 712-713.

Meampel, G. Z. (1992). The Arabian voyage of 1761-67 and Malta: Forsskål and his contribution to the study of local natural history. Proceedings of history week 1992, p. 35-76. The Malta historical society. Retrieved 02/09/2006, 2006, from http://uk.geocities.com/davidmallia2000/Thierens/hw92fors.html

Menkhaus, K. (2003). *Somalia: A situation analysis and trend assessment*. Geneva: UNHCR.

Mion, G., & Oberti, M. (1998). [Epidemiologic study of qat use in the national army of Djibouti]. *Med Trop (Mars), 58*(2), 161-164.

Mion, G., Ruttimann, M., Oberti, M., & Aversenq, C. (1997). [Acute khat-induced psychotic crisis]. *Ann Fr Anesth Reanim, 16*(2), 201-202.

Mogapi, N. (2004). Reintegration of soldiers: The missing piece. *Intervention, 2*(3), 221-225.

Moggaddam, B., & Krystal, J. H. (2003). The neurochemistry of schizophrenia. In S. R. Hirsch & D. Weinberger (Eds.), *Schizophrenia* (2nd ed., pp. 349-364). Oxford: Blackwell.

Mollica, R. F., Caspi-Yavin, Y., Bollini, P., Truong, T., Tor, S., & Lavelle, J. (1992). The Harvard Trauma Questionnaire. Validating a cross-cultural instrument for measuring torture, trauma, and posttraumatic stress disorder in Indochinese refugees. *J Nerv Ment Dis, 180*(2), 111-116.

Mollica, R. F., Donelan, K., Tor, S., Lavelle, J., Elias, C., Frankel, M., et al. (1993). The effect of trauma and confinement on functional health and mental health status of Cambodians living in Thailand-Cambodia border camps. *Jama, 270*(5), 581-586.

Mueser, K. T., Drake, R. E., & Wallach, M. A. (1998). Dual diagnosis: A review of etiological theories. *Addict Behav, 23*(6), 717-734.

Mueser, K. T., Rosenberg, S. D., Goodman, L. A., & Trumbetta, S. L. (2002). Trauma, PTSD, and the course of severe mental illness: An interactive model. *Schizophr Res, 53*(1-2), 123-143.

Mueser, K. T., Yarnold, P. R., Levinson, D. F., Singh, H., Bellack, A. S., Kee, K., et al. (1990). Prevalence of substance abuse in schizophrenia: Demographic and clinical correlates. *Schizophr Bull, 16*(1), 31-56.

Nabuzoka, D., & Badhadhe, F. A. (2000). Use and perception of khat among young Somalis in a UK city. *Addiction Research, 8*(1), 5-26.

Nencini, P., & Ahmed, A. M. (1989). Khat consumption: A pharmacological review. *Drug Alcohol Depend, 23*(1), 19-29.

Nencini, P., Ahmed, A. M., Amiconi, G., & Elmi, A. S. (1984). Tolerance develops to sympathetic effects of khat in humans. *Pharmacology, 28*(3), 150-154.

Nencini, P., Grassi, M. C., Botan, A. A., Asseyr, A. F., & Paroli, E. (1989). Khat chewing spread to the Somali community in Rome. *Drug Alcohol Depend, 23*(3), 255-258.

Neuner, F., Schauer, M., Karunakara, U., Klaschik, C., Robert, C., & Elbert, T. (2004). Psychological trauma and evidence for enhanced vulnerability for posttraumatic stress disorder through previous trauma among west Nile refugees. *BMC Psychiatry, 4*(1), 34.

Nielen, R. J., van der Heijden, F. M., Tuinier, S., & Verhoeven, W. M. (2004). Khat and mushrooms associated with psychosis. *World J Biol Psychiatry, 5*(1), 49-53.

Nishith, P., Resick, P. A., & Mueser, K. T. (2001). Sleep difficulties and alcohol use motives in female rape victims with posttraumatic stress disorder. *J Trauma Stress, 14*(3), 469-479.

Nordal, A. (1980). Khat: Pharmacognostical aspects. *Bull Narc, 32*(3), 51-64.

Norman, R. M., & Malla, A. K. (1993). Stressful life events and schizophrenia. I: A review of the research. *Br J Psychiatry, 162*, 161-166.

Nuechterlein, K. H., Dawson, M. E., Gitlin, M., Ventura, J., Goldstein, M. J., Snyder, K. S., et al. (1992). Developmental processes in schizophrenic disorders: Longitudinal studies of vulnerability and stress. *Schizophr Bull, 18*(3), 387-425.

Numan, N. (2004). Exploration of adverse psychological symptoms in Yemeni khat users by the Symptoms Checklist-90 (SCL-90). *Addiction, 99*(1), 61-65.

Odenwald, M. (in press). Chronic khat use and psychotic disorders: A review of the current literature and future prospects. *Sucht*.

Odenwald, M., Catani, C., Schauer, E., Kohiladevy, M., Neuner, F., Ruf, M., et al. (2005a). Posttraumatic stress disorder among tsunami-affected children in Sri Lanka, *XIII World Congress of Psychiatry*. Cairo, Egypt: World Psychiatric Association.

Odenwald, M., Hinkel, H., Schauer, E., Neuner, F., Schauer, M., Elbert, T., et al. (in prep.). The effects of khat and posttraumatic stress on psychotic symptoms: Results from a cross sectional study in Somalia.

Odenwald, M., Hinkel, H., Schauer, E., Neuner, F., Schauer, M., Elbert, T., et al. (submitted-a). Self-reported khat use and opinion about drug consumption among active military personnel in Somalia: A cross-sectional study.

Odenwald, M., Lingenfelder, B., Schauer, M., Neuner, F., Rockstroh, B., Hinkel, H., et al. (submitted-b). Screening for posttraumatic stress disorder among Somali ex-combatants: A validation study.

Odenwald, M., Neuner, F., Schauer, M., Elbert, T. R., Catani, C., Lingenfelder, B., et al. (2005b). Khat use as risk factor for psychotic disorders: A cross-sectional and case-control study in Somalia. *BMC Med, 3*(1), 5.

Okulate, G. T., & Jones, O. B. (2006). Post-traumatic stress disorder, survivor guilt and substance use--a study of hospitalised Nigerian army veterans. *S Afr Med J, 96*(2), 144-146.

Omolo, O. E., & Dhadphale, M. (1987). Prevalence of khat chewers among primary health clinic attenders in Kenya. *Acta Psychiatr Scand, 75*(3), 318-320.

Omolo, O. E., & Dhadphale, M. (1987). Alcohol use among khat (catha) chewers in Kenya. *Br J Addict, 82*(1), 97-99.

Onyut, P. L., Neuner, F., Schauer, E., Ertl, V., Odenwald, M., & Elbert, T. (submitted). Prevalence of posttraumatic stress disorder among Somali and Rwandese refugees living in Nakivale refugee settlement (Uganda).

Ormel, J., VonKorff, M., Ustun, T. B., Pini, S., Korten, A., & Oldehinkel, T. (1994). Common mental disorders and disability across cultures. Results from the WHO collaborative study on psychological problems in general health care. *Jama, 272*(22), 1741-1748.

Orsillo, S. M., Weathers, F. W., Litz, B. T., Steinberg, H. R., Huska, J. A., & Keane, T. M. (1996). Current and lifetime psychiatric disorders among veterans with war zone-related posttraumatic stress disorder. *J Nerv Ment Dis, 184*(5), 307-313.

Othieno, C. J., Kathuku, D. M., & Ndetei, D. M. (2000). Substance abuse in outpatients attending rural and urban health centres in Kenya. *East Afr Med J, 77*(11), 592-595.

Ouimette, P., Moos, R. H., & Finney, J. W. (2003). PTSD treatment and 5-year remission among patients with substance use and posttraumatic stress disorders. *J Consult Clin Psychol, 71*(2), 410-414.

Overall, J. E., & Goreham, D. R. (1962). The Brief Psychiatric Rating Scale. *Psychological Reports, 10*, 799-812.

Pantelis, C., Hindler, C. G., & Taylor, J. C. (1989). Use and abuse of khat (catha edulis): A review of the distribution, pharmacology, side effects and a description of psychosis attributed to khat chewing. *Psychol Med, 19*(3), 657-668.

Patel, S. L., Wright, S., & Gammampila, A. (2005). Khat use among Somalis in four English cities (Vol. Home Office Online Report 47/05): Home Office.



Pantelis, C., Hindler, C. G., & Taylor, J. C. (1989). Use and abuse of khat (catha edulis): A review of the distribution, pharmacology, side effects and a description of psychosis attributed to khat chewing. *Psychol Med, 19*(3), 657-668.



Patel, V., Prince, M., & Saxena, S. (2006). Global mental health - call for papers. *The Lancet, 367*, 1471-1472.

Pehek, E. A., Schechter, M. D., & Yamamoto, B. K. (1990). Effects of cathinone and amphetamine on the neurochemistry of dopamine in vivo. *Neuropharmacology, 29*(12), 1171-1176.

Perkins, H. W., Haines, M. P., & Rice, R. (2005). Misperceiving the college drinking norm and related problems: A nationwide study of exposure to prevention information, perceived norms and student alcohol misuse. *J Stud Alcohol, 66*(4), 470-478.

Peters, L., Andrews, G., Cottler, L. B., Chatterji, S., Janca, A., & Smeets, R. M. W. (1996). The Composite International Diagnostic Interview posttraumatic stress disorder module: Preliminary data. *International Journal of Methods in Psychiatric Research, 6*, 167-174.

Phillips, P., & Johnson, S. (2001). How does drug and alcohol misuse develop among people with psychotic illness? A literature review. *Soc Psychiatry Psychiatr Epidemiol, 36*(6), 269-276.

Poole, R., & Brabbins, C. (1996). Drug induced psychosis. *Br J Psychiatry, 168*(2), 135-138.

Prigerson, H. G., Maciejewski, P. K., & Rosenheck, R. A. (2001). Combat trauma: Trauma with highest risk of delayed onset and unresolved posttraumatic stress disorder symptoms, unemployment, and abuse among men. *J Nerv Ment Dis, 189*(2), 99-108.

Reed, V., Gander, F., Pfister, H., Steiger, A., Sonntag, H., Trenkwalder, C., et al. (1997). To what degree does the Composite International Interview (CIDI) correctly identify DSM-IV disorders? Testing validity issues in a clinical sample. *International Journal of Methods in Psychiatric Research, 7*(3), 142-155.

Regier, D. A., Farmer, M. E., Rae, D. S., Locke, B. Z., Keith, S. J., Judd, L. L., et al. (1990). Comorbidity of mental disorders with alcohol and other drug abuse. Results from the Epidemiologic Catchment Area (ECA) study. *Jama, 264*(19), 2511-2518.

Robinson, T. E., & Becker, J. B. (1986). Enduring changes in brain and behavior produced by chronic amphetamine administration: A review and evaluation of animal models of amphetamine psychosis. *Brain Res, 396*(2), 157-198.

Rossler, W., Salize, J., & Knapp, M. (1998). [The costs of schizophrenia]. *Fortschr Neurol Psychiatr, 66*(11), 496-504.

Rosenheck, R., & Fontana, A. (1994). A model of homelessness among male veterans of the Vietnam war generation. *Am J Psychiatry, 151*(3), 421-427.

Saraceno, B., & Barbui, C. (1997). Poverty and mental illness. *Can J Psychiatry, 42*(3), 285-290.

Sartorius, N., Jablensky, A., Korten, A., Ernberg, G., Anker, M., Cooper, J. E., et al. (1986). Early manifestations and first-contact incidence of schizophrenia in different cultures. A preliminary report on the initial evaluation phase of the WHO collaborative study on determinants of outcome of severe mental disorders. *Psychol Med, 16*(4), 909-928.

Sato, M., Chen, C. C., Akiyama, K., & Otsuki, S. (1983). Acute exacerbation of paranoid psychotic state after long-term abstinence in patients with previous methamphetamine psychosis. *Biol Psychiatry, 18*(4), 429-440.

Sato, M., Numachi, Y., & Hamamura, T. (1992). Relapse of paranoid psychotic state in methamphetamine model of schizophrenia. *Schizophr Bull, 18*(1), 115-122.

Savarese, V. W., Suvak, M. K., King, L. A., & King, D. W. (2001). Relationships among alcohol use, hyperarousal, and marital abuse and violence in Vietnam veterans. *J Trauma Stress, 14*(4), 717-732.

Savoca, E., & Rosenheck, R. (2000). The civilian labor market experiences of Vietnam-era veterans: The influence of psychiatric disorders. *J Ment Health Policy Econ, 3*(4), 199-207.

Saxena, S., Sharan, P., & Saraceno, B. (2003). Budget and financing of mental health services: Baseline information on 89 countries from WHO's project atlas. *J Ment Health Policy Econ, 6*(3), 135-143.

Schauer, M., Neuner, F., Karunakara, U., Klaschik, C., Robert, C., & Elbert, T. (2003). PTSD and the "building block" effect of psychological trauma among west Nile Africans. *ESTSS Bulletin, 10*(2), 5-6.

Schechter, M. D. (1990a). Dopaminergic nature of acute cathine tolerance. *Pharmacol Biochem Behav, 36*(4), 817-820.

Schechter, M. D. (1990b). Rats become acutely tolerant to cathine after amphetamine or cathinone administration. *Psychopharmacology (Berl), 101*(1), 126-131.

Schneider, M. , Drews, E., & Koch, M. (2004). Behavioral effects in adult rats of chronic prepubertal treatment with the cannabinoid receptor agonist WIN 55,212-2. *Behavioural Pharmacology, 16(5-6)*, 447-453.

Schneier, F. R., & Siris, S. G. (1987). A review of psychoactive substance use and abuse in schizophrenia. Patterns of drug choice. *J Nerv Ment Dis, 175*(11), 641-652.

Schnurr, P. P., & Spiro, A., 3rd. (1999). Combat exposure, posttraumatic stress disorder symptoms, and health behaviors as predictors of self-reported physical health in older veterans. *J Nerv Ment Dis, 187*(6), 353-359.

Scholte, W. F., Olff, M., Ventevogel, P., de Vries, G. J., Jansveld, E., Cardozo, B. L., et al. (2004). Mental health symptoms following war and repression in eastern Afghanistan. *Jama, 292*(5), 585-593.

Schopen, A. (1979). Qat im Jemen. In H. Gros (Ed.), *Rausch und Realität: Eine Kulturgeschichte der Drogen* (Vol. 2). Stuttgart: Ernst Klett Verlag.

Selassie, S. G., & Gebre, A. (1996). Rapid assessment of drug abuse in Ethiopia. *Bull Narc, 48*(1-2), 53-63.

Seyoum, E., Kidane, Y., & Gebru, H. (1986). Preliminary study of income and nutritional status indicators in two Ethiopian communities. *Food and Nutrition Bulletin, 8*(3), 37-41.

Shahandeh, B., Geadah, R., Tongue, A., Tongue, E., & Rolli, J. (Eds.). (1983). *International conference on khat: The health and socio-economic aspects of khat use, January 17-21, 1983, Antananaribo, Madagascar*. Lausanne, Switzerland: International Council Against Alcohol and Addictions, ICAA.

Sharp, T., Zetterstrom, T., Ljungberg, T., & Ungerstedt, U. (1987). A direct comparison of amphetamine-induced behaviours and regional brain dopamine release in the rat using intracerebral dialysis. *Brain Res, 401*(2), 322-330.

Sheehan, D. V., Lecrubier, Y., Sheehan, K. H., Amorim, P., Janavs, J., Weiller, E., et al. (1998). The Mini-International Neuropsychiatric Interview (M.I.N.I.): The development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. *J Clin Psychiatry, 59 Suppl 20*, 22-33;quiz 34-57.

Sheeran, T., & Zimmerman, M. (2002). Screening for posttraumatic stress disorder in a general psychiatric outpatient setting. *J Consult Clin Psychol, 70*(4), 961-966.

Shipherd, J. C., Stafford, J., & Tanner, L. R. (2005). Predicting alcohol and drug abuse in Persian Gulf war veterans: What role do PTSD symptoms play? *Addict Behav, 30*(3), 595-599.

Sloan, K. L., & Rowe, G. (1998). Substance abuse and psychiatric illness: Treatment experience. *Am J Drug Alcohol Abuse, 24*(4), 589-601.

Smith Fawzi, M. C., Murphy, E., Pham, T., Lin, L., Poole, C., & Mollica, R. F. (1997a). The validity of screening for post-traumatic stress disorder and major depression among Vietnamese former political prisoners. *Acta Psychiatr Scand, 95*(2), 87-93.

Smith Fawzi, M. C., Pham, T., Lin, L., Nguyen, T. V., Ngo, D., Murphy, E., et al. (1997b). The validity of post-traumatic stress disorder among Vietnamese refugees. *J Trauma Stress, 10*(1), 101-107.

Somasundaram, D. J., & Sivayokan, S. (1994). War trauma in a civilian population. *Br J Psychiatry, 165*(4), 524-527.

Spanagel, R., & Weiss, F. (1999). The dopamine hypothesis of reward: Past and current status. *Trends Neurosci, 22*(11), 521-527.

Szendrei, K. (1980). The chemistry of khat. *Bull Narc, 32*(3), 5-35.

Tang, S. S., & Fox, S. H. (2001). Traumatic experiences and the mental health of Senegalese refugees. *J Nerv Ment Dis, 189*(8), 507-512.

Terlinden, U. (2006). *Fast update Somalia: Semi-annual risk assessment, July 2005 to January 2006*. Berne, Switzerland: Swisspeace.

Thabet, A. A., & Vostanis, P. (1999). Post-traumatic stress reactions in children of war. *J Child Psychol Psychiatry, 40*(3), 385-391.

Thapa, S. B., & Hauff, E. (2005). Psychological distress among displaced persons during an armed conflict in Nepal. *Soc Psychiatry Psychiatr Epidemiol, 40*(8), 672-679.

Thompson, J. L., Pogue-Geile, M. F., & Grace, A. A. (2004). Developmental pathology, dopamine, and stress: A model for the age of onset of schizophrenia symptoms. *Schizophr Bull, 30*(4), 875-900.

Thordstein, M., Jansson, T., & Kristiansson, B. (1991). Cerebral function of the guinea pig neonate after chronic intrauterine exposure to khat (catha edulis forsk.). *Biol Neonate, 59*(3), 161-170.

Thulesius, H., & Hakansson, A. (1999). Screening for posttraumatic stress disorder symptoms among Bosnian refugees. *J Trauma Stress, 12*(1), 167-174.

Tiilikainen, M. (2003). Somali women and daily Islam in the diaspora. *Social Compass, 50*(Mar), 59-69.

Toennes, S. W., Harder, S., Schramm, M., Niess, C., & Kauert, G. F. (2003). Pharmacokinetics of cathinone, cathine and norephedrine after the chewing of khat leaves. *Br J Clin Pharmacol, 56*(1), 125-130.

Toennes, S. W., & Kauert, G. F. (2004). Driving under the influence of khat--alkaloid concentrations and observations in forensic cases. *Forensic Sci Int, 140*(1), 85-90.

U.N. (1971). Convention on psychotropic substances: United Nations.

UNDP (2001). *Human Development Report 2001 Somalia*. New York: United Nations Development Program.

UNHCR (2005). *2004 global refugee trends*. Geneva: UNHCR.

UNICEF (2003). *From perception to reality. A study on child protection in Somalia.* Nairobi: UNICEF Somalia.

UNODC (1956). Khat. *Bulletin on Narcotics, 8*(4), 6-12.

UNODC (1999). *The drug nexus in Africa*. Vienna: United Nations Office for Drug Control and Crime Prevention.

UNODC (2002). East Africa drug information system, EADIS, first annual meeting, November 26-28, 2001, Nairobi, Kenya. United Nations International Drug Control Program. Vienna: United Nations Office for Drug Control and Crime Prevention.

UNODC (2004). *World Drug Report 2004*. New York: United Nations.

UNODC (2005). *Bi-annual seizure report 2005/1*. Vienna: United Nations Office on Drugs and Crime.

Van Ommeren, M., de Jong, J. T., Sharma, B., Komproe, I., Thapa, S. B., & Cardena, E. (2001). Psychiatric disorders among tortured Bhutanese refugees in Nepal. *Arch Gen Psychiatry, 58*(5), 475-482.

Van Zelst, W. H., de Beurs, E., Beekman, A. T., Deeg, D. J., Bramsen, I., & van Dyck, R. (2003). Criterion validity of the Self-Rating Inventory for Posttraumatic Stress Disorder (SRIP) in the community of older adults. *J Affect Disord, 76*(1-3), 229-235.

Ward, C. (2000). *Yemen: CDR Qat.* Washington, D.C.: World Bank.

Weathers, F., Litz, B., Huska, I., & Keane, T. (1994). *The PTSD Checklist-Civilian Version (PCL-C): Scale available from the National Center for PTSD*. Boston, US: Boston VA Medical Center.

Weir, S. (1985). *Qat in Yemen: Consumption and social change*. London: British Museum Publications Limited.

Welzl, H., D'Adamo, P., & Lipp, H. P. (2001). Conditioned taste aversion as a learning and memory paradigm. *Behav Brain Res, 125*(1-2), 205-213.

White, S. M., Kucharik, R. F., & Moyer, J. A. (1991). Effects of serotonergic agents on isolation-induced aggression. *Pharmacol Biochem Behav, 39*(3), 729-736

WHO (1983). *Report of the WHO inter-country meeting on the health, social and economic aspects of khat, Mogadishu, 24 - 28 October 1983*. Geneva: World Health Organization.

Widler, P., Mathys, K., Brenneisen, R., Kalix, P., & Fisch, H. U. (1994). Pharmacodynamics and pharmacokinetics of khat: A controlled study. *Clin Pharmacol Ther, 55*(5), 556-562.

Woolverton, W. L., & Johanson, C. E. (1984). Preference in rhesus monkeys given a choice between cocaine and d,l-cathinone. *J Exp Anal Behav, 41*(1), 35-43.

Worldbank. (1999). *Groundwater: Legal and policy perspectives; World Bank Technical Paper no. 456*. Washington, D.C.: World Bank.

Worldbank. (2001). *Yemen economic update, issue 6*. Sana'a: The World Bank Group Sana'a Office.

Worldbank. (2005). *Yemen economic update, spring 2005*. Sana'a: World Bank Sana'a Country Office.

World Health Organization. (2001). *The World Health Report 2001: Mental health: New understanding new hope*. Geneve: World Health Organization.

World Health Organization. (1997). *Composite International Diagnostic Interview (CIDI): Core version 2.1* (Version 1.1. ed.). Geneva: World Health Organization.

Yanagita, T. (1986). Intravenous self-administration of (-)-cathinone and 2-amino-1-(2,5-dimethoxy-4-methyl)phenylpropane in rhesus monkeys. *Drug Alcohol Depend, 17*(2-3), 135-141.

Yousef, G., Huq, Z., & Lambert, T. (1995). Khat chewing as a cause of psychosis. *Br J Hosp Med, 54*(7), 322-326.

Yui, K., Ikemoto, S., Goto, K., Nishijima, K., Yoshino, T., & Ishiguro, T. (2002). Spontaneous recurrence of methamphetamine-induced paranoid-hallucinatory states in female subjects: Susceptibility to psychotic states and implications for relapse of schizophrenia. *Pharmacopsychiatry, 35*(2), 62-71.

Zammit, S., Allebeck, P., Andreasson, S., Lundberg, I., & Lewis, G. (2002). Self reported cannabis use as a risk factor for schizophrenia in Swedish conscripts of 1969: Historical cohort study. *Bmj, 325*(7374), 1199.

Zein, Z. A. (1988). Polydrug abuse among Ethiopian university students with particular reference to khat (catha edulis). *J Trop Med Hyg, 91*(2), 71-75.

Zelger, J. L., Schorno, H. X., & Carlini, E. A. (1980). Behavioural effects of cathinone, an amine obtained from catha edulis forsk.: Comparisons with amphetamine, norpseudoephedrine, apomorphine and nomifensine. *Bull Narc, 32*(3), 67-81.

Zilberg, N. J., Weiss, D. S., & Horowitz, M. J. (1982). Impact of event scale: A cross-validation study and some empirical evidence supporting a conceptual model of stress response syndromes. *J Consult Clin Psychol, 50*(3), 407-414.

Zimmerman, M., & Mattia, J. I. (1999). Psychotic subtyping of major depressive disorder and posttraumatic stress disorder. *J Clin Psychiatry, 60*(5), 311-314.

Zubin, J., Magaziner, J., & Steinhauer, S. R. (1983). The metamorphosis of schizophrenia: From chronicity to vulnerability. *Psychol Med, 13*(3), 551-571