Ischemic Stroke as a Health Concern in Young Adults

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ISCHEMIC STROKE AS A HEALTH CONCERN IN YOUNG ADULTS

by

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ABSTRACT

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Stroke is the fourth leading cause of death in the United States and one of the leading causes of long-term disability. Surprising to many, recent data from the Nationwide Inpatient Sample showed that 4.9% of all strokes in the United States occurred in individuals who were between 18 and 44 years of age. Moreover, stroke in young adults appears to be increasing. Therefore, a better understanding of the root causes of stroke in this age group, as well as detailed examination of outcome, was sought via a review of contemporary research. While studies highlight traditional risk factors such as hypertension, dyslipidemia, and smoking to be the most predominant risk factors, lesser known risk factors such as oral contraceptive use, alcohol consumption, and migraine play a role as well. Risk of mortality and recurrence after stroke are favorable in the young; however, functional ability, occupational status, and quality of life may be compromised. Studies have shown that many of the risk factors for stroke in the young adult are modifiable. Therefore, this study suggests a need for increased stroke awareness and education in order to decrease the negative affects of modifiable vascular risk factors associated with stroke in the young adult.

KEYWORDS: ischemic stroke, young adult, risk factors, prognosis
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CHAPTER ONE

Introduction

Recent stroke statistics from the American Heart Association (AHA) highlight stroke as the fourth leading cause of death in the United States (Go et al., 2013). Ischemic stroke remains a leading cause of death and disability around the world. While stroke has been long associated with the elderly, recent studies show an increasing trend of ischemic stroke in young adults (Kiservlet et al., 2012). Ischemia refers to the occlusion of blood flow to the brain and contributes to 87% of all strokes (Go et al., 2013). In 2007, data from the Nationwide Inpatient Sample showed that 4.9% of all strokes in the United States occurred in individuals who were between 18 and 44 years of age (Ellis, 2010). Increased incidence among young adults necessitates specific attention to this population.

Many risk factors contribute to ischemic stroke. Traditional risk factors such as hypertension, dyslipidemia, and smoking have long been associated with stroke in young adults; however, evidence suggests other lesser known risk factors including alcohol consumption, migraine, and oral contraceptive use may help explain the increasing trend. Findings suggest that traditional risk factors are among the most prevalent for ischemic stroke in young adults; however, lesser known risk factors might also play a role.

While risk of mortality is low in young stroke patients compared to the elderly stroke population, death rates are elevated compared to the young in the general population. Additionally, recurrence is a strong possibility, especially considering young adults typically have more years to live than the elderly. Further, ischemic stroke can have devastating effects among young adult survivors. Functional disability, social and
cognitive deficits, financial burden, as well as risk of recurrence potentially pose additional challenges to this population.

This thesis will examine traditional and lesser known risk factors for ischemic stroke in young adults. Further, it will report prognosis, including mortality, recurrence, functional disability, occupational status, and quality of life. Inconsistencies on what ages constitute young adult arise throughout studies. In the studies examined, ages ranged from 15 to 54 years old. For purposes of this paper, young adult is defined as persons 15 to 45 years, unless otherwise noted.
CHAPTER TWO

Background

Definition of Stroke

The U.S. Department of Health and Human Services Centers for Disease Control and Prevention (2003) formally defined stroke as “a sudden impairment of brain function, sometimes termed ‘brain attack’ that results from interruption of circulation to one or another part of the brain following either occlusion or hemorrhage of an artery supplying that area.” There are two predominant types of stroke, ischemic and hemorrhagic.

Ischemic stroke accounts for 87% of strokes (Go et al., 2013) and occur when there is an obstruction of blood flow to one or more parts of the brain. Lack of blood flow, also known as ischemia, causes oxygen deprivation and, consequently, results in the death of neurons. Ischemia may result in further damage to the brain in the form of inflammation and edema, hours to days after the initial event. The most common contributor to ischemic stroke is a thrombus, or obstructive blood clot. A thrombus occurs when a clot forms on the wall of a blood vessel, impairing blood flow. A clot that breaks off the wall and travels through the blood stream is referred to as an embolus. Another contributor to ischemic stroke is atherosclerosis, or the buildup of plaque on the inside wall of a blood vessel. As the plaque grows, the blood vessel walls narrow, impairing blood flow. Transient ischemic attack (TIA) is similar to an ischemic stroke, except duration of symptoms in a TIA last less than 24 hours. Despite their short occurrence, TIAs are capable of causing considerable damage to the brain, and serve as a
warning. Up to 20% of patients who experience a TIA, will have an ischemic stroke within 90 days (Stroke: Challenges, progress, and promise).

Hemorrhagic stroke occurs when a blood vessel ruptures in the brain (intracerebral hemorrhage) or within the subarachnoid space (subarachnoid hemorrhage). During a hemorrhagic stroke, red blood cells, white blood cells, and other molecules break through the blood brain barrier and into the susceptible space around neurons. The blood is toxic for the neurons and disrupts the highly regulated environment that neurons need to survive. The buildup of blood may lead to an increase in intracranial pressure, thus decreasing normal blood flow and resulting in further damage to the brain. The lack of blood flow through the arteries after the rupture can also be a cause of death to the neurons (Stroke: Challenges, progress, and promise).

Incidence and Prevalence

According to the AHA 2013 Statistical Update of Heart Disease and Stroke, each year approximately 795,000 people experience a stroke, of which, 610,000 are first attacks and 185,000 are recurrent attacks (Fig. 1). Of all strokes, 87% are ischemic, 10% are intracerebral hemorrhagic strokes, and 3% are subarachnoid hemorrhagic strokes. Gender differences exist in stroke incidence. Each year, approximately 55,000 more women than men experience a stroke, and women have a higher lifetime risk of stroke. However, women have lower age-adjusted stroke
incidence than men (Go et al., 2013). Racial disparities also affect incidence of stroke. Data from the Northern Manhattan Stroke Study (NOMASS) found the age-adjusted incidence of first ischemic stroke per 1000 was 0.88 in whites, 1.91 in blacks, and 1.49 in Hispanics (Jacobs, Boden-Albala, Lin, & Sacco, 2002). When exclusively looking at young adults, racial differences remain (Jacobs, Boden-Albala, Lin, & Sacco, 2002). The GCNKSS reports that among young adults, blacks have almost three times the incidence than white patients (Kissela et al. 2012).

![Leading Causes of Death in U.S. (2010)](chart.png)

Figure 2: Chart was made using data from American Heart Association 2013 Statistical Update.

Stroke is the fourth leading cause of death in the United States, behind heart disease, cancer, and chronic lower respiratory disease (Fig. 2). In 2009, stroke accounted for approximately 1 out of every 19 deaths in the United States; however, a marked decrease in the number of deaths caused by stroke has been observed. From 1999 to 2009, the stroke death rate decreased by 36.9%. Decreases have most notably been observed among men and in individuals 65 years of age or older (Go et al., 2013).
While stroke death rates in older individuals appear to be declining, a new trend highlights an increase in stroke incidence in young adults. In 2007, data from the Nationwide Inpatient Sample showed that 4.9% of all strokes in the United States occurred in individuals who were between 18 and 44 years of age (Ellis, 2010). Moreover, stroke in this age group appears to be increasing. As shown in Figure 3, findings from the Greater Cincinnati/Northern Kentucky Stroke Survey (GCNKSS) show stroke incidence increased among individuals aged 20-44 years from 4.1% to 4.6% to 6.4% in 1993/1994, 1999, and 2005, respectively. When individuals aged 20-54 years in the same study were included, incidence increased from 12.9% to 13.3% to 18.5% between study periods (Kissela et al., 2012). The latter set of data included a broader age range and incidence rate was notably higher. This data reveals how inclusion of different age ranges can produce important changes in data, and that many strokes in young adults are among the “older” young adults. Although this data included both ischemic and
hemorrhagic stroke, the study reported the most significant increases in incidence occurred in ischemic stroke. Studies suggest that increases in incidence in young adults probably mirror increases in risk factors such as diabetes, obesity, hypertension, and smoking in this population (Kissela et al., 2012, George et al., 2011).
CHAPTER THREE

Risk Factors

Predominant Risk Factors

The AHA identifies three types of risk factors for stroke: nonmodifiable, well-documented and modifiable, and less well-documented or potentially modifiable. Although the AHA refers to the latter as less well-documented or potentially modifiable, for the practicality of this paper, these factors will be referred to as lesser known risk factors. Nonmodifiable risk factors include age, gender, race, ethnicity, and heredity. Well-documented and modifiable risk factors, typically known as traditional risk factors, include diabetes mellitus, hypertension, dyslipidemia, coronary heart disease, and cigarette smoking. Lesser known risk factors include alcohol consumption, history of migraine, and oral contraceptives (Sacco et al., 1997).

Increases in ischemic strokes in young adults may be attributed to an increase in traditional risk factors such as diabetes mellitus, hypertension, and obesity. However, this increasing trend may also be due to increasing trends in lesser known risk factors in young adults including substance abuse, smoking, and the use of oral contraceptives. (de los Ríos et al., 2012).
Table 1: Three most predominant risk factors and frequencies in ischemic stroke in young adults. Note: Under the column Type of Stroke, I refers to ischemic stroke and H refers to hemorrhagic stroke.

<table>
<thead>
<tr>
<th>Study</th>
<th>Location</th>
<th>Age (years)</th>
<th>n</th>
<th>Three Predominant Risk Factors</th>
<th>Frequency (%)</th>
<th>Type of Stroke</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kissela et al. (2012)</td>
<td>Greater Cincinnati/Northern Kentucky, USA</td>
<td>20-54</td>
<td>293</td>
<td>Hypertension</td>
<td>52.2</td>
<td>I &amp; H</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Smoking</td>
<td>45.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Obesity</td>
<td>43.8</td>
<td></td>
</tr>
<tr>
<td>Putaala et al. (2009a)</td>
<td>Helsinki, Finland, Europe</td>
<td>15-49</td>
<td>1008</td>
<td>Dyslipidemia</td>
<td>59.5</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Smoking</td>
<td>44.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hypertension</td>
<td>39.1</td>
<td></td>
</tr>
<tr>
<td>Putaala et al. (2009b)</td>
<td>Europe</td>
<td>15-49</td>
<td>3944</td>
<td>Dyslipidemia</td>
<td>45.8</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Smoking</td>
<td>48.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hypertension</td>
<td>35.9</td>
<td></td>
</tr>
<tr>
<td>von Sarowski et al.</td>
<td>Europe</td>
<td>18-44</td>
<td>1787</td>
<td>Smoking</td>
<td>54.7</td>
<td>I (includes TIA)</td>
</tr>
<tr>
<td>(2013)</td>
<td></td>
<td></td>
<td></td>
<td>Physical Inactivity</td>
<td>44.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hypertension</td>
<td>29.3</td>
<td></td>
</tr>
<tr>
<td>Kappelle et al. (1994)</td>
<td>Iowa, USA</td>
<td>15-45</td>
<td>296</td>
<td>Smoking</td>
<td>57.0</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hypertension</td>
<td>29.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hyperlipidemia</td>
<td>21.0</td>
<td></td>
</tr>
<tr>
<td>Kaku et al. (1990)</td>
<td>San Francisco, CA, USA</td>
<td>15-44</td>
<td>214</td>
<td>Smoking</td>
<td>36.0</td>
<td>I &amp; H</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Drug Abuse</td>
<td>34.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hypertension</td>
<td>22.0</td>
<td></td>
</tr>
</tbody>
</table>

In Table 1, data from six studies was gathered to determine the three most predominant risk factors of each study. The location of the study, age ranges of participants, population (n), as well as the type of stroke (ischemic or hemorrhagic) were included. The three most predominant risk factors from each study were listed in order of their frequency. The frequencies reported were not mutually exclusive, because more than one risk factor might be present in one individual. Many risk factors, particularly the traditional vascular risk factors, co-exist. For example, if a patient were obese, hypertension and dyslipidemia would both be more likely.
In general, most studies found the predominant risk factors to be traditional risk factors including hypertension, smoking, and dyslipidemia. This is not surprising considering these risk factors directly affect the vascular system. While the general findings between studies are fairly consistent, several differences exist.

Arguably, differences in the most predominant risk factors may be due to differences in the design of each study. For example, age ranges are not consistent, and, as shown in Figure 3, when including larger age ranges, the frequency of risk factors increases. Also, location was limited to studies in the United States and Europe. Studies from other countries are needed to determine if findings would remain consistent.

Differences are also observed depending on what type of stroke was included in the study. For example, von Sarnowski et al. (2013) included TIAs with ischemic stroke, possibly skewing the frequencies. It cannot be determined if these frequencies would remain as elevated if the study only included ischemic strokes. Also, Kaku et al. (1990) found drug abuse to be a predominant risk factor; however, the study includes both ischemic and hemorrhagic stroke. The study did not identify which risk factors were seen in which stroke subtype; however, it can be assumed that drug abuse would not be among the top three predominant risk factors if the study only included ischemic stroke. As the paper will later discuss, drug abuse is more commonly associated with hemorrhagic stroke than ischemic stroke.

Other differences in the studies are due to differences in what risk factors were included in the study, as well as how these risk factors were defined. Von Sarnowski et al. (2013) included physical inactivity as a separate risk factor from obesity, whereas most studies did not. Had physical inactivity not been included, dyslipidemia would have
been the third most predominant risk factor of this study with 23.7% frequency. In the study by Kappelle et al. (1994), hyperlipidemia was included as a risk factor, rather than dyslipidemia. Hyperlipidemia cannot be compared with dyslipidemia because they have two different definitions. Hyperlipidemia refers to high lipid levels, whereas dyslipidemia refers to an abnormal amount of lipid levels, either too high or too low (Kappelle et al., 1994). Since hyperlipidemia and dyslipidemia have two different definitions, these factors cannot be compared across studies.

Males most often had traditional risk factors, including dyslipidemia and smoking, whereas females experienced other lesser known risk factors, specifically migraine and oral contraceptive use, with greater frequency. Additionally, females were more likely to be ≤35 years, while males were often older (Putaala et al, 2009a).

Among the less well-documented risk factors, alcohol consumption was more common in men and migraine was more common in women. Risk factors were more often seen in persons over the age of 45, further illustrating that traditional risk factors increase with age (von Sarnowski et al., 2013).
As shown in Figure 4, the Helenski Young Stroke Registry in Helenski, Finland found the most common risk factors in patients aged 15-49 years with first-ever ischemic stroke are dyslipidemia (60%), smoking (44%), and hypertension (39%). The study further broke down the risk factors that occurred in patients aged 15 to 44 years. When comparing the risk factors in patients aged 15 to 44 years to those 15 to 49 years, dyslipidemia, smoking, and hypertension remained the most predominant risk factors; however, these factors occurred at lower frequencies (50%, 42%, and 28%, respectively). Traditional risk factors were more frequent in men and in individuals over 44. Additionally, other lesser known risk factors, such as migraine and oral contraceptive use, were more frequent in 15 to 44 year olds than in the more inclusive age range (Putaala et al., 2009b). These differences among age groups suggest that as age increases...
so do traditional vascular risk factors, while lesser known risk factors may be more common in younger populations.

It is not surprising that the traditional risk factors, particularly hypertension and smoking, are the most predominant risk factors among young adults. More than 75% of individuals who have a stroke for the first time have a blood pressure greater than 140/90 mm Hg (Go et al., 2013). While this includes all age ranges, hypertension proves to be a powerful risk factor in young adults (Putaala et al., 1999a; Putaala et al., 1999b; von Sarnowski et al., 2013; Janssen, de Leeuw, & Janssen, 2011). Additionally, the AHA (2013) reports that individuals who are current smokers have a two to four times increased risk of all types of stroke compared to nonsmokers. Evidence also suggests that there is a relationship between dose and risk of stroke, and cessation of smoking is associated with reduced risk of stroke (Go et al., 2013). The CDC estimates that almost 20% of Americans are current smokers, with frequencies highest among young adults (2011).

Lesser Known Risk Factors

Well-known and modifiable risk factors may be the most prominent risk factors among young adults; however, although more controversial, lesser known risk factors such as substance abuse, alcohol consumption, migraine, and oral contraceptive use play a role in ischemic stroke in young adults as well.

Substance Abuse. According to National Survey on Drug Use and Health (NSDUH), in 2010, an estimated 22.1 million Americans (almost 9% of the population) were classified with substance abuse or dependence based on criteria outlined in the
Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV). This included individuals who abused illicit drugs, alcohol, or both (Substance Abuse and Mental Health Service Administration, 2011).

Drug abuse is a well-established risk factor for stroke in young adults and continues to become a growing concern (Mohr et al., 2011). The NSDUH estimated that nearly 22.6 million Americans reported using an illicit drug in the month prior to the survey. Among users, young adults reported the highest frequency of illicit drug abuse (2011).

![Figure 5: Chart made using information from data from study by Kaku & Lowenstein (1990)](image)

In one of the first major studies exploring the relationship between drug abuse and stroke (Fig. 5), drug abuse was found to be one of the predominant risk factors in the study. Almost half (45%) of patients reported cocaine use, followed by heroin (38%), amphetamine (29%), and methylphenidate (10%). These factors were not mutually exclusive; in fact, nearly 30% of patients reported using more than one drug. While the study was not limited to the young adult population, it did report that drug abuse
prevalence was greater in individuals 35 years or younger. However, this study includes both hemorrhagic and ischemic strokes. The study concluded that drug abuse was more often related to hemorrhagic stroke than ischemic stroke and did not specify frequencies of drug abuse in ischemic stroke alone (Kaku & Lowenstein, 1990).

More recently, the GCNKSS found that drug abuse trends increased over time, most notably in the young; however, drug abuse was only reported in 4% of ischemic strokes, compared to 26% reported in hemorrhage stroke (Kissela et al., 2012). In general, while drug abuse is a risk factor for ischemic stroke in young adults, findings indicate it is most often associated with hemorrhagic stroke. Therefore, drug abuse poses a minimal threat for ischemic stroke in young adults.

Alcohol Consumption. Although many studies have examined the relationship between alcohol and stroke, data is limited on the risk in the young. In fact, no studies specifically looked at ischemic stroke in young adults. However, general patterns between studies emerged, suggesting this pattern may exist in the young as well.

Figure 6: Chart made using data from Sacco et al., 1999.
Across studies, no alcohol consumption was associated with a low risk of stroke and heavy alcohol consumption was associated with a higher risk. Surprisingly, many studies reported a protective effect of moderate alcohol consumption. Therefore, many studies feature a J-shape relationship between alcohol consumption and stroke.

The study featured in Figure 6 demonstrates the J-relationship between alcohol and stroke (Sacco et al., 1999). This relationship was determined using odds ratios. An odds ratio (OR) represents the likelihood something would occur given a particular exposure compared to the odds the event would occur in absence of exposure. For example, if the odds ratio of alcohol consumption for ischemic stroke in young adults was equal to one, that would mean there was neither an increased nor decreased risk compared to those who do not consume alcohol. Further, an OR greater than 1 is associated with a higher risk and an OR less than 1 is associated with a lower risk (Szumilas, 2010).

In the study featured in Figure 6, nondrinkers had an OR=1, while moderate drinkers (up to two drinks per day) had an OR=.51, and heavy drinkers (more than five drinks per day) had an OR=1.63 (Sacco et al., 1999). Although studies differed on definitions of moderate and heavy drinking, the J-shape relationship remained fairly consistent (Mukamel et al., 2005; Malarcher et al., 2001). The Stroke Prevention in Young Women study claimed women who were current, light to moderate drinkers had an almost 40% less chance of ischemic stroke than women who did not drink (Malarcher et al., 2001). The protective effect of moderate alcohol consumption has yielded inconsistent results across studies (Camargo, 1998; Sacco et al., 1999; Malarcher, 2001).
Differences regarding the protective effect of moderate alcohol consumption and stroke may be due to racial disparities. For example, studies of white populations found protective effects among light to moderate drinkers, whereas Asian populations have found no association (Camargo, 1998). However, other studies reported no significant differences between races (Sacco et al., 1999; Malacher et al., 2001). Not surprisingly, these results mirror debates about the role of alcohol consumption and cardiovascular health.

Some studies have shown that type of alcohol may have a relationship with incidence of ischemic stroke. Red wine consumption was inversely associated with ischemic stroke risk, which was significantly different when compared to white wine and liquor (Mukamel et al., 2005). Additionally, red wine may have potential vascular benefits. The Stroke Prevention in Young Women Study found that wine consumption might reduce the risk of stroke by 50%, although this was not limited to only red wine (Malarcher et al., 1990). However, not all studies observed a relationship between type of beverage and risk of stroke.

In general, most studies observed a J-shaped relationship between ischemic stroke and alcohol consumption. Findings differed on definitions of moderate and heavy alcohol consumption. Some studies included only women, only men, or both types of stroke. Despite this, heavy alcohol consumption was consistently a risk factor for ischemic stroke. Although none of the studies observed specifically looked at the risk in the young, it can be assumed that the risk is similar in this population, especially considering heavy drinking is a popular trend in young adults.
Migraine. Migraine has more recently been investigated as a possible risk factor for ischemic stroke in young adults, especially in young women (Carolei et al., 1996; George et al., 2011). Migraine is a chronic headache disorder that is often accompanied with nausea and visual disturbances (Mohr et al., 2011). Both migraine without aura (OR 3) and migraine with aura (OR 6.2) were associated with ischemic stroke in young women (Tzouri et al., 1995). The role of migraine as a risk factor for ischemic stroke decreases with age (Mohr et al., 2011). A large case-control study found 25% of young European women (20-44 years) who experienced a stroke reported a personal history of migraine and 25% reported a family history of migraine. The risk of ischemic stroke among young European women was increased more than threefold if they experienced migraines. Additionally, stroke may directly extend from a migraine attack in up to 40% of young women with migraines (Chang, Donaghy, and Poulter, 1999; Mohr et al., 2011).

Oral contraceptives. In the 1970s, shortly after oral contraceptives were introduced in the United States, the risk of stroke among women using oral contraceptives was five times greater than in non-users. This increase in risk of stroke included all stroke subtypes. Elevated risk was most evident in women older than 35 years and women who had other cardiovascular risk factors, specifically cigarette smoking and hypertension (Mohr et al., 2011). As the estrogen content in oral contraceptives was lowered, so did the risk of stroke in woman using them (Bousser & Kittner, 2001).

The risk of stroke in modern, low-dose oral contraceptives is less clear. Generally, there was no increased risk of stroke with low-dose oral contraceptives unless additional vascular risk factors were present (Bousser, 2004; Tzouri et al., 1995; WHO,
1996; Schwartz, 1997; Bousser & Kittner, 2000; Mohr et al., 2011). Moreover, there appears to be a synergistic effect for ischemic stroke in those with multiple risk factors, namely, migraine, smoking, and oral contraceptive use (Chang, Donaghy, & Poulter, 1999; Schwartz et al. 1997).

A study conducted by the World Health Organization (WHO, 1996), shown in Figure 7, claimed there was no increased risk of stroke with low-dose oral contraceptives (OR 1.53). However, when other risk factors such as smoking, hypertension, and migraine coexisted with oral contraceptive use, the OR increased (Bousser, 2004; Tzouri et al., 1995; WHO, 1996; Schwartz, 1997; Bousser & Kittner, 2000; Mohr et al., 2011). The risk further increased when multiple risk factors coexisted. The WHO study found the odds ratio reached 34.4 in women who experienced migraines, used oral contraceptives, and smoked (1996).

![Figure 7: Chart made using data from the World Health Organization Study (1996). Odds Ratio of oral contraceptive use and migraine was obtained from Tzouri et al. (1995).](image)
Overall, the absolute risk of stroke among oral contraceptive users is fairly low (only 6.7 women per 100,000 women in those who use a low-dose oral contraceptive). Women younger than 35 who use oral contraceptives and have no other vascular risks have a 1 per 200,000 risk of stroke. Oral contraceptive use alone does not pose a substantial increase in risk of stroke, but when other vascular risk factors are present the risk of stroke markedly increases (Bousser & Kittner, 2000).
CHAPTER FOUR

Prognosis

Mortality & Recurrence

Short-term prognosis is favorable in young adults, with low rates of mortality and recurrence. However, recurrence is possible, especially if young adults do not adapt to lifestyle changes after stroke. Further, long-term prognosis can have a considerable impact, affecting functional ability, occupational status, and quality of life.

Generally, long-term risk of mortality after ischemic stroke in young adults is minimal. Figure 8 shows mortality rates in four studies. Although follow-up time differed, the studies observed a similar trend; mortality is highest in the first year after stroke, and decreases in subsequent years (Leys et al., 2002; Kappelle et al., 1994; Varona et al., 2004; Putaala et al., 2009a).

![Mortality Rates After Ischemic Stroke in Young Adults](image)

**Figure 8:** Mortality rates in four studies of ischemic stroke in young adults.

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Often, the type of stroke predicted prognosis. Mortality and recurrence occurred more frequently in patients whose initial stroke was caused by large-vessel atherosclerosis compared with strokes of other subtypes (Kappelle et al., 1994; Putaala et al., 2009a). Some risk factors were more frequently associated with mortality. Malignancy, heavy drinking, and diabetes predicted death during follow-up (Putaala et al., 2009a). Additionally, male gender, and unfavorable initial course (patients with severe handicaps at discharge) were associated with mortality (Varona, Bermejo, Guerra, & Molina, 2004), as well as myocardial infarction and epileptic seizures (Leys et al., 2002).

Like mortality, recurrence rate is highest in the first year after stroke, but decreases in subsequent years (Leys et al. 2002; Varona, Bermejo, Guerra, & Molina, 2004). Risk factors associated with recurrence include age over 35 years, hypertension, and the presence of cardiovascular risk factors, especially diabetes mellitus (Varona, Bermejo, Guerra, & Molina, 2004; Naess, Nyland, Thomassen, Aarseth, & Myhr, 2004). With risk of recurrence as a potential threat, some patients chose to modify their current lifestyle in order to reduce risk of recurrence. Between the two studies that reported lifestyle changes after ischemic stroke in young adults, almost all women discontinued use of oral contraceptives. One study reported 91% of hypertensive patients received treatment after stroke (Kappelle et al., 1994), while another study reported only about 33% received treatment (Leys et al., 2002). Surprisingly, both studies reported that around one-fourth of patients quit smoking after stroke (Kappelle et al., 1994; Leys et al., 2002).
Although mortality and recurrence rates are generally low in young adults, the threat still exists. Generally, mortality and recurrence rates are highest in the first year after stroke and decrease in subsequent years (Leys et al., 2002). Additionally, prognosis worsens with age (Kapelle et al., 1994; Putaala et al., 2009; Varona, Bermejo, Guerra, & Molina, 2004). Despite low rates of mortality and recurrence, other factors such as functional disability, occupational status, and quality of life might be compromised.

Functional Disability

The U.S. Centers for Disease Control and Prevention (2009) found stroke to be the leading cause of serious long-term disability. In 2008, The AHA estimated that there are 5.8 million individuals experiencing functional limitations as a result of a stroke (Vanhook, 2009). Results vary across studies concerning the functional outcome of young adults after ischemic stroke. Generally, rate of disability among young adults after first-ever ischemic stroke is generally low, especially when compared with the elderly.

Five studies reported functional disability after stroke in young adults. On average, 81% of patients were considered independent following stroke (range 74%-88%). This outcome is favorable when compared to only 60%-65% of the elderly obtaining independence (Kappelle et al., 1994; Leys et al., 2002; Varona, Bermejo, Guerra, & Molina, 2004; Ferro & Crespo, 2004; Naess, Waje-Andreassen, Thomassen, Nyland, & Myhr, 2006). Independence was measured using the modified Rankin Scale (Fig. 9) and the Barthel Index (Fig. 10). The modified Rankin Scale gives a patient a score based on level of disability after a stroke (Van Swieten, Koudstaal, Visser, Shouten, & van Gijn, 1988). The Barthel Index ranks the level of functioning for ten activities of
daily living including feeding, bathing, and toilet use (Mahoney & Barthel, 1965). The major predictor of independence was the severity of the initial stroke (Ferro & Crespo, 1994). Although the studies generally demonstrated favorable outcomes, one study reported almost 11% of patients with severe disability (Kappelle et al., 1994). While outcome is generally good for young adults after ischemic stroke, other forms of impairment exist, including limitations in occupational status and quality of life.

<table>
<thead>
<tr>
<th>MODIFIED RANKIN SCALE (MRS)</th>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>No symptoms at all</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>No significant disability despite symptoms; able to carry out all usual duties and activities</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Slight disability; unable to carry out all previous activities, but able to look after own affairs without assistance</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Moderate disability; requiring some help, but able to walk without assistance</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Moderately severe disability; unable to walk without assistance and unable to attend to own bodily needs without assistance</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Severe disability; bedridden, incontinent and requiring constant nursing care and attention</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Dead</td>
</tr>
</tbody>
</table>

**TOTAL (0–6):**

*Figure 9: Van Swieten, Koudstaal, Visser, Schouten, & van Gijn (1988)*
<table>
<thead>
<tr>
<th>Activity</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FEEDING</strong></td>
<td></td>
</tr>
<tr>
<td>0 = unable</td>
<td></td>
</tr>
<tr>
<td>5 = needs help cutting, spreading butter, etc., or requires modified diet</td>
<td></td>
</tr>
<tr>
<td>10 = independent</td>
<td></td>
</tr>
<tr>
<td><strong>BATHING</strong></td>
<td></td>
</tr>
<tr>
<td>0 = dependent</td>
<td></td>
</tr>
<tr>
<td>5 = independent (or in shower)</td>
<td></td>
</tr>
<tr>
<td><strong>GROOMING</strong></td>
<td></td>
</tr>
<tr>
<td>0 = needs to help with personal care</td>
<td></td>
</tr>
<tr>
<td>5 = independent face/hair/teeth/shaving (implements provided)</td>
<td></td>
</tr>
<tr>
<td><strong>DRESSING</strong></td>
<td></td>
</tr>
<tr>
<td>0 = dependent</td>
<td></td>
</tr>
<tr>
<td>5 = needs help but can do about half unaided</td>
<td></td>
</tr>
<tr>
<td>10 = independent (including buttons, zips, laces, etc.)</td>
<td></td>
</tr>
<tr>
<td><strong>BOWELS</strong></td>
<td></td>
</tr>
<tr>
<td>0 = incontinent (or needs to be given enemas)</td>
<td></td>
</tr>
<tr>
<td>5 = occasional accident</td>
<td></td>
</tr>
<tr>
<td>10 = continent</td>
<td></td>
</tr>
<tr>
<td><strong>BLADDER</strong></td>
<td></td>
</tr>
<tr>
<td>0 = incontinent, or catheterized and unable to manage alone</td>
<td></td>
</tr>
<tr>
<td>5 = occasional accident</td>
<td></td>
</tr>
<tr>
<td>10 = continent</td>
<td></td>
</tr>
<tr>
<td><strong>TOILET USE</strong></td>
<td></td>
</tr>
<tr>
<td>0 = dependent</td>
<td></td>
</tr>
<tr>
<td>5 = needs some help, but can do something alone</td>
<td></td>
</tr>
<tr>
<td>10 = independent (on and off, dressing, wiping)</td>
<td></td>
</tr>
<tr>
<td><strong>TRANSFERS (BED TO CHAIR AND BACK)</strong></td>
<td></td>
</tr>
<tr>
<td>0 = unable, no sitting balance</td>
<td></td>
</tr>
<tr>
<td>5 = major help (one or two people, physical), can sit</td>
<td></td>
</tr>
<tr>
<td>10 = minor help (verbal or physical)</td>
<td></td>
</tr>
<tr>
<td>15 = independent</td>
<td></td>
</tr>
<tr>
<td><strong>MOBILITY (ON LEVEL SURFACES)</strong></td>
<td></td>
</tr>
<tr>
<td>0 = immobile or &lt; 50 yards</td>
<td></td>
</tr>
<tr>
<td>5 = wheelchair independent, including corners, &gt; 50 yards</td>
<td></td>
</tr>
<tr>
<td>10 = walks with help of one person (verbal or physical) &gt; 50 yards</td>
<td></td>
</tr>
<tr>
<td>15 = independent (but may use any aid; for example, stick) &gt; 50 yards</td>
<td></td>
</tr>
<tr>
<td><strong>STAIRS</strong></td>
<td></td>
</tr>
<tr>
<td>0 = unable</td>
<td></td>
</tr>
<tr>
<td>5 = needs help (verbal, physical, carrying aid)</td>
<td></td>
</tr>
<tr>
<td>10 = independent</td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL (0–100):**

*Figure 10: Mahoney & Barthel (1965)*
Occupational Status

Ischemic strokes that occur in young adults often occur during a patient’s academic or occupational life. Stroke can have a considerable impact on employment, which can be particularly devastating in young adults. Information on occupational status after ischemic stroke in young patients was collected from four different studies. On average, 57% of patients returned to work after stroke (range 42%-73%). Further, many individuals who returned to work had to make adjustments, such as work part-time (Kappelle et al., 1994; Leys et al., 2002; Varona, Bermejo, Guerra, & Molina, 2004; Ferro & Crespo, 2004). It is surprising that only 57% of patients return to work, when 81% were identified as independent after stroke.

Factors that may be associated with unemployment include fatigue, depression, and social and cognitive deficits (Naess, Nyland, Thomassen, Aarseth, & Myhr, 2004). Additionally, severe disability relates to unemployment (Varona, Bermejo, Guerra, & Molina, 2004). Conversely, those who were married and were more educated were more likely to be employed (Naess, Nyland, Thomassen, Aarseth, & Myhr, 2004).

Overall, about 57% of young adults return to work after ischemic stroke and many have to make adjustments in their occupational life as a result of a stroke. While functional disability is generally low, the unemployment rate among this population is considerably high in comparison.

Quality of Life

While functional disability outcomes after stroke in young adults is generally favorable, major disruptions appear to be in the individual’s quality of life. Quality of
life is measured using the eight subscales of the Short-Form General Health Survey. The eight subscales include: physical functioning, role limitations due to physical problems, bodily pain, general health perceptions, vitality, social functioning, role limitations due to emotional problems, and emotional well-being. Patients fill out this 36-question survey in order to determine quality of life after stroke (Naess, Waje-Andreassen, Thomassen, Nyland, & Myhr, 2006). Almost half of the patients in the Iowa Registry of Stroke in Young Adults noted significant disturbances in quality of life, particularly in physical and social functions. Additionally, 55% of patients acknowledged periods of depression following their initial stroke (Kappelle et al., 1994).

Young adults with ischemic stroke generally scored lower on the physical functioning, general health, and social functioning subscale when compared to a control group and the general population. Quality of life was lower in patients who were functionally dependent, depressed, unmarried, and unemployed. Also, fatigue and depression were independently associated with lower quality of life. Identification and improved therapy for depression and fatigue may improve quality of life in young adults after ischemic stroke, as well as physical therapy to address specific physical limitations. (Naess, Waje-Andreassen, Thomassen, Nyland, & Myhr, 2006).

Due to the subjectivity of quality of life measurements, they may not always provide an accurate portrayal of life satisfaction after a stroke. It is important to look at how the patient and their caregivers view the impact the stroke has had. Many of the themes in quality of life studies after stroke concern the change in social relationships. The extreme stress on relationships after stroke might result in the dissolution of that relationship (Lynch et al., 2008). One study found 7% of young adults reported divorce
as a result of stroke (Leys et al., 2002). Patients often claimed coping with communication issues was very difficult, more so than physical disability. Another important theme identified was the patient’s dependence on the caregiver. Often stroke patients must rely on their caregiver for many daily activities, stressing the importance of social relationships after stroke. Role changes appear to have an impact on the relationship between patient and caregiver, especially when the patient can no longer return to work. Social roles play a significant role in recovery after stroke (Lynch et al., 2008). In fact, King (1996) noted that social support was one of the most predictive factors of quality of life after a stroke.
CHAPTER FIVE

Discussion and Conclusion

Ischemic stroke in young adults is rising, warranting special attention and examination. Consistently, traditional risk factors such as hypertension, dyslipidemia, and smoking are predominant risk factors for ischemic stroke in young adults. Additionally, lesser known risk factors including heavy alcohol consumption, oral contraceptive use, and migraine contributed to ischemic stroke in the young. Often, these risk factors coexist, markedly increasing risk of stroke. However, most of these risk factors are modifiable, many of which can be resolved with an alteration in lifestyle choices.

Literature on risk factors in ischemic stroke in young adults is limited. It is difficult to draw conclusions from the studies available because each study is slightly different. The definition of young adult is not consistent; therefore, risk factor prevalence differs depending on what age range is included. Also, some studies included both ischemic and hemorrhagic stroke, and others included TIAs with studies of ischemic stroke. Thus, risk factor prevalence in ischemic stroke among the younger population remains uncertain. More studies with similar designs are needed to draw comparable data. Despite this, most studies consistently showed traditional risk factors such as hypertension, smoking, and dyslipidemia to be among the most prevalent risk factors. Data on lesser known risk factors, including alcohol consumption, oral contraceptive use, and migraine is more controversial, although most play at least a small role.
Limited literature is available on the prognosis in young adults after ischemic stroke. However, of the short- and long-term follow ups, many studies yielded similar results. Overall risk of mortality and recurrence in young adults is low. Recurrence is often associated with the same risk factors that prompted the initial stroke. Therefore, lifestyle modification is important after stroke. Ischemic stroke in the young may also affect functional ability, occupational status, as well as quality of life. While almost 81% of young patients are ranked as independent after ischemic stroke, only about 57% return to work, many of which have to make adjustments. Quality of life after stroke is generally lower with as many as 55% of survivors reporting periods of depression. Young adults who experience ischemic stroke need social support in order to have optimal quality of life after ischemic stroke. Additionally, lifestyle changes are necessary to prevent recurrence.

Whether it be to prevent first-ever ischemic stroke in young adults or to prevent recurrence, aggressive public health initiatives are necessary to educate the young of the risk factors associated with this population. Education of healthy behaviors and prevention strategies are needed to reduce this increasing trend of ischemic stroke in the young.
BIBLIOGRAPHY


