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Nutrition, Weight Status and Physical Activity in Saudi Arabia
- with Special Focus on Women

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To my parents – in loving gratefulness,
and to my family – for being here.

ABSTRACT

Background: The prevalence of obesity and physical inactivity in the Kingdom of Saudi Arabia (KSA) has been escalating to levels that are threatening the public health of the entire KSA population, especially the female population. However, both physical activity (PA) education and research have only focused to a limited extent on women's health status.

Objectives: The overall aim of this thesis was to increase our knowledge on the current health situation of both a hospital-based and a healthy female population in the KSA with regard to nutritional status, habits, practices, and PA.

Methods: This thesis contains four Papers (**I–IV**) whose data were collected in the southwestern region of the KSA. A total of 166 hospital patients (60 women and 106 men) were screened regarding their nutritional status, 15 registered nurses were interviewed, and 663 female university students self-reported their PA levels and nutritional habits and had their anthropometrics measured. The data were analyzed using SPSS (Papers **I**, **III**, and **IV**) and latent content analysis (Paper **II**).

Findings: Significantly more women (29%) than men (10%) were found to be obese in Paper **I**. There was no significant difference in the prevalence of patients at risk for undernutrition between women and men (40% *vs.* 38%), but significantly more women than men received care targeting undernutrition in the hospital-based study population. Individual interviews with nurses in Paper **II** showed that nurses were "bridging malnutrition and physical inactivity" by identifying "potentials to provide good nutrition and PA" to the patients and their relatives and by stating their "ability to provide patients with good nutrition and PA". The majority (57.0%) of the female participants in Papers **III** and **IV** were of normal weight, 19.2% were underweight, and 23.8% were overweight/obese. The mean body mass index (BMI) of the students in relation to high, moderate, and low levels of PA was 23.0, 22.9, and 22.1, respectively. Significant associations were found between PA and marital status, the mother's education level, the participant's BMI, and residential proximity to parks and recreational facilities. Several variables were found to correlate with dietary habits, underweight, and overweight/ obesity. Of special interest were the negative and positive associations between the number of siblings and the participants' BMI and dietary habits.

Interpretations: The results of these studies emphasize the coexistence of underweight and overweight/obesity among both healthy persons and hospital patients. The total prevalence of overweight/obesity among both hospital patients and female university students is higher in the KSA compared to other international settings. Furthermore, the fact that patients at risk of undernutrition or with manifest undernutrition do not get adequate nutritional care is understandable given our results showing that the interviewed nurses were not given the authority to provide the nutritional care that they thought necessary.

Conclusions: This thesis suggests that the promotion of PA and nutritional education for women should be a major target for policy makers as well as public health practitioners and researchers. The goal for such activities would be to prevent the inevitable health complications related to poor dietary habits and lack of PA.

Keywords: Nutrition, physical activity, weight status, women, Saudi Arabia.

LIST OF PUBLICATIONS

I. Khalaf, A., Berggren, V., Al-Hazzaa, H., Bergström, S., & Westergren, A. (2011). Undernutrition risk, overweight/obesity, and nutritional care in relation to undernutrition risk among inpatients in southwestern Saudi Arabia. A hospital-based point prevalence study. *Journal of Nutritional Disorders and Therapy* 1:104. doi:10.4172/jndt.1000104

II. Khalaf, A., Westergren, A., Ekblom, Ö., Al-Hazzaa, H., & Berggren, V. (2014). Nurses bridging malnutrition and physical inactivity: Nurses' views and experiences of caring for malnourished patients in surgical settings in Saudi Arabia – A qualitative study (submitted).

III. Khalaf, A., Ekblom, Ö., Kowalski, J., Berggren, V., Westergren, A., & Al-Hazzaa, H. (2013). Female university students' physical activity levels and associated factors – A cross sectional study in south western Saudi Arabia. *International journal of environmental research and public health*, 10(8):3502-3517.

IV. Khalaf, A., Westergren, A., Berggren, V., Ekblom, Ö., & Al-Hazzaa, H., (2014). Associated factors to female university students' dietary habits and body weight in Saudi Arabia (submitted).

These articles will be referred in the text by their roman numerals (**I – IV**). The published papers included in this thesis have been reproduced with permission of the publishers of the respective journals.

CONTENTS

1 LIST OF ABBREVIATIONS

ATLS	Arab Teens Lifestyle Study
BMI	Body-mass index (kg/m^2)
CI	Confidence Interval
GCC	The Cooperation Council of the Arab States of the Gulf (Gulf Cooperation Council)
KSA	Kingdom of Saudi Arabia
MEOF-II	Minimal Eating Observation Form - version II
MET	Metabolic Energy Turnover
n	Population
OR	Odds Ratio
PA	Physical activity
SD	Standard Deviation
WC	Waist Circumference
WHO	World Health Organization
WHtR	Waist-to-height ratio

2 INTRODUCTION

My background profession is in nursing, and providing proper nutrition to patients is an integral part of nursing care. My master's studies focused on undernutrition among hospitalized patients. During the clinical part of my work as a university lecturer in a public university in Saudi Arabia, I observed a scanty documentation on nutritional care provided to patients, and found patients in hospitals that did not get proper nutritional care. With these experiences, I made a search through databases on the role of nutrition in Saudi Arabia. The search revealed only two studies, and I concluded that the subject was understudied in this context. The female population in relation to their nutritional status and nutritional habits appeared to be an almost unexplored research area.

Considering the rapid development in Saudi Arabia, the increased household income might have impact on the peoples' dietary habits and physical activity patterns. In previous studies, several other contributing factors were identified, regarding the increasing and public health threatening prevalence of overweight and obesity, especially among the female population, in Saudi Arabia. This thesis's sub-studies are just the beginning of an attempt to combat the prevailing prevalence of overweight, obesity and physical inactivity among women in Saudi Arabia.

3 BACKGROUND

Both underweight and overweight/obesity represent serious public health challenges worldwide (WHO, 2013). The rising trend in overweight/obesity over the past three decades is also an emerging problem in the KSA, but knowledge and research about undernutrition and underweight in this context, and their associated factors, are still limited. The KSA is one of several Arab countries that have made considerable progress over the past few decades in improving the health and well-being of their citizens (Khawaja et al., 2008), but there is still a significant need for more research on the prevalence of underweight and overweight/obesity in both hospital and non-hospital settings. Such research needs to focus on how best to promote awareness among the population of both the health hazards and ways of controlling these conditions. The importance of lifestyle habits on such conditions cannot be overemphasized.

3.1 NUTRITIONAL AND LIFESTYLE HABITS IN THE KSA

The KSA has been undergoing a rapid urbanization in recent years, and this has had a direct impact on its people's dietary habits and lifestyles. National studies have shown an increase in skipping meals and replacing them with a large number of snacks throughout the day, and most of these snacks are high in calories and low in nutrients (Al-Khateeb et al., 2008; Amin et al., 2008). Bakhotmah (2012) studied Saudi Arabian women's nutritional knowledge, behavior, and food preferences – and their desire to change these preferences – using a convenience sample of 151 participants. In that study, a gap between the participants' perceived and actual knowledge ($p < 0.05$) was identified as well as a desire among the participants to increase their intake of fruits, vegetables, and dairy products and to reduce their fat consumption (Bakhotmah, 2012).

Several factors are contributing to the high incidence of obesity among women in the KSA. It has been shown that watching television and eating snacks are the main activities during leisure time, especially because the majority of women are not employed (Madani, 2000). In addition, the traditional, long, comfortable, and loose clothing worn by women in the KSA might prevent them from noticing gradual weight change over time. The modernization and affluence in the KSA over the last three decades has contributed to the increased prevalence of overweight/obesity in the country. Some women, especially those middle aged and older might even still consider being overweight to be a sign of affluence (Madani, 2000). Furthermore, women in the KSA have been shown to be significantly more sedentary and less active than men (Al-Hazzaa et al., 2013; Al-Almaie, 2005; Al-Nuaim et al., 1996). Based on these findings, the strategy recommended by researchers to prevent the increasing prevalence of overweight/obesity in

the KSA should include the encouragement of PA, reduced intake of high-fat foods, and behavior modification.

Like obesity, being underweight has been reported to be associated with an increased risk of mortality (Lindstrand et al., 2006) and an increased risk of morbidity including osteoporosis, bronchial and lung diseases, intestinal diseases, coronary artery disease, and mental health impairment (Suastika et al., 2012; Mond et al., 2011). However, over the past two decades there has been a documented increase in the influence of the media on weight-loss attempts, especially among women, in order to achieve the "Western image" of an ideal body shape and weight (Jones et al., 2001; Strelan et al., 2003; Musaiger et al., 2004). The results of such weight-loss activities might lead to the development of undernutrition and underweight (Keski-Rahkonen et al., 2003), and researchers have found that negative attitudes towards obesity and socio-cultural preferences for thinness can even induce persons who are already underweight to attempt weight control (Choi et al., 2013). Although underweight and its underlying factors in relation to women have not been studied in depth in the KSA, women with higher educational levels in the KSA were found to be more likely to favor slimness as an ideal body shape (Rasheed, 1998).

3.2 LIFESTYLE TRANSITION IN THE KSA

In the past, the traditional diets in many developing countries – including those in the Middle East – were characterized by high intakes of cereals (WHO, 2007; Poskitt, 2009). In the early 1960s, Middle Eastern citizens' total energy intakes were based on the energy derived from cereals (57.2%), fruits (5.6%), meat and pulses (9.3%), milk and dairy products (4.7%), vegetable oils (6.5%), and from added sugars and solid fats (13.5%) (Poskitt, 2009). In recent years, dietary trends in many low- and middle-income countries have taken an unfavorable turn toward a "Westernized" diet (Popkin, 2002). Many developing countries have adapted a "Coca-Colonization" (Nagata et al., 2011) and "McDonaldization" (Ritzer, 1996) that have contributed to dietary transitions and changes in health beliefs (Popkin et al., 2012). Economic development in these countries has increased the availability of Westernized processed foods that are often calorie-dense and nutrient-poor (Nagata et al., 2011).

Similarly, the influence of the media on body weight alteration has been found to be greater among women than men (McCabe et al., 2001). Studies in some Arab countries have demonstrated a major shift from preferences for plumpness to those for a thinner body shape, particularly among women (Rasheed, 1998; Eapen et al., 2006). Furthermore, data from five Arab countries showed that women who were exposed to mass media were more likely to have dieted to lose weight (Musaiger et al., 2014). This transition in

exposure to popular media and the adoption of "Western" body shape ideals (Musaiger et al., 2004) might influence the weight status of Saudi Arabian women and lead to an inappropriate weight perception that is known to be linked to unhealthy behaviors such as eating disorders (Bellisle et al., 1995; Blokstra et al., 1999; Sepulveda et al., 2007).

The KSA is not immune from the global trend of increasing BMI. The globally accelerated nutrition transition reported by Welch et al. (2009) – with significant weight and BMI increases over a period of about four decades (between the years 1962 and 2006) – is similar to increases that have been reported in the KSA (Ng et al., 2011a; Ng et al., 2011b). Welch et al. (2009) also reported that income and wealth were significantly associated with fatness measures for both sexes combined and for females separately. In line with such findings, the affluent society of the KSA has started to witness weight changes as a result of increased household income (Ng et al., 2011a).

In the countries of the Gulf Cooperation Council (GCC) – at both the population and individual levels – the very high intake of energy-dense foods (fats, sugars, and refined carbohydrates) and low vegetable and fruit consumption combined with a sedentary lifestyle with minimum PA are associated with aggressive commercial marketing of fast foods (Bagchi, 2008). A recently published study conducted in seven Arab countries (of which two were part of the GCC along with the KSA) showed that lack of information on healthy eating, lack of motivation to eat a healthy diet, and not having time to prepare or eat healthy food were the main barriers to healthy eating among both men and women (Musaiger et al., 2013).

Patterns of PA in the population of the KSA (Al-Hazzaa, 2010) are similar to the trends that have recently been reported on a global level (Kohl et al., 2012). While women in the KSA have traditionally engaged in moderately intensive PA through housekeeping tasks (Al-Hazzaa, 2010), their reported prevalence of moderate and vigorous PA (2%) is among the lowest in the world (Sisson et al., 2008). In a recently published study, females in general were found to face more barriers to PA than males, including lack of motivation to engage in PA, less support from teachers, and a lack of time to engage in PA (Musaiger et al., 2013).

3.3 OVERWEIGHT/OBESITY, UNDERWIEGHT, PHYSICAL INACTIVITY AND HEALTH CONSEQUENCES

According to the World Health Organization (WHO), there were more than 500 million obese adults over the age of 20 worldwide in 2008, of which 297 million were women (WHO, 2014). Chronic non-communicable diseases related to overweight/obesity are responsible for 60% of all deaths worldwide, and 80% of these deaths occur in low- and middle-income countries (WHO,

2002). Further, in Asians, in general, the health risks associated with obesity occur at a lower BMI cut-off level compared to Caucasians (Almajwal et al., 2009; WHO/IASO/IOTF, 2000).

An increase in the prevalence of overweight/obesity during the past two to three decades is seen as an emerging problem in the KSA (Al-Hazzaa, 2007a), and this raises concerns about the physical and psychosocial consequences of obesity during adolescence (Al-Hazzaa, 2007a; Swallen et al., 2005). In addition to overweight/obesity, adolescent girls in the KSA are also faced with a high prevalence of underweight (Abahussain et al., 1999), but underweight has not been investigated in-depth in some parts of the country.

The coexistence of overweight/obesity and underweight in developing countries is being replaced by a continuous increase in overweight/obesity, although the prevalence of underweight is still high (Ha et al., 2011) and is between 19% and 40% in countries such as India, Pakistan, Madagascar, Thailand, and Vietnam (WHO, 2006). Mendez et al. (2005) reported that underweight remains a concern especially among women living in rural areas of the least developed countries. There are few studies on trends in the underweight and overweight/obesity status of women in developing countries, and thus it is not known whether similar patterns have existed in the past or if these are modern occurrences (Mendez et al, 2005). In the KSA, research on underweight and undernutrition is still limited with regard to adults and to females in particular.

The health consequences related to underweight can be devastating for a society and include increased mortality from primary viral infections (Ritz et al., 2006) and increased comorbidities such as osteoporosis and diabetes caused by undernutrition (Sairenchi et al., 2008; Gillespie et al., 2001). Underweight has also been found to be associated with increased mortality in general relative to normal weight individuals (Flegal et al., 2005). Reproductive-age women who are underweight have increased risks of infertility, of pregnancy complications, and of giving birth to stunted and thin babies (Ha et al., 2011). Furthermore, adults suffering from undernutrition are less able to engage in PA and this affects their ability to work (Lindstrand et al., 2006). They have lower work output, earn less at work, and are less likely to be hired as daily wage laborers compared to better-nourished adults (Ha et al., 2011).

There are gender differences in the prevalence of overweight/obesity in KSA. The rates of obesity are increasing more in women (Bakhotmah, 2012) than in men (Al-Hazzaa, 2007b; Al-Nozha et al., 2007; Al-Othaimeen et al., 2007; Al-Hazzaa, 2004). Two recent studies of obesity rates in women concluded that 65% of women in the eastern region of the KSA (Al-Qauhiz, 2010) and

71% of women in the western region at Jeddah are overweight/obese (Al-Suliman, 2008). Although lower rates were reported among adolescent men, the prevalence of overweight men was 13.8% and the prevalence of obesity men was 20.5% in Riyadh (Al-Rukban, 2003).

Population-based studies have shown that the underlying factors for overweight/obesity include physical inactivity (Swallen et al., 2005; Al-Nuaim et al., 1996; Al-Almaie, 2005), diabetes (Musaiger et al., 2011; El-Hazmi et al., 2000), dietary habits (Amin et al., 2008), employment, and education (Amin et al., 2008; Warsy et al., 1999). Mobaraki and Söderfeldt's (2010) review highlights the many challenges faced by Saudi women and suggests that their limited roles and rights within Saudi society might have negative impacts on their health. In a recently published qualitative study (Alyaemni et al., 2013), the majority of the interviewed women perceived their health to be worse than men's and attributed this to their child-bearing, their domestic and care-giving roles, restrictions on their mobility, poverty, psychological stress related to their responsibilities for children, and marital conflict.

Several studies have investigated the risk factors for overweight/obesity. One study conducted on Saudi women found that the high prevalence of overweight/obesity (41%) was positively and significantly associated with age and was negatively associated with education level (Rasheed, 1998). It was also reported that the rate of obesity among Saudi women increases with advancing age and that marriage and a history of parental obesity were associated with increased risk of obesity (Hajian-Tilaki et al., 2006). Economic, social, and environmental factors have contributed significantly to this lifestyle transition, and efforts to reduce the negative consequences of overweight/obesity are urgently needed.

Findings from a Saudi study among female medical and nursing students showed that the prevalence of obesity in these young Saudi women was notably high (30.6%) and supported the findings of earlier studies regarding the high occurrence of female obesity in this region (Al-Baghli et al., 2008). Recent research indicates that female university students, regardless of weight status, benefit from open discussions with health educators regarding healthy and effective dietary practices to achieve or maintain a healthy body weight (Malinauskas et al., 2006). However, the factors associated with overweight/obesity in adults and in highly educated women still require further investigation. Special focus should be placed on the relationship between PA patterns and nutritional habits of the female population in order to highlight their health situation and to plan suitable strategies to motivate them to choose healthy lifestyles.

Despite global concerns about non-communicable diseases, increasing rates of obesity, and rapid changes in patterns of work, transportation, and recreation, the surveillance and monitoring of PA has only been carried out in a few countries (Al-Hazzaa, 2000). Physical inactivity and sedentary lifestyles, along with their associated low level of physical fitness, have become increasingly prevalent in Saudi society (Farghaly et al., 2007). Men more frequently report high levels of PA than women (Al-Hazzaa, 2000). Because of all of the health consequences mentioned above, it is not just nutrition but also physical inactivity that should be a major target of overweight/obesity prevention in all age groups.

Not many studies have been conducted on the relationship between nutrition, overweight/obesity, *and* PA in southwestern KSA. To our knowledge, not a single study has been performed that investigates PA interventions in women in the KSA.

Both undernutrition and overweight occur in institutional care. For example, a Swedish study found that 27% of both hospital patients and people living in special accommodations were considered to have a moderate to high risk of undernutrition and that 39% of hospital patients and 30% of people living in special accommodations were overweight (Westergren et al., 2009a). A literature search in the relevant scientific databases revealed only two studies (Abahussain et al., 1999; Alhamdan, 2004) that were explicitly related to undernutrition in the KSA, and these involved adolescent girls in eastern KSA and men living in the Riyadh nursing home. Thus, there is a lack of studies within Saudi hospitals that focus on undernutrition, and there is a crucial need for more studies, especially with regard to undernutrition, because such studies are important for establishing nutritional guidelines. Such studies are also important in order to identify factors that facilitate or hinder nutritional care and to promote nutritional awareness among healthcare staff in the KSA.

In healthcare institutions, the nurses' knowledge, attitudes, and routines are likely to have a significant impact on the nutritional care that is provided to patients. Findings from a Swedish qualitative study of the experiences of registered clinical nurses and nursing assistants in treating patients with undernutrition showed a frustration in nursing, a joy in nursing, and that undernutrition is a taboo subject (Khalaf et al., 2009). There is a lack of similar studies in the KSA.

3.4   SETTING

The KSA is located in the Middle East between the Persian Gulf and the Red Sea. It has an area of 2.15 million square kilometers and has a population of 28.3 inhabitants (World Bank, 2012), which makes it the largest of the Persian Gulf countries (WHO, 2014). The KSA is built upon the largest reserves of petroleum in the world, and this has led to rapid

socio-economic transformation and helped to improve the status of health and healthcare in the country (Rawas et al., 2012).

Source: http://www.vbmap.org/middle-east-maps-10/saudi-arabia-map-316/ (accessed 1 February, 2014)

The KSA is a monarchy and Saudis practice the Islamic religion. This doctrine's religious beliefs are reflected in all aspects of Saudi public life, including social and economic development (Aldossary et al., 2008; Littlewood et al., 2000). The influence of Islam also extends to many aspects of the lives of Saudi citizens, including food, behavior, language, and healthcare. Moreover, Islam offers beliefs about the maintenance of good health (El-Gilany et al., 2001). For example, Islam decrees that people should eat moderately, exercise regularly, practice good personal hygiene, and abstain from the use of alcohol and tobacco. However, the degree to which these guidelines are followed (for example smoking) can be influenced by a range of other socio-cultural factors. For example, increasingly liberal notions have resulted in more young women taking up unhealthy habits such as pipe smoking in cafes and restaurants with their girlfriends (Rawas et al., 2012).

The population of the KSA shares some characteristics of developing countries such as a high birth rate (22 births/1000 people) (Gapminder, 2012); a high total fertility rate of 2.7 (Malik, 2013; Gapminder, 2012); a high percentage of the population under the age of fifteen years (28.8%); and a relatively high infant mortality rate (15.61 deaths/1000 live births) (Alyaemni et al., 2013). However, life expectancy (74.4 years in 2012) is more comparable to that of developed industrialized countries. The KSA is ranked 56th out of 187 countries in the 2011 Human Development Index and as such is classified as a 'high human development' country (Malik, 2013).

The Saudi government has played a major role in improving the healthcare system in the KSA, which is responsible for providing free healthcare services to every Saudi citizen and every non-Saudi who is working in the

public sector (Aldossary et al., 2008). Healthcare services in the KSA are universal and are accessible by every Saudi citizen. Nevertheless, there is a lack of well-trained native Saudi healthcare providers (El-Gilany et al., 2001), and this is especially true for nurses and is similar to the severe shortage of nurses in many developing countries (Al-Enezi, 2009). This shortage has led the KSA to rely heavily on expatriate nursing staff (Al-Enezi, 2009) as a way to overcome the shortage of native nurses (Kingma, 2001) and to cope with the dramatic changes facing the KSA as a result of industrialization, urbanization, and population growth (Al-Enezi, 2009).

The hospital described in this thesis is the biggest government hospital (about 658 beds) in southwestern KSA. It is a referral and tertiary hospital with many subspecialties and provides 24-hour emergency care. The official language used for communication and documentation in healthcare facilities throughout the KSA is English (Al-Shahri, 2002). When patients are admitted, especially women, they are usually accompanied by a sitter that is most often a relative of the patient. The sitter assists the patient in his or her daily routines and is called a *mourafiq* in the case of a male sitter or *mourafiqah* in the case of a female sitter (Al-Shahri, 2002). Furthermore, nurses, whether local or expatriate, are usually educated in English.

The selected university is a public institution located in Abha, the capital of Aseer province in southwestern KSA. According to the Ministry of Higher Education, the university as a whole offers 40 different colleges and provides education to more than 52,625 students (37,099 women and 15,526 men) (MoHE, 2013). During the time of data collection for this thesis (2009–2010), the selected university center had 1,681 female students enrolled in six different medical science colleges and one computer science college.

3.4.1 The status of women in the KSA

In this unique country, conservative interpretations of Islamic laws and social norms can sometimes have a negative impact on the health and well being of women (Mobaraki et al., 2010; Al-Khateeb, 1998). The country ranks 135th out of 146 countries on the Gender Inequality Index (Malik, 2013). Further, family responsibilities, social strains, and lack of family friendly policies in the institutions are some of the contributing factors to slower academic development for women (Al-Tamimi, 2004). However, Saudi women do not suffer a strong educational disadvantage compared to men; 50.3% of women compared to 57.9% of men attain at least a secondary education (KSA/UNDP, 2011) and at present women have significantly out-performed men in higher education in terms of PhD degrees earned in the KSA (Kelly et al., 2010). Women now account for 58% of all Saudi university students, and this rate is expected to increase

(World Policy, 2011). However, about 30% of Saudi women are still illiterate (Vidyasagar et al., 2004), no seats in the national parliament are occupied by women, and their labor force participation is very low (at 21.7%, compared to men's at 79.8%). There is no sports education in girls' schools, and it is prohibited by social norms for females to engage in PA in public (Al-Hazzaa et al., 2011c). According to the latest official figures, 49.9% of the Saudi population is female (MoH, 2011) but barely 21% of them contribute to social development because it is socially unacceptable for women to work in fields other than teaching and medicine (Vidyasagar et al., 2004).

Key aspects of gender roles and relations in Saudi society are governed by the religious law (Sharia) and include sex-segregation and limits on the social and spatial mobility of women (Alyaemni et al., 2013). Sex-segregation is strictly enforced, and almost all women wear a veil when they enter the public domain (Mobaraki et al., 2010).

There is, however, a rapid development that is leading to more women working in banking now than ever before. There are also women who have recently been allowed to become lawyers and are starting to work in attorney offices. A problem in understanding Saudi women's roles in society is that many of the references in the literature are considered old, and changes and development sometimes occur so rapidly that the published information is quickly outdated. It is still true that unemployment among women is higher than among men, but this could be due in part to the higher number of female graduates but fewer job opportunities available after graduation (Al-Hazzaa, 2014, personal communication).

3.4.2 The KSA's reforms on physical activity

The KSA has been taking steps to reform its view on women and sports. The biggest step came with the announcement that the KSA would send two female athletes – Wujdan Shahrkhani in judo and Sarah Attar in track and field – to the London Olympics in 2012 (HRW, 2013). This was followed by discussions that led to the establishment of private women's sports clubs and to women being able to formally register with the Ministry of Sport (CNN, 2013). Private schools are now allowed to have physical education programs for girls, and this move might extend in the future to include public schools as well. Sports stadiums have also arranged separate sections for women and families interested in attending football matches in the country. These steps have been taken to encourage a healthy lifestyle among women in the KSA (Arab news, 2013).

4 AIMS AND RESEARCH QUESTIONS

The overall aim of this thesis was to increase our knowledge on the current health situation of both a hospital-based and a healthy female population in the KSA with regard to nutritional status, habits, practices, and PA.

The specific research questions were:
1. What is the prevalence of overweight/obesity and undernutrition among male and female patients in hospital settings in the KSA?
2. What are the nurses' reflections when caring for malnourished patients in surgical health care settings in the KSA?
3. What are the prevalence and determinants of BMI and dietary habits among female university students in the KSA?
4. What are the levels of physical activity and inactivity and associated factors among female university students in the KSA?

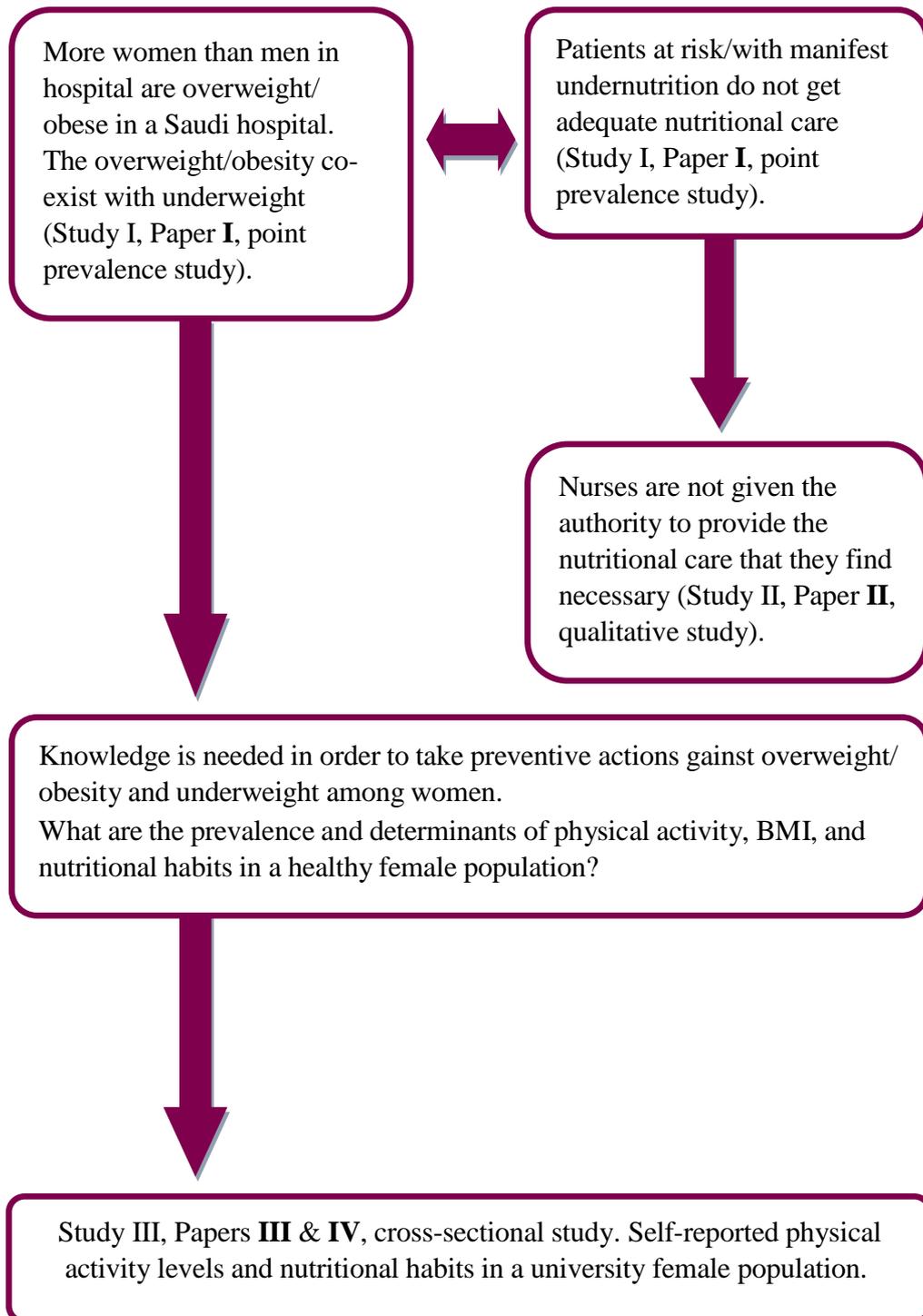The thesis was planned and developed as shown in (Figure 1).

More women than men in hospital are overweight/obese in a Saudi hospital. The overweight/obesity co-exist with underweight (Study I, Paper **I**, point prevalence study).

Patients at risk/with manifest undernutrition do not get adequate nutritional care (Study I, Paper **I**, point prevalence study).

Nurses are not given the authority to provide the nutritional care that they find necessary (Study II, Paper **II**, qualitative study).

Knowledge is needed in order to take preventive actions gainst overweight/obesity and underweight among women.
What are the prevalence and determinants of physical activity, BMI, and nutritional habits in a healthy female population?

Study III, Papers **III** & **IV**, cross-sectional study. Self-reported physical activity levels and nutritional habits in a university female population.

Figure 1. Stepwise development of the sub-studies in this thesis.

5 METHODS

5.1 STUDY DESIGN

Out of an ontological perspective, the world could be seen both as measurable/objective as well as subjective. Therefore both a qualitative and a quantitative approach are used in this thesis's studies. Both methods require an epistemological empirical point of view in order to reach a subjective level when describing the participants' experience of the reality and an objective level in description of the reality in order to gain knowledge. The project began with a point prevalence study phase that gave insight into the existing nutritional status and related nutritional interventions given to hospital patients in the KSA. This insight study was followed by a qualitative study that was exploratory in nature and sought to deepen the understanding of the healthcare staffs' priorities with regard to nutritional care. Results from these two studies were used in designing the quantitative study among healthy female university students. Table 1 summarizes the study title, participants, methods, and analyses of the data.

5.2 PARTICIPANTS AND DATA COLLECTION

5.2.1 Quantitative studies

5.2.1.1 The hospital-based point prevalence study (Paper *I*)

Information on the study design, schedule, and resource requirements was given to the management personnel and to all departments of the hospital. One or two nurses from each department were selected to perform data gathering during the data collection day. The study used seven nurses in total, four female nurses – including the primary investigator (AK) – and three male nurses. The nurses concentrated solely on data collection during the day of the study so they were not involved in the daily work at the wards. All the nurses who were involved in the data collection were Arabic speaking staff; the female nurses were stationed in the female wards while AK and the male nurses were on the male wards. This distribution was due to the fact that there were fewer male nurses than female nurses but more patients in the male wards than the female wards. The nurses were given instructions, both individually and as a group, in how to ask for informed consent, collect the data, and fill in the form. This preparation was completed prior to the pilot study, which was carried out in March 2009 among 30 patients. The 30 patients had their nutritional status assessed and their BMI measured. In the pilot data collection, the staff involved in collecting the data answered an open-ended questionnaire giving suggestions for modifications. The data collection form was then slightly altered to accommodate local cultural needs and differences that were found. One example is that "Date of birth" was changed to "Age".

Table 1. Overview of study design.

Paper	Study Title	Participants	Methods	Analyses
I	Undernutrition risk, overweight/obesity, and nutritional care in relation to undernutrition risk among inpatients in southwestern Saudi Arabia. A hospital-based point prevalence study	166 in-hospital patients (60 women and 106 men). Mean age was 54 and 45 for women and men, respectively.	Nutritional status and BMI were measured in a point prevalence survey. Risk for undernutrition was measured using the instrument MEOF-II, unintentional weight loss and underweight.	Statistical analysis using SPSS: ANOVA, Chi-square and Mann-Whitney U-test.
II	Nurses bridging malnutrition and physical inactivity: Nurses' views and experiences of caring for malnourished patients in surgical settings in Saudi Arabia – A qualitative study.	Registered nurses (n=15) of different nationalities. Median age was 30 ranging between 24 and 53 years.	Nurses were selected purposefully and interviewed individually. The pilot four interviews were followed by 11 semi-structured interviews.	The interviews were transcribed verbatim and analyzed by latent content analysis.
III	Association of female weight status with dietary habits and socio-demographic factors: A cross-sectional study in Saudi Arabia.	Female university students (n=663, 18-22 years).	Students self-reported their dietary habits and socio-demographic facts. They also had their weight, height and waist circumference measured.	Descriptive statistics and regression analyses (multiple linear and logistic regressions).
IV	Female university students' physical activity levels and associated factors – A cross sectional study in south western Saudi Arabia.	Female university students (n=663, 18-22 years).	Students answered a self-reporting questionnaire with data on physical activities and socio-demographics. Measurements were conducted on the participants' anthropometrics.	Descriptive statistics and univariate as well as multivariate ordinal regression analyses.

MEOF = Minimal Eating Observation Form.

In the point prevalence study day (July 2009, between 7 a.m. and 3 p.m.) the following wards were investigated: male surgical, male medical, male orthopedic, male urological, male neurological, male cardiology, female surgical, female medical, and female fine surgical. The patients were informed by the examining nurse, both orally and in writing, about the study, and consent was obtained during the data collection day.

All adult inpatients 18 years or older registered at the selected wards between 7 a.m. and 9 p.m. were asked to participate in study **I**. The survey was completed in all the wards except the pediatric wards, intensive care units, maternity wards, and outpatient wards. If the patient did not want to participate only questions 1 to 9 were filled in and a comment for the patient's reason for not participating was given. Thus one form for every patient, even if they did not have nutritional problems or eating difficulties or if they did not want to participate, was filled in and returned to AK.

The total number of inpatients registered in the ward between 7 a.m. and 9 p.m. during the day of data collection was recorded. This was used together with ward-specific information in order to calculate the dropout rate among patients.

Data that were collected included measures of height and weight using standard tape measures and manual scales. The presence of edema/ascites was assessed. Data about nutritional care provided to patients, admission weight and height, and contact with a dietitian were obtained through nursing and medical records. Patients were observed during mealtimes, and the assessment of eating difficulties was performed at breakfast or at lunchtime for each patient during the data collection day.

The responsible researcher (AK) was present all day long to answer questions that arose during the data collection. The following day, AK visited each ward checking whether there had been any new admissions during the previous evening (before 9 p.m.).

A total of 219 patients 18 years or older were available for inclusion in the investigated wards. Of these, 166 (76%) chose to participate and 53 (24%) chose not to participate, and all those who chose to participate were included in the statistical analysis. Significantly more women (37%) than men (14%) declined to participate in the study ($p < 0.0005$). Those not participating had significantly longer hospital stays between admission and the data collection than the sampled patients (the median was 12 days and 6 days for the nonparticipant and participant patients, respectively, $p = 0.001$).

5.2.1.1.1 <u>Instruments and definitions</u>

Risk of undernutrition was estimated according to Swedish recommendations (SWESPEN, 2006) that define the risk of undernutrition as the occurrence of any of the following: involuntary weight loss (irrespective of time and amount), BMI below a certain limit, or the presence of eating difficulties (in this study measured according to Minimal Eating Observation Form – Version II (MEOF-II) as described in (Westergren et al., 2009). Unintentional weight loss, low BMI, and change in food intake are based on evidence in the literature and are correlated with changes in function and clinical outcome (Kondrup et al., 2003). A low risk of undernutrition was defined as having one criterion fulfilled, a moderate risk as two of the criteria fulfilled, and high risk as all three of the criteria fulfilled. In this study, it was decided that if two or three of the above three criteria were fulfilled the person should be considered at risk of undernutrition.

The standardized assessments of eating using MEOF-II included sitting position, manipulating food on the plate, transporting food to the mouth, chewing, manipulating food in the mouth, swallowing, food consumption, reduced alertness, and reduced appetite (Westergren et al., 2009). The MEOF-II was previously validated using factor analysis methods among 2,600 patients and had good reliability with an average agreement between observers of 89% (Kappa coefficient = 0.70) (Westergren et al., 2009). In a systematic review, the MEOF-II was found to be the most psychometrically robust instrument to screen for eating difficulties and for use in clinical practice and research (Hansen et al., 2011).

*5.2.1.2 The university-based cross-sectional study (Papers **III** and **IV**)*
This study was based on a cross-sectional design and conducted among university female students at a university center for female students in southwestern KSA. The choice of this highly educated cohort of females allowed for a convenience sample that was eligible for completing the questionnaire in a study of a healthy female population in the KSA with regard to their PA patterns and nutritional habits. The total number of students attending the investigated female university center was 1,681 students. With a statistical power of 80% and a 95% confidence interval (CI) the selection of the eligible sample was estimated to be a minimum of 600 female students. The sample was selected using a multistage stratified cluster random sampling technique carried out by tossing a coin. Figure 2 shows an example of the randomization that started with selecting the colleges followed by choice of levels and then classes, all by tossing a coin.

```
┌─────────────────────────────────┐   ┌───────────────────────────┐
│ First-year female students      │   │ Goal: 150 students from   │
│                                 │   │ levels 1 and/or 2         │
└─────────────────────────────────┘   └───────────────────────────┘
              │
        ┌───────────────┐
        │ Tossing a coin│
        └───────────────┘
              │
              ▼
┌─────────────────────────────────┐   ┌───────────────────────────┐
│ Colleges                        │   │ • Nursing, L2             │
│                                 │   │ • Medicine, L2            │
└─────────────────────────────────┘   │ • Computer Sciences, L2   │
              │                        │ • Biology, L2             │
        ┌───────────────┐             └───────────────────────────┘
        │ Tossing a coin│
        └───────────────┘
              │
              ▼
┌─────────────────────────────────┐   ┌───────────────────────────┐
│ Classes                         │   │ • Nursing: class 466      │
│                                 │   │   (35 students)           │
└─────────────────────────────────┘   │ • Medicine: class 226 (59 │
                                       │   students)               │
                                       │ • Computer Sciences:      │
                                       │   class 311 (31 students) │
                                       │ • Biology: class 66, 62,  │
                                       │   59, 70 (27, 23, 21, 22  │
                                       │   students)               │
                                       └───────────────────────────┘
```
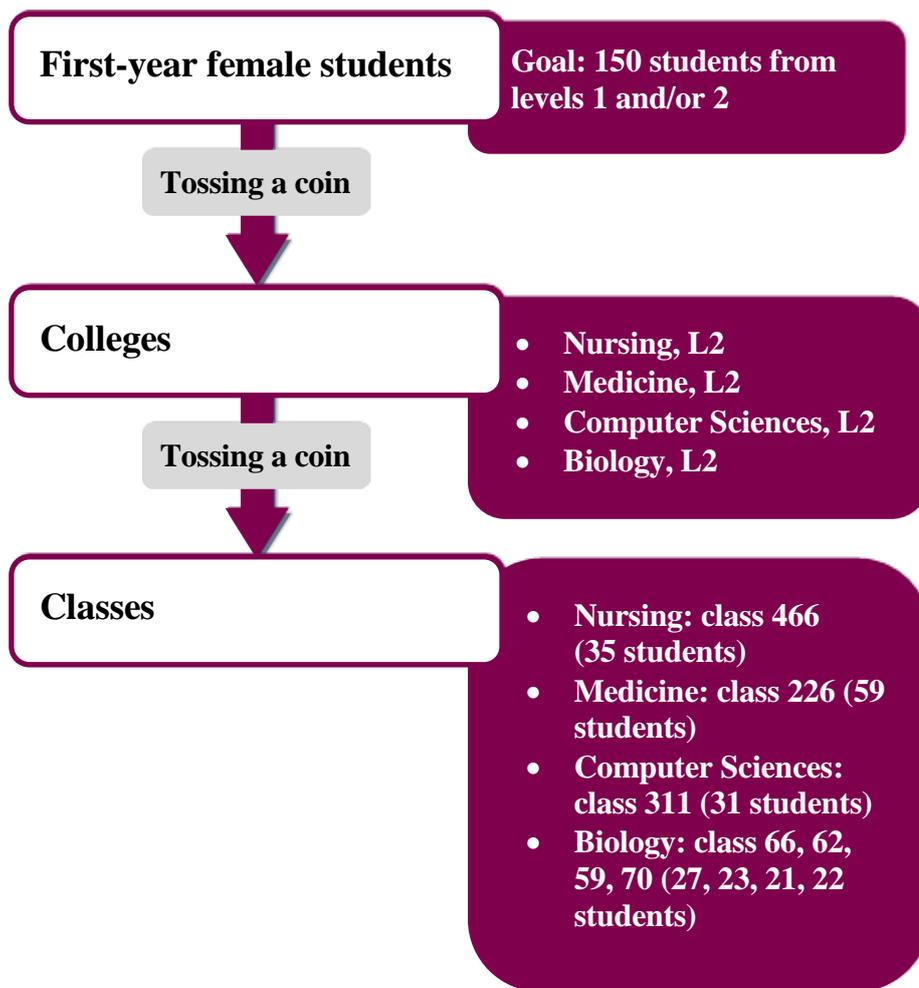
Figure 2. An example of the sampling process on fresh women (First-year female students) level (L) using a multistage stratified cluster random sampling technique carried out by tossing a coin.

Thus, women were selected on an equal basis from four levels (freshman (first-year female students), sophomore, junior, and senior levels) at the university center. Sampling insufficiency related to potential drop-outs was precluded by the distribution of 700 questionnaires that yielded 663 completed questionnaires during the spring of 2010.

Prior to the study, a pilot survey with 30 female participants was conducted to ensure that no modification of the questionnaire was needed. The data collection team consisted of AK and three lecturers who served as research assistants during the data collection. They were trained by AK in how to ask for informed consent, collect the data, and fill in the forms. All of the anthropometric measures were taken by AK.

The first step in the data collection was for the participating female students to fill in the self-reported questionnaire and the additional background information (a further description of the questionnaires will follow). The second step was the measurements of the students' body mass (to the nearest

0.1 kg), body height (to the nearest cm), and waist circumference (WC) (at the level of umbilicus to the nearest cm) using a calibrated medical scale, stadiometer, and measuring tape, respectively. BMI was calculated as body mass in kg over the squared height in meters. The waist to height ratio (WHtR) was calculated by dividing the waist measurement in cm by height measured in cm. The BMI, WC (WHO, 2011), and WHtR cutoffs adjusted for age (adults) and gender (female) according to the WHO (WHO, 2006) are shown in Table 2.

Table 2. BMI, waist circumference, and waist to height ratio adjusted for age and gender according to the WHO.

	Underweight	Normal weight	Overweight	Obesity
BMI[a]	<18.5	18.5–24.9	≥25.0	≥30.0
Waist Circumference ≥80 cm[b]	-	-	Increased	High
Waist Circumference ≥88 cm[b]	-	Increased	High	Very high
Waist-height ratio <0.5[c]	-	-	-	-
Waist-height ratio ≥0.5[c]	-	Increased	High	Very high

[a] Source: WHO, 2006. http://www.who.int/bmi/index.jsp?introPage=intro_3.html
[b] Source: WHO, 2011. http://whqlibdoc.who.int/publications/2011/9789241501491_eng.pdf
[c] Sources: Ashwell et al., 2005; Hsieh et al., 2003.
Increased, high, and very high = increased health risks.

5.2.1.2.1 Instruments and definitions

WHO recommendations for PA levels for promoting and maintaining health among adults (WHO, 2010) are similar to the PA recommendations of the American College of Sports Medicine (ACSM) (Haskell et al., 2007). The WHO recommends aerobic PA of structured or unstructured character at moderate-intensity for 150 minutes/week, vigorous-intensity aerobic PA for 75 minutes/week, or an equivalent combination of moderate-intensity and vigorous-intensity activity throughout the week as a means of improving health (Haskell et al., 2007; WHO, 2010). Periods of activity should be at least 10 minutes long.

The questionnaire that was used to record lifestyle information was built upon the Arab Teens Life Style (ATLS) research instrument (Al-Hazzaa et al., 2011a; Al-Hazzaa et al., 2011b). The ATLS consists of 43 items including self-reported PA, sedentary activities, and dietary habits. The first three items are age, weight, and height. Items 4–30 comprise the PA questionnaire, items 31–33 record sedentary activities, and items 34–43 focus on dietary habits.

The original questionnaire was previously shown to have a high reliability (intraclass correlation = 0.85; 95% CI: 0.70–0.93) and acceptable validity (r = 0.30; p < 0.05) against pedometer-assessed activity in a convenience sample of young males aged 15–25 years (Al-Hazzaa et al., 2003; Al-Ahmadi et al., 2004). In a recent validity study on both males and females aged 14–19 years, the ATLS PA questionnaire was validated against an electronic pedometer and provided equivalent and significant coefficients for statistical surveying among Arab youth (r = 0.37, p < 0.001) (Al-Hazzaa et al., 2011a). The criterion validity of the ATLS might, therefore, be considered to be comparable to other instruments for self-reported PA.

The PA portion of the questionnaire was designed to collect information on the frequency, duration, and intensity of low, moderate, and vigorous-intensity physical activities during a typical week. Diverse forms of energy expenditure in conjunction with household, leisure, transport, fitness, and sports activities were covered by the PA questionnaire. The PA measured in the survey included moderate-intensity activities (pace walking, brisk walking, recreational swimming, household activities, and recreational sports such as volleyball, badminton, and table tennis) and vigorous-intensity activities and sports (stair climbing, aerobic exercise, jogging, running, cycling, self-defense, weight training, soccer, basketball, handball, and singles tennis). The intensity of the participants' activity or exercise was measured in units of Metabolic Energy Turnover (MET), and total PA levels were expressed as MET minutes per week spent in each of the moderate- and vigorous-intensity activities. The MET values were derived from the compendium of PA (Ainsworth et al., 2011). Moderate-intensity recreational sports were assigned an average MET value of 4 and vigorous-intensity sports were assigned an average MET value of 8. These cut-offs, however, are not necessarily applicable for questionnaires. When using accelerometers, the MET values were 3 for moderate-intensity PA and 6 for vigorous-intensity PA, so these were considered to be the lower limits for this study. For the PA cut-off values, we used three categories (low, moderate, and high activity) based on tertiles of total MET min/week. Persons were considered as l active when they achieved ≤ 611.56 MET min/week, moderately active with 611.57 to 1389.63 MET min/week, and highly active with ≥ 1389.63 MET min/week.

For sedentary behaviors, the questionnaire was designed to assess typical time spent per day on sedentary activities, including television viewing, playing video/electronic games, and using the computer and internet. The total screen time was reported as hours per day spent on screen viewing, i.e. typical time spent sleeping was excluded from sedentary behavioral time (Al-Hazzaa et al., 2011a; Al-Hazzaa et al., 2011b).

The questionnaire included 10 specific questions designed to determine the frequency of certain dietary habits of adolescents. The questions included those related to how many times during a typical week the participants consumed breakfast, sugar-sweetened drinks, vegetables (cooked and uncooked), fresh fruit, milk and dairy products, fast foods, French fries/potato chips, donuts and cakes, candy and chocolate, and energy drinks. The fast foods in this questionnaire included examples from both Western fast foods and Arabic fast-food choices such as shawarma (grilled meat in pita bread with salad). These questions covered healthy and unhealthy dietary habits and the participants were divided into two categories. A healthy intake was defined as an intake of breakfast, fresh fruits, vegetables, and milk/dairy products ≥ 5 days/week and intake of sugar-sweetened drinks, fast foods, French fries/potato chips, donuts and cakes, candy and chocolate, and energy drinks <3 days/week. All other alternatives were defined as unhealthy intakes (Al-Hazzaa et al., 2011b). The answers on the nutritional habits ranged from zero intake (never) to a maximum intake of 7 days per week.

Additional information about the participants' anthropometric, socioeconomic, environmental, and cultural factors was obtained in a separate questionnaire. The students gave information about their age, marital status, education level of their parents, number of siblings (sisters and brothers separately), type of residence, and number of cars in the household. Environmental factors included the proximity of the participants' residences to parks and recreational facilities, malls, and supermarkets. Further information was collected on the students' PA-related behavior such as receiving parental support for regular exercise, reasons for being physically active or inactive, and the presence of regular exercise among parents and/or siblings. All socioeconomic and environment-related background information was self-reported. For example, the participants subjectively assessed the distances between their residence and parks, malls, and supermarkets.

The anthropometric measurements included body weight (to the nearest 0.1 kg), body height (to the nearest cm), and WC (to the nearest cm) and were measured using a calibrated medical scale, stadiometer, and measuring tape, respectively. BMI was calculated as weight in kg divided by the squared height in meters.

5.2.2 Qualitative study (Paper II)

The nurse participants in Paper **II** were selected in collaboration with a nurse supervisor working in the Nursing Education Department using the purposeful sampling method (Polit et al., 2006). Purposeful sampling means choosing participants who are characteristic of the population under study or who have specific knowledge of the study questions, i.e. the individuals who are most informative in relation to the research questions (Polit et al., 2006). The nurse supervisor was the first link to recruiting the nurses who were

informed both in writing and orally about the study. Nurses who were interested in participating were contacted by AK and provided with additional information. After the first four pilot interviews, the snowball technique (Polit et al., 2006) was used to recruit the rest of the informants where the interviewed nurses recommended potential colleagues to participate in the study who were subsequently contacted by AK. Before the nurses were provided informed consent to participate, they received information about confidentiality, handling of the study material, and the right to withdraw from the study at any time without an explanation. Informed consent was signed before each interview. We included a variety of participants with regard to sex, age, nationality, total job experience as a nurse in years, and total job experience in the nurse's current ward. Our participants consisted of clinically active registered nurses from the Philippines (n = 10 women), India (n = 1 woman), and the KSA (n = 4, including 1 woman and 3 men).

The interview guide consisted of open-ended questions covering the following four themes: 1) knowledge and reflection of malnutrition in health care, 2) the experiences of practical nursing care in relation to surgical patients' nutrition, 3) reflections on, and experiences of, ethical problems in caring for surgical patients' nutrition, and 4) professional challenges in relation to the organization. This interview guide was developed based on the guide used in an earlier qualitative study conducted in an orthopedic ward in a Swedish hospital (Khalaf et al., 2009).

In order to capture the nurses' experiences of caring for surgical patients and their nutritional status, an inductive qualitative approach with an interview-based procedure was chosen (Denzin et al., 2011). The study began with a pilot phase in which four interviews were conducted to examine and develop the themes that were the focus of the interviews (Polit et al., 2006). Out of the four pilot interviews conducted in the nurses' working languages – English and/or Arabic – two were transcribed directly. This led to the deletion of two questions that were found to be difficult to understand by the participants or to be irrelevant. Those questions were 1) Do you work after a special model regarding nutrition in your ward and 2) How do you look at the optimal conditions to prevent that those patients will be undernourished or overnourished?

The pilot interview phase was followed by eight semi-structured interviews. A further three interviews were conducted in order to reach saturation, i.e. when no further variation or any additions to the statements were found by the research team (Polit et al., 2006). All of the interviews took place, after agreement with the participating nurses, in a private meeting room in the ward where they worked and were tape recorded. The interviews were conducted by AK in English or in Arabic depending on the wishes of the participant. A total of eleven interviews were conducted in English and the

other four in Arabic. The time for each of the interviews varied between 42 minutes and 68 minutes. All interviews took place between January 5, 2010, and June 17, 2010. All fifteen interviews were included in the analysis.

5.3 DATA MANAGEMENT AND ANALYSIS

5.3.1 Study I

In the analysis, comparisons were made between independent groups (men *vs.* women and No/Low Risk of undernutrition *vs.* Moderate/High Risk of undernutrition). The method of analysis was chosen depending on the type of data; ANOVA was used only for comparisons of age, the Mann–Whitney U-test was used for ordinal data and for ratio scales without normal distributions (as in difficulties in chewing, type of diet, consistency of food), and the chi-square test (and, when applicable, Fisher's exact test) was used for nominal data (such as for residential status and background diseases) (Altman, 1990). *P*-values below 0.05 were considered statistically significant. All analyses were performed with SPSS 17.0 for Windows.

Different cut-offs are suggested for Caucasian and Asian people (WHO/IASO/IOTF, 2000) (Table 3). In this thesis (Paper **I**) the findings were presented according to both cut-off alternatives on the same population.

Table 3. Age-adapted BMI cut-offs used in Paper **I**.

	Caucasian		Asian	
	$\leq$ 69 years	$\geq$ 70 years	$\leq$ 69 years	$\geq$ 70 years
Underweight, BMI	<20	<22	<20	<22
Overweight				
Grade 1. Overweight, BMI	25–29	27–31	23–27	25–29
Grade 2. Obesity, BMI	30–39	32–41	28–37	30–39
Grade 3. Severe obesity, BMI	>40	>42	>38	>40

5.3.2 Study II

Eleven of the interviews were conducted in English, and seven of these were transcribed verbatim by the main investigator (AK) and four by a research assistant. The four interviews conducted in Arabic were translated into English either in writing or orally so that all of the members of the research team could understand them.

Atlas-ti was used as an initial sorting assistant program in the analysis based on its capabilities for conducting different types of analyses (Muhr, 1991; Rambaree, 2007). The software was used to confirm our manual identification of meaning units, coding, categorizations, and themes. We used latent content analysis to reveal deeper or latent meanings in the text (Berg, 2001). Both

manifest and latent content analysis include an interpretation of the text, but the two techniques vary when it comes to the depth and level of abstraction of the interpretation (Graneheim et al., 2004).

The analysis started with reading through the transcribed interviews in English by three of the authors individually in order to get an understanding of the whole material. On the basis of the first reading, certain thoughts and reflections were distinguished in the texts. These were recorded in the transcript margins and were used continuously during the remaining stages of the analysis process as codes, body text, or points for discussion. The material was discussed and analyzed stepwise while keeping the aim of the study in mind. Meaning units were then identified (Graneheim et al., 2004), i.e. assertions from the content of the text. Meaning units with similar content were organized into different topics with the aim of the study in focus. Comparisons were made to find similarities and differences and to get a deeper understanding of the underlying text in the latent analysis. The meaning units were condensed, i.e. the sentences were shortened while the core was preserved (Berg, 2001). The analyzed material was then sorted into subcategories. In the last stage, the subcategories were linked together into two main categories that expressed the latent content. After several re-readings of the material, an overall pattern was seen to be embedded in all of the findings and this was considered to represent the overall understanding of the material.

5.3.3 Study III

In Paper **III**, the response variable BMI was classified according to the WHO as underweight (BMI $\leq$ 18.49), normal weight (BMI = 18.5–24.99), and overweight/obesity (BMI $\geq$ 25) (WHO, 2006). These classifications were used for comparison between the groups and their association with predictor variables. For each predictor variable a reference category for further statistical analysis was created. Ordinal independent variables were analyzed using the Kruskal–Wallis test (three-group comparisons) in the first step, and if the differences were significant the Mann–Whitney *U*-test (two-group comparisons) was used in the second step. The variables with continuous nature – such as age and screen time – were analyzed by parametric one-way ANOVA.

The second analysis included a multiple linear regression procedure with BMI as a continuous dependent variable. Dummy variables were created from the independent ordinal variables, and these were then entered into the linear regression analysis model. Independent variables with fewer than five observations were not included in the analysis. In the first multiple linear regression model (backward method), the following predictor variables were entered: age (continuous), dietary habits (dummy variables created as shown below), economic factors (dummy variables), social and behavioral factors (dummy variables), and environmental factors (dummy variables). For the

predictor variables of dietary habits (the intake of breakfast, vegetables, fruits, milk/dairy products, sugar-sweetened drinks, fast foods, French fries/potato chips, sweets/chocolates, cakes/donuts/biscuits, and energy drinks) dummy variables were created. Dummy variable 1 = unhealthy intake *vs.* healthy intake and dummy variable 2 = less healthy intake *vs.* healthy intake. The economic factors consisted of parents' occupations, household monthly income, and the number of cars in the household. The social and behavioral factors were marital status, presence of obese siblings and/or parents, parents' level of education, number of siblings, activity levels, and total screen time (television + computer) in hours per week. Environmental factors were the proximity to malls and to parks and recreational facilities. The variables that were statistically significant ($p < 0.05$) or statistically indicated ($p = 0.05$–0.10) in the first step of the multiple linear regression were entered into a new regression analysis model using the manual backward deletion method. All significant variables from the second step were then presented in tables in Paper **III**. The probability of F-to-enter was set to 0.05 and the probability of F-to-remove was set to 0.10.

The third step in the analysis included a multiple logistic regression analysis (the backward conditional method) for the dietary variables. All healthy food habits were dichotomized into healthy intakes ($\geq$ 5 intakes/week) and unhealthy intakes (0–4 intakes/week). Likewise, the unhealthy food habits were dichotomized into healthy intakes (0–4 intakes/week) and unhealthy intakes ($\geq$ 5 intakes/week).

Included independent variables were age, marital status, father's level of education, mother's level of education, presence of obese parents, presence of obese siblings, number of brothers, number of sisters, parents' occupational status, household's monthly income, number of cars in the household, proximity to supermarkets, proximity to malls, activity levels, and BMI. The variables that were statistically significant ($p < 0.05$) or statistically indicated ($p = 0.05$–0.10) in the first step of the multiple logistic regression were entered into a new regression analysis model using the manual backward deletion method. For the dependent variables of overweight/obesity and underweight, the independent continuous variable of BMI was excluded. All significant variables from step two were then presented in tables in the paper. The probability of F-to-enter was set to 0.05 and the probability of F-to-remove was set to 0.10. Variables with few observations were merged, for example, in the variables of father's and mother's level of education the PhD degree or higher category was merged with the bachelor's degree category. Another variable with low (n) and merged categories was the number of brothers for which the categories of no brothers and one brother were merged. Variable categories were considered to have low (n) if they contained fewer than 10 individuals. Some categories in other variables where eliminated altogether, such as the category of not having any car in the variable of number of cars in the household.

Before we started the analysis of Paper **IV**, an operationalization of items/variables and a check of the data quality in the database were carried out. The major modifications introduced into the database were as follows:

- Any mismatched data were fixed. For example, if someone answered that they ran for 3 days per week but provided a duration of running of zero minutes, then zero was used for her answer as the number of days she was running per week and vice versa. In either case, the final answer would be zero because we were multiplying the number of days by the number of minutes to get the total minutes of running per week.

- All PA time at the vigorous-intensity level was capped at 120 minutes per day except for household activity, which was capped at 180 minutes per day. This was done in order to avoid over reporting of PA. Similarly, the variable of stair climbing was truncated at a maximum of 30 floors per day by assuming a reasonable and realistic maximum of 3 trips up a 10-story building or 5 trips up a 6-story building (Hazzaa et al., 2011b).

- When an absolute cut-off value from the International Physical Activity Study (Bauman et al., 2009) was used for classifying the participants into the *active* category, the "activity index" revealed that only seven women were considered active, which would limit the comparisons between activity categories. Therefore, a new variable named "activity level" was introduced based on activity tertiles and this included the lower third, middle third, and upper third of total MET min/week).

The first step in the data analysis (Paper **IV**) was a descriptive statistical analysis to determine the prevalence and 95% CI of the three activity categories based on tertiles of MET min/week. Tertile distribution enabled equivalency in intragroup comparisons and facilitated the discernment of the association between PA and the predictor variables. The descriptive data were then presented as the number of participants, row percentages, means, and standard deviation (SD) when applicable. The row percentages were used to show the distribution of the predictor variables in percentages for the outcome variable of interest, namely the activity levels based on MET tertiles. The proportion of participants meeting the WHO recommendations for moderate-intensity and vigorous-intensity PA levels were calculated using cut-off scores for moderate-intensity PA of 150 min per week and vigorous-intensity PA of 75 min per week.

The descriptive analysis was followed by univariate and multivariate ordinal regression to examine the association between activity levels and predictor variables. All statistically significant ($p < 0.05$) and statistically indicated ($p = 0.05–0.10$) variables in the results of the univariate analysis were included

in the multivariate regression analysis. At the final step, after finding a final multiple regression model, we tested all remaining non-significant variables one at a time to ensure that no other variables could significantly influence the final model. In the final model for multivariate ordinal regression, the following variables were entered initially: classification of BMI, marital status, mother's education level, and residential proximity to parks. For each predictor variable, a reference category was created. Odds ratios (OR) and 95% CI were calculated in an Excel document, and the statistical analysis was run with SPSS version 20 (SPSS Inc., White Plains, NY, USA). Analysis and interpretation of the results were conducted in collaboration with a statistician.

5.4 PRE-UNDERSTANDING

The pre-understanding of the primary investigator (AK) consisted of previous knowledge and experiences related to the nursing profession. The prerequisite knowledge, related to KSA, was gained through meetings, discussions and participation in local traditional celebrations as well as clinical teaching and thereby observing different practices and lifestyle related behaviors. Further, the native language of AK is Arabic, and this made the data collection easier because some of the interviews were conducted in Arabic, all communication with the hospital patients was in Arabic, and all information given to the participating university students – including the questionnaires – was in Arabic. Those language skills could also influence the participation rate in a positive way.

However, awareness of the pre-understanding made it possible to conduct the study. The goal was to present all the facts that were relevant for the purpose of this thesis with a critical approach and to add to the body of existing knowledge.

5.5 ETHICAL CONSIDERATIONS

The Helsinki Declaration (WHO, 2001; WMA, 2013) ethical recommendations and principles for conducting scientific work were followed during the planning and implementation of all studies. Further, the four ethical principles of respect for autonomy or self-determination, the principles of nonmaleficence and beneficence as well as the principle of justice were all taken into account when planning the studies (Beauchamp & Childress, 1994).

Studies **I** and **II** were both approved by the investigated hospital's local ethics committee (No. 50/80/26889) and the Ministry of Health (MoH) (20 April 2009). The patients or their close relatives were asked for their informed consent during the data collection day. Both verbal and written information about the project, the planned measurements, and the right to freely participate was given and patients were guaranteed anonymity.

Data for study **II** were collected among registered nurses who were asked for signed informed consent on the day of the interview. Both verbal and written information was given about voluntary participation and the nurses' right to withdraw at any time during the study without giving any explanation and that the material would then be immediately destroyed. The nurses were also guaranteed confidentiality and no personal identification numbers or names were collected. Further, the confidentiality meant that only the researcher had knowledge of who responded to the questions. The nurse participants were also informed that the interviews would be tape recorded and that the records would be coded and stored separately from the identification list.

Studies **III** and **IV** were approved by the Ethical Committee of King Khalid University, Abha, KSA (7/1078). The informed consent that was obtained from each participant was signed during the data collection. The students were provided information sheets about the project with contact details for the responsible researcher (AK).

6 MAIN FINDINGS

6.1 WEIGHT STATUS IN WOMEN

In Paper **I**, more women than men in the hospital were found to be obese (29% of women versus 10% of men using Caucasian-based cut-offs or 40% of women versus 23% of men using Asian cut-offs). The combined overweight/obesity rate among in-hospital female patients was 49% according to the Caucasian cut-offs and 45% among male patients. With regard to the prevalence of grade 2 or grade 3 overweight (obesity or severe obesity, respectively), women differed significantly from men with both Caucasian-based BMI cut-offs ($p = 0.003$) and Asian-based BMI cut-offs ($p = 0.028$). In comparison to male patients and using the Asian BMI cut-offs, the prevalence of overweight/obesity was 62% among women and 51% among men. Low BMI was found among 22% of women and 23% of men. There was no significant gender difference regarding BMI (the mean BMI for women was 24.3 and for men was 22.6) among patients at risk for moderate to high risk of undernutrition.

In Paper **IV**, the mean BMIs of the female university students in relation to their PA were 23.0, 22.9, and 22.1 for highly active, moderately active, and low active, respectively. With regard to the respondents' BMI categories in relation to WHO recommended amounts of PA at a moderate intensity level, the analysis revealed that the percentage of participants not meeting the PA recommendations decreased significantly ($p = 0.005$) from the underweight group to the overweight/obese group (underweight = 50%, normal weight = 36%, and overweight/obese = 32%). Moreover, about 87% of the underweight students did not meet WHO recommendations for vigorous-intensity activity levels compared to 85% of the normal weight respondents and 83% of those who were overweight/obese. The differences in terms of vigorous-intensity PA were not statistically significant.

In Paper **III**, the majority of the university students were found to be normal weight (57.0%), and the prevalence of underweight (19.2%) and overweight/obese (23.8%) were significant ($p < 0.001$). The underweight group was additionally found to be significantly younger than the normal weight and the overweight/obese groups ($p = 0.01$). Similarly, the mean WC measurements – 62.5 cm in the underweight group, 69.5 cm in the normal weight, and 81.6 cm in the overweight/obese group – differed significantly ($p < 0.001$) between the three groups. Likewise, the WHtR – 0.39, 0.44, and 0.52 in the underweight, normal weight, and overweight/obese groups, respectively – was found to differ significantly between the groups ($p < 0.001$).

When using the Asian-adapted BMI cut-off on the study population in Paper **III** and Paper **IV**, the prevalence of overweight increased from 18.9% to

30.0% and the obesity rate increased from 6.0% to 12.8%. As expected, the prevalence of normal weight fell accordingly from 59.6% to 41.7% using these cut-offs (Table 4).

Table 4. Frequencies of the female university students' BMI when using Asian or Caucasian-adapted BMI cut-offs.

Caucasian BMI cut-offs	Frequency (%)	Asian BMI cut-offs	Frequency (%)
Underweight (BMI < 18.5)	127 (19.2)	Underweight (BMI < 18.5)	127 (19.2)
Normal weight (BMI = 18.5–24.9)	376 (57.0)	Normal weight (BMI 18.5–22.9)	263 (39.9)
Overweight (BMI = 25–30)	119 (18.0)	Overweight (BMI = 23–27.5)	189 (28.6)
Obesity (BMI > 30)	38 (5.8)	Obesity (BMI > 27.5)	81 (12.3)

6.2 NUTRITION AND PHYSICAL ACTIVITY

In Paper **II**, the interviews with the clinically active nurses linked spontaneous and recurrent malnutrition with physical inactivity. They were "bridging malnutrition and physical inactivity" by identifying the first central theme of "potential for nurses to provide good nutrition and PA" to their patients as well as to their patients' relatives and by stating the second central theme of "having the ability but not the power to provide patients with good nutrition and physical activity. The nurses stated how they used health education as a key tool for providing good nutrition and PA for their patients.

"Those who are underweight are usually weak and need health education. We can tell the patient about the best types and amounts of food that she should eat. And if the patient has problems with being overweight, then she can also benefit from health education"

The nurses felt that it was important to use all possible approaches and opportunities to educate patients about lifestyle changes and about improvements that they could make with regard to nutritional and PA issues.

"At the same time, we encourage them be more physically active … because we are there to guide and support them"

Despite these concerns, the nurses suggested that a barrier to providing patients with proper nutritional care was a lack of control and influence over their patients' food intake. The participating nurses denied the hospitalizations' role in patients' development of malnutrition and blamed the *mourafiqs'* involvement in the patients' nutritional condition.

"For example, if a patient is diabetic and is prescribed a fat-free diet but then the patient's relatives give them meat and everything else high in fat, we are powerless to prevent the patient from consuming such an unhealthy diet"

In Paper **IV**, the female students' BMI was found to affect their levels of PA. The students who were underweight showed significantly less interest in PA compared to their normal weight counterparts (OR 0.59, $p = 0.018$). The majority of the students who desired to lose weight through PA and were exercising regularly were active at a moderate level (38%) or high level (34%). Those exercising regularly to enhance their health were mostly low active (37%) in comparison to those were moderately active (34%) and highly active (29%). There were also participants who exercised regularly for recreation, and these included both low (31%) and moderate activity levels (31%), but the majority of these participants were highly active (38%). On the other hand, lack of time was considered to be the main reason for students not exercising regularly, and of those reporting a lack of time 34% were low active, 31% were moderately active, and 35% were highly active. In addition, 28% of those who were not being encouraged by their parents to exercise regularly were highly active and 36% of those who were supported by their parents were highly active. The majority of the participants were unmarried (33% of them were low active, 34% were moderately active, and 33% were highly active).

When comparing the activity levels of the participants in Paper **IV** based on BMI cut-offs for Caucasians *vs*. the cut-offs for Asians, most of the normal weight participants were found to be moderately active (34.6% for Caucasian cut-offs) or highly active (34.2% for Asian cut-offs) (Table 5).

In Paper **I**, 64% of the men and 62% of the women had eating difficulties according to MEOF-II. Within the category of food intake (sitting position, manipulating food on the plate, and conveying food to the mouth) significantly ($p = 0.003$) fewer women (2%) than men (17%) were found to have difficulties. Low BMI levels were found among both men and women (23% and 22%, respectively). Unintentional weight loss was shown to be higher among men (46%) compared to women (43%), and more men (40%) than women (38%) were at moderate or high risk of undernutrition. There were no significant differences in nutritional interventions between men and women except that significantly more women (61%) than men (31%) in the moderate/high nutritional risk group were served smaller portions. In addition, only a few patients at moderate/high risk for undernutrition received nutritional interventions such as having their food intake registered (<21%), being provided oral supplements (<21%), receiving artificial nutritional support (<29%), or being provided partial or total eating assistance (<29%).

Table 5. Comparison between Asian and Caucasian BMI cut-offs in relation to PA patterns.

	Activity levels based on tertiles of MET-min/week			
	Low active	**Moderately active**	**Highly active**	*p*-value
Asian BMI cut-offs, n (%)				0.015[a, b]
Underweight (BMI < 18.5)	46 (46.9)	26 (26.5)	26 (26.5)	
Normal weight (BMI = 18.5–22.9)	86 (32.7)	87 (33.1)	90 (34.2)	
Overweight (BMI = 23–27.49)	53 (28.0)	71 (37.6)	65 (34.4)	
Obese (BMI > 27.5)	23 (28.4)	28 (34.6)	30 (37.0)	
Caucasian BMI cut-offs, n (%)				0.014[a, b]
Underweight (BMI < 18.5)	46 (46.9)	26 (26.5)	26 (26.5)	
Normal weight (BMI = 18.5–24.9)	119 (31.6)	130 (34.6)	127 (33.8)	
Overweight (BMI = 25–29.99)	32 (26.9)	45 (37.8)	42 (35.3)	
Obese (BMI > 30)	11 (28.9)	11 (28.9)	16 (42.1)	

Kruskal Wallis test (three group comparisons).

[a] Significant differences between 1st and 2nd group, after Bonferroni Correction.

[b] Significant differences between 1st and 3rd group, after Bonferroni Correction.

The nurses experienced several barriers to providing proper nutritional care and PA to in-hospital patients, and these were described in Paper **II**. The expected role of women in Saudi society was viewed by the nurses as one of the obstacles to female patients partaking in a healthy lifestyle, including exercise and proper food intake. Other barriers were a lack of power, poor communication, and the influence of relatives.

"Pregnant women also tend to become overweight because the women believe that if they eat more they will nourish the baby"

"My work is also affected by the manner and style of communication among nurses and doctors. It is also affected when the patient won't cooperate and when there are differences in culture or difficulties in understanding each other"

In the nurses' attempts to address malnutrition and physical inactivity, they described potential methods for providing nutritional care for their patients as well as obstacles to providing such care. One observation that came up quite often in the interviews was that the patients' relatives often made it difficult for the nurses to provide adequate care, but the relatives also provided a potential opportunity for practical nutritional care.

"Here it's always the relatives who influence the patients' diets because they are always bringing in food from outside of the hospital"

The healthy female population of university students described in Paper **III** had no significant differences in their dietary habits except for their weekly intakes of breakfast, which were 36.2%, 51.7%, and 37.6% for the underweight, normal weight, and overweight/obese participants, respectively ($p = 0.001$), and their weekly consumption of French fries/potato chips, which were 34.6%, 32.4%, and 22.3% for the underweight, normal weight, and overweight/obese groups, respectively ($p = 0.035$). For the whole population, there was a statistical indication for differences between the groups with regard to fruit intakes ($p = 0.081$), and cake/donut/biscuit consumption ($p = 0.078$). The intakes of vegetables (47.6%), milk/dairy products (56.7%), sugar-sweetened drinks (50.9%), fast foods (13.6), sweets/chocolates (53.8), and energy drinks (96.7%) showed no significant differences between the underweight, normal weight, and overweight/obese groups.

6.3 ASSOCIATED FACTORS

Associations were found between physical activity and BMI in Papers **III** and **IV:** the marital status of the participants was found to be significantly and positively correlated with both PA levels (Paper **IV**, OR 3.33, $p = 0.005$ for married students without children) and BMI (Paper **III**: OR 2.01, $p = 0.045$ for married students without children and OR 4.34, $p = 0.010$ for married students with children) in comparison to unmarried students (who represented 92% of the total sample). Similarly, parents' level of education was associated with the participants' PA level and BMI. More specifically, the higher the mother's level of education the higher the participant's PA level (Paper **IV**: OR 1.89, $p = 0.004$) and the higher the father's level of education the higher the BMI (Paper **III**: OR 2.15, $p = 0.032$). As expected, an inverse relation was found between BMI and PA. In Paper **IV**, the underweight students were found to be less active than their normal weight counterparts (OR 0.59, $p = 0.018$).

With regards to nutritional habits and PA, the low activity levels, in Paper **III**, were found to be positively associated with the breakfast intakes ($p = 0.029$, OR 1.56 compared to high activity levels). The consumption of fresh fruits was negatively associated with the moderate levels of activity.

Regarding the unhealthy dietary habits (Paper **III**), the participants' BMI and their activity levels were associated with the intakes of sugar-sweetened drinks (OR 1.04 for BMI and OR 1.53 for low PA compared to high PA), fast foods (OR 2.02 for moderately active compared to highly active persons), intakes of French fries/potato chips, sweets, and chocolates (OR 1.05 for BMI), and intakes of cakes/donuts/biscuits (OR 1.06 for BMI). Furthermore, with regard to the participants' BMI, being low physically active had a negative effect on being underweight (OR 0.44).

Another associated factor to PA (Paper **IV**) was found to be proximity to parks (OR 0.62 for far located parks compared to very close). For BMI (Paper **III**), other significant correlates were presence obese parents and siblings as well as number of sisters. The number of siblings was also associated with the nutritional intakes of fresh fruits consumption (OR 0.25 for six sisters or more compared to none), and cake/doughnuts/biscuits (OR 1.71). Further, the number of sisters was associated to both underweight (OR 0.12) and overweight/obese (OR 5.55), while number of brothers was associated with the overweight/obese (OR 2.13 for two-three brothers compared to none). Other factors significantly associated with underweight were found to be age, presence of obese parents and siblings and activity levels. For the overweight/obesity the associated factors, besides number of siblings, were presence of obese parents and sibling as well as parents' occupational status.

7 DISCUSION

7.1 NUTRITIONAL STATUS, PRACTICES AND HABITS

The findings that were presented in Paper **I** revealed that few obese women or those at risk of undernutrition received nutritional interventions. More women than men were served small portions even though there were no significant gender differences regarding BMI. The results of this thesis (Paper **I**) indicated that the nutritional care of the patients in a hospital setting was not optimal. Nutritional routines were poor or lacking, and undernutrition was undertreated. BMI was seldom documented, food and beverage intake was seldom registered, few patients at nutritional risk received oral supplements, and none of the patients were provided with protein- and energy-enriched food. Furthermore, although women and men at moderate/high risk for undernutrition had similar BMIs, more women than men were served a small portion (61% *vs*. 31%). One explanation for this could be that women might have had relatives providing them with food brought from outside of the hospital. Other reasons could be that men were more active and thus were considered to be in need of more food. It could also be that staff incorrectly thought that the women needed to lose weight due to overweight/obesity despite their being in the hospital due to acute illness. If so, the patient could be put at increased risk of undernutrition. The poor targeting of nutritional interventions to patients at nutritional risk has previously been shown in Sweden (Westergren et al., 2009a). In an intervention study in a hospital in Iceland, a nutritional program was implemented that resulted in improved precision of individual nutritional care activities and in more patients having their BMI documented (Westergren et al., 2010). Thus, in Saudi Arabian hospitals, as well as in other countries, it seems necessary to implement nutritional guidelines that focus on how to identify persons at risk of undernutrition and what measures to take for patients at risk. In addition, the targeting of nutritional interventions towards in-hospital patients at nutritional risk are indicators of quality of care.

By viewing the central themes of Paper **II** (*Potentials for nurses to provide good nutrition and physical activity* and *Having the ability but not the power to provide good nutrition and PA for patients*) in light of the Theory of Cultural Care Diversity and Universality, we can highlight culturally meaningful recommendations for care. Culturally congruent care means providing care that is meaningful and that fits with the cultural beliefs and way of life of the patient (Leininger, 1999).

It was further shown in Paper **II** that the relationship between nurses and their patients often suffered from miscommunication and misunderstanding. Some of the reasons for such communication issues are related to cultural factors and to language barriers. Tate et al. (Tate, 2003) showed that

speaking different languages creates confusion and misunderstanding, while from the nurse's side being aware of the patient's cultural background will give the nurse an opportunity to provide holistic care. The cultural theorist Leininger (2007) states that obtaining knowledge about patients' social structure and factors such as religion, politics, economics, cultural history, lifespan values, kinship, and philosophy of life helps the nurse to provide congruent care that can maximize wellness, prevent illness, alleviate cultural stress, and help to sustain the patient's quality of cultural life (Leininger, 2007). Thus, it would appear to be important to further educate expatriate nurses about Saudi Arabian culture, religion, and language. Such education could possibly have an impact on the nutritional care of patients in the KSA.

An important observation from Paper **II** was that the presence of relatives during the patient's' hospital stays was experienced both as a resource and as a limitation for the nurses' opportunities to provide proper health care for the patients, especially with regard to their nutrition. The challenge of having relatives present during patients' hospital stays in the KSA has been described in previous studies (Al-Shahri, 2002). The relatives or significant others can often influence the care that is provided and often try to provide care themselves. Especially in female wards, a *mourafiq* (relative or outside sitter) is often present during the hospital stay (Al-Shahri, 2002). Saudi researchers like Aboul-Enein (2002) say that it is important for expatriate nurses to recognize the significance of strong extended family ties among the majority of the Saudi Arabian population. This is in line with the theory of Cultural Care Diversity and Universality (Leininger, 2002), which recommends that healthcare staff obtain knowledge about every individual patient's cultural background. This challenge of having a relative present during the patient's entire hospital stay is not common in Western countries. Thus, from a medical perspective it seems highly important to inform the relatives in the KSA about the specific nutritional needs the patient has in order to include them in optimizing the patient's nutritional care.

Aside from language barriers, both a lack of cooperation and the role of relatives are possible factors explaining poor nutritional care. For instance, when nursing care is not enough there is a need to involve other professionals such as a dietitian (Kulick et al., 2010). In Paper **I** it was shown that patients at risk of undernutrition did not receive oral supplements, energy-enriched meals, or even consultation with a dietitian. Thus, the findings of Paper **I** support those of Paper **II** in highlighting the need to implement nutritional policies to facilitate good nutritional nursing care. In addition, the "denial" of the problem by nurses, i.e. the belief that patients were admitted with existing problems of undernutrition, increases the risk of patients not receiving adequate care. This is not unique to the KSA, and other studies have highlighted similar problems. For instance, in a Swedish study (Khalaf et al.,

2009) it was shown that nutritional problems were perceived as taboo among nurses and that undernutrition was not always recognized and talked about. The nurses thought that this did not develop during the hospital stay but was instead assumed to have developed prior to the patient's admission to the hospital. Thus, in order to facilitate the identification of undernutrition and the monitoring of nutritional status, it is necessary to implement systematic screening for undernutrition and follow-up of weight status.

The high prevalence of overweight among females in Paper **I** highlighted the need for further studies on a healthy female population's nutritional habits. Paper **IV** presents the unexpected finding that the prevalence of underweight female students was almost as high as overweight/obese students in a healthy highly educated population. Results reported in a university population (Al-Mukhtar, 2000) in the United Arab Emirates, a neighboring gulf country of the KSA highlighted the BMI status of women (n = 200, 18 to 24 years). The prevalence of underweight reported was 20% and 31.5% were overweight/obese. One can argue that attempts to promote healthy weight in the community considering both underweight and overweight/obesity should have been taken during the last 14 years, i.e. since the study of (Al-Mukhtar, 2000) was published. Contrary to this study's findings, Al-Rethaiaa et al. (2010) found that only 5% of the male university-based population in the KSA were underweight (n = 357). In the present study (Paper **IV**), factors significantly associated with the participants being underweight were found to be age, number of sisters, presence of obese siblings and parents, and the activity levels of the participants. However, these findings need to be studied further with specific focus on underweight and its determinants in a healthy female population in the KSA. This is especially the case considering that most previous studies have been conducted with special focus on overweight/obesity (Al-Rethaiaa et al., 2010; El-Hazmi et al., 2002; El Mouzan et al., 2010; El Mouzan et al., 2012) and less is known about the prevalence of underweight persons in healthy populations. Researchers mean that underweight and overweight/obesity coexist in all countries around the world, though to different extent, and that many developing countries face the dual challenge of continuing underweight and increasing overweight (Kim et al., 2010). Since the present thesis results show a high level of underweight students, this phenomenon should be emphasized and targeted in future research regarding body weight, body image and associated factors. The results of such studies could possibly form the basis for prevention of social consequences related to ideal body shape perceptions in KSA society, especially since it was shown that UW is not socially accepted in KSA society (Musaiger et al., 2004). The results could also be beneficial to healthcare officials and policy makers in helping them to prevent many underweight - related health conditions, including infectious diseases (Lindstrand et al., 2006), osteoporosis (Tanaka et al., 2013), and compromised immune system diseases such as tuberculosis (Podewils et al., 2011).

With regards to the nutritional habits of the population, Paper **IV** showed that overweight/obese students had the highest intakes of unhealthy foods and that unhealthy intakes of French fries/potato chips were significantly correlated with higher BMI levels. A recently published study (Al-Rethaiaa et al., 2010)

conducted on male university students in the KSA in which 21.8% were overweight and 15.7% were obese indicated that the students' most common eating habits were eating with family and having two meals per day including breakfast together with frequent snacks and fried food consumption, all of which are consistent with the results of current study. Further, vegetables and fruits were not frequently consumed by most students (Al-Rethaiaa et al., 2010), which is also similar to the findings in Paper **IV**. Other researchers (Lazzeri et al., 2013) have identified significant correlations between low fruit and vegetable intake and irregular breakfast habits among children aged 11 to 15 years. Older female participants in particular were shown to be at higher risk of low fruit and vegetable intake (Lazzeri et al., 2013).

Additionally, the similarities between the reported prevalence of overweight/obesity in Paper **III** and in the study conducted on male university students (Al-Rethaiaa et al., 2010) might be related to one of the major causes of obesity. The diet in the KSA has seen significant changes, in terms of both quantity and quality, and has become more "Westernized" (Antonio et al., 2005) implying an increased consumption of foods from international fast food chains. Most of Saudi students (63.3%) (Al-Rethaiaa et al., 2010) eat irregular meals while 64.6% of Lebanese (Yahia et al., 2008) and 81.6% of Chinese (Sakamaki et al., 2005) male university students consume regular meals. The eating habits of the Saudi youth population need to be improved using educational programs to promote healthy eating habits. The modernization and affluence in the KSA that has increased significantly over the last three decades has brought the problems of obesity to the surface. Following this, strategies to prevent obesity in the KSA should include modification of eating behavior such as reduced intake of high-fat foods and increased consumption of fruits and vegetables.

In Paper **III**, the sisters' influence on the study participants' intakes of fresh fruit and sweets might be related to cultural effects of sharing meals with family. The meals eaten together with the family were found to be of great importance in influencing adolescents' food choices (Neumark-Sztainer et al., 2010). The social networks' role is suggested to have even more important effect on a person's risk of obesity than genes do (Christakis et al., 2007). A recently published study in the US (Larson et al., 2013) found that frequently shared meals in young adulthood were associated with greater intakes of fruit among males and females and with higher intakes of vegetables, milk products, and some key nutrients among females. Furthermore, fruits and sweets might be consumed during social events and family gatherings (Pedersen et al., 2012) where sisters usually gather together. A recent study showed that women more frequently make healthier dietary food choices and are more likely to consume fruits as snacks (Hartmann et al., 2012) in comparison to men. Another possible reason for the influence of sisters, either as models for eating behaviors or as social peers, might be the nature of Saudi

culture where women are usually separated from men (Mobaraki et al., 2010). Thus, the most effective way to prevent unhealthy intakes of sweets and to encourage healthy fruit consumption would be to target healthy food campaigns to the family as a whole. As a consequence of such activities, obesity-promoting dietary habits might also be targeted to help increase the health of Saudi women.

Another interesting finding in Paper **III** was that a greater number of sisters was significantly correlated with the development of either overweight/obese or underweight. This contradictory finding might be related to the previously mentioned cultural structure of Saudi society (Mobaraki et al., 2010) leading to an increased socialization of sisters in the household environment. While some studies have found that a larger number of siblings decreased the OR for overweight (P for trend < 0.001) (Ochiai et al., 2012), other studies tried to study the potential mechanisms explaining correlated BMI outcomes in a biologically related social network. In the study by Brown et al. (2012), the researchers found that time-constant factors such as genetic heritability and habits formed during childhood could explain some of the overall correlation between siblings and BMI. Further, they found that factors that change over time, for example, social norms or environmental factors such as opportunities for exercise, only significantly impact the overall correlation in BMI for adolescent siblings suggesting that the influence of social network on correlations in BMI is facilitated by sharing the same household (Brown et al., 2012). Bakhotmah (2012) suggested that any effective nutritional education program should be based on a proper understanding of factors related to a population's nutritional knowledge, behavior, food preferences, and desire to change these preferences.

7.2   WOMEN AND PHYSICAL ACTIVITY

Underweight female students were found to be less active than overweight/obese students (Paper **IV**). Moreover, of those not encouraged by their parents to be physically active, only 28% were highly active. The mother's level of education, the student's marital status, and the proximity of the student's residence to parks all had significant impacts on the student's PA level.

The findings in Paper **IV** with regard to PA levels among female university students are consistent with studies conducted in similar environments and cultures in other countries (Al-Hazzaa, 2004; Janssen et al., 2005; Wang et al., 2002; Dumith et al., 2011). For example, the study by Al-Hazzaa (2004) showed a prevalence of physical inactivity levels that ranged between 43% and 99% among Saudi children and adults alike, and this can be compared to Paper **IV** that showed a high prevalence of students not meeting the WHO recommendations for PA at a vigorous-intensity level (85%). Results

from other international studies conducted in different cultures with similar lifestyle patterns to that of the KSA (Al-Nozha et al., 2007; Al-Nuaim et al., 2012) also indicated high inactivity levels among Saudi women (Varela-Mato et al., 2012). The observed similarities might be explained in terms of a trend towards replacement of an active lifestyle with an increasing frequency of sedentary routines in daily life and a growing trend towards unhealthy weight gain. In addition, global physical inactivity patterns were reported to be more prevalent in affluent societies and among women (Hallal et al., 2012; Kimm et al., 2002). This trend was also recently reported among adolescent females in the KSA (Al-Hazzaa et al., 2011b; Al-Nakeeb et al., 2012). Thus many researchers suggested that a better understanding of cultural influences is necessary in order to effectively promote PA (Al-Eisa et al., 2012).

One of the more surprising findings in Paper **IV** was the fact that underweight women were found to be less active than their overweight peers. We did not, however, have complementary data on the health status of the students who participated in the study in Papers **III** and **IV** and this suggests that further research is needed in this area. Several explanations can be given for this apparent discrepancy. For example, underweight persons might have lower levels of PA relative to their peers with greater BMI due to lower energy levels and/or a greater disposition to fatigue (Stang et al., 2005). Another reason might be a desire by this group to increase their weight by being physically inactive and thus conserving energy (Neumark-Sztainer et al., 2004). However, this phenomenon has not been sufficiently studied and more research on underweight women's PA patterns is crucial. Other noteworthy reasons for these findings may be that overweight participants might have over-reported their PA in order to meet the social expectations of movement (Adam et al., 2005), or that they are physically active and thus have more muscle mass that weigh more (Haskell et al, 2007; Rothman, 2008).

Previous studies have reported a considerable decline in PA levels, especially among adolescent females in some of the major cities in the KSA (Al-Hazzaa et al., 2007b). International studies, including that of Kimm et al. (2002), have shown a significant age-specific decline in PA that is seemingly correlated with adolescence and the female sex. In a recently published study, the major barrier to PA among women was identified to be lack of time while in the men it was a lack of motivation (Al-Otaibi, 2013). Another recently published review reported significant correlations between increased BMI and a decline in PA levels (Harris et al., 2009). Contrary to this, a study conducted on American university students of Arabic origin found that the overweight students were more active than their underweight counterparts (Kahan, 2007). Levin et al. (2003) also reported that underweight adolescents were less active than what previous studies had indicated.

In addition, the results of Paper **IV** confirmed a positive and significant correlation between the mothers' levels of education and the students' PA levels. Another noteworthy finding in Paper **IV**, though not statistically significant, was the proportion of highly active females (28%) who were not encouraged by their parents to exercise regularly, an observation that might at least in part be explained by the propensity of females to engage in household activities (Mabry et al., 2010). The extent to which parental influence impacts the PA patterns of young women has been examined in several studies and shown some or a considerable degree of correlation (Alderman et al., 2010). The students' PA behaviors in relation to the indicated effects of parental support for regular exercise can partially be explained by the socioecological model of Sallis and Owen (2008). Consistent with such a model, interpersonal factors seem to play an important role in shaping the students' behavior with regard to PA levels. Although the students in the current study lacked a social network of physically active and/or supportive individuals, the students found ways to engage in high-intensity PA. It might be argued, therefore, that it is valuable to provide physical education classes for female students as well as some kind of intervention for their mothers.

A number of evidence-based studies indicate that individuals who engage in PA at an adequate level are considered healthier than their physically inactive counterparts (Sisson et al., 2008; Bauman et al., 2009; Hallal et al., 2012; Popkin, 2001; Beets et al., 2010). While recent indications that a large proportion of overweight/obese women are physically active might be a sign that public health efforts and information campaigns in the KSA have been effective, it is still too early to draw any firm conclusions of this nature. Messages from public health authorities with regard to the importance of PA are reaching the intended audience and seem to be affecting behavior patterns, but results have not yet been reported on any significant scale. Another possible reason for the reported high PA levels among overweight/obese females could be the self-reported questionnaire that led to over-reporting of the levels of PA as indicated in previous studies (Dumith et al., 2011). Furthermore, a person's perception of the 'amount of effort required to perform an activity' is also involved in their assessment of whether an activity should be characterized as being at a low, moderate, or high level.

7.3 METHODOLOGICAL CONSIDERATIONS

7.3.1 Quantitative studies

In Paper **I**, a possible methodological limitation was discussed in which the nature of the cross-sectional study design would mean that patients with longer lengths of hospital stays would have a higher probability of taking part in the point prevalence study (Pernicka et al., 2009). However, in Paper **I** the relation between hospital stay and dropout was shown to be the opposite. One explanation could be that patients with longer hospital stays

had more severe or complex diseases and, therefore, were less able to participate in the studies.

Another limitation discussed in Paper **I** was the dropout rate, which was significantly higher among women (37%) compared to men (14%). This finding appears similar to what was found in a previous Saudi study reporting a higher refusal rate among women than among men (Al-Subaihi, 2008). This has implications not only for studies in the KSA and the Middle East region but also for efforts to involve immigrant women from this part of the world in studies conducted in other countries. Motivational strategies, therefore, need to be developed that focus on increasing Saudi women's participation in research.

Another methodological consideration is that 15 (11%) of the included patients in Paper **I** were placed in the cardiology unit where they might have received diuretics. However, this was not taken into account when assessing the risk of undernutrition with regard to the criterion of unintentional weight loss. The first reason for this was that we did not collect information about the patients' medical treatments, i.e. we did not have evidence for diuretic intake before or during the time of data collection. Second, if only one criterion was fulfilled the patient was considered to have only a low risk of developing undernutrition.

A possible limitation of the study presented in Papers **III** and **IV** might be related to choice of the self-reporting questionnaire based on the ATLS questionnaire as the survey instrument. However, this questionnaire was validated previously with equivalent and significant validity coefficients for use among Arab youth (Al-Ahmadi et al., 2004). Furthermore, the questionnaire is comparable to other self-reporting instruments on the whole (Ainsworth et al., 2011). The results of this study should, therefore, be generalizable to other female university students, not only in the KSA but also in other Arab countries. Another potential shortcoming of this study might be the rigor with which its results can be applied to expectations of PA behavior of the entire Saudi population because the study participation was limited to female university students. In addition, these students lived at a high altitude (2000–2300 m above sea level), which might make this sample population environmentally different compared to the rest of the Saudi population. Nevertheless, the chosen sample was considered to be of sufficiently representative size and with enough statistical power to make the results with this sample transferable with respect to female university students, and this is a strength in and of itself in the analysis.

Although Paper **IV** offers insight into the current nutritional and BMI status of a healthy and highly educated sample, a number of limitations exist. Generalizability is limited due to the selectivity of the study setting. On the

other hand, the number of participants was considered to be representative of the studied population. Furthermore, the risk for committing type I error increases with an increased number of tests and this can be avoided by using a lower p-value cut-off for statistical significance (for example 0.01 instead of 0.05). This was, however, not done in our analysis because reducing the probability of getting a type I error increases the probability of getting a type II error due to the inverse relationship between the two (Altman, 1991).

Using culturally suitable research questions as the basis for motivation strategies regarding increasing PA levels might be one of the more important factors for achieving better health and adequate PA levels among the entire Saudi population, particularly among the more vulnerable groups such as women. The requirement to carry out a culturally adapted research method in this study was at least in part fulfilled by the choice and implementation of the ATLS instrument in Paper **III** (Al-Ahmadi et al., 2004; Ainsworth et al., 2011).

7.3.2 Qualitative study

Within qualitative research, terms like credibility, dependability, and transferability have to be described to show the different aspects of trustworthiness within the research topic. The procedures utilized to achieve research results must, therefore, be examined to evaluate the outcomes of such analysis (Graneheim et al., 2004). To achieve credibility, the methods need to be described as openly and thoroughly as possible, not least of which being how the categorization of the results was undertaken. Having a well-designed data collection method and describing the context in which the data collection was made as accurately as possible increases the credibility of the analysis (Graneheim et al., 2004).

In order to achieve trustworthiness, it is important to choose a suitable method for data collection. An interview-based method was chosen for Paper **II** in order to explore the experiences of healthcare staff in providing nursing care for malnourished patients. The trustworthiness of this study was strengthened by triangulation (Denzin et al., 2011) in which three of the authors independently analyzed the text and then compared their analyses and agreed upon a common interpretation (Kvale, 1997; Graneheim et al., 2004).

In order to facilitate the transferability of the results, it is important to give the reader a clear description of the study context, the selection of respondents, the data collection, and the analysis process (Polit et al., 2006; Granskär et al., 2012), and this information is usually presented early in the manuscript. Furthermore, the use of quotations in the results section facilitates and confirms the trustworthiness of the interpretations (Graneheim et al., 2004).

To provide a comprehensive picture of the variation and width of the investigated healthcare issue, it must be viewed from several different perspectives. Because both local and expatriate nurses have the primary responsibility in the care of the patients in a ward, representative samples from both groups of nurses were selected to participate in the study. This increased the credibility of the results (Graneheim & Lundman, 2004). Presumably, a larger number of informants and an increasingly diverse selection could contribute to greater variety in the results. Almost all the participants were women, and only three men reported their interest in the study and were interviewed. The selection of informants might still be considered representative because nurses, just as in other parts of Saudi society, are segregated. Both genders need to give their opinion on the healthcare provided to diverse patient groups, and this means that the sample in this study is well representative of the staff compositions of other Saudi hospitals.

Polit et al. (2006) argue that there are no rules for the sample size of the group and that this is guided instead by the purpose of the study, the quality of the collected data, and the selection strategy. An interview guide was used in order to ensure that the interviews provided answers to questions relevant to this study and as a means for the interviewer to get the informants to stay on topic. This yielded a rich material on which the analysis was based and enhanced the credibility of the results (Graneheim et al., 2004). The last three interviews yielded no new information, but they confirmed the perceptions and experiences of the nurses as revealed in the earlier interviews and this strengthened the credibility of the results (Graneheim et al., 2004).

Kvale (1997) suggests that the interviewer should be knowledgeable in the chosen subject of the interview and be good at interacting with other people. The best way to become a good interviewer is to gain experience by conducting interviews. This was achieved by the three pilot interviews that were transcribed and critically reviewed by both the primary investigator (AK) and the two co-authors before the remaining interviews were conducted. There was a risk that the author (AK) had a kind of pre-understanding of what the respondents would take up in the interviews based on her previous experiences conducting studies in similar facilities and in the same clinic. However, such knowledge and experience could actually be an advantage because this makes it easier to understand what the respondents actually mean. The study's significance lies mainly in that the results of the study might be of benefit by increasing healthcare professionals' awareness of the risks of malnutrition and to arouse interest in observing and documenting patients' nutritional status in clinical settings.

8 CONCLUSIONS

The targeting of nutritional interventions toward in-hospital patients at nutritional risk is an indicator of quality of care. Thus, in Saudi hospitals, as well as those in other countries, it is necessary to implement nutritional guidelines that focus on how to identify persons at risk of undernutrition and what measures to take for patients at risk. Furthermore, in order to facilitate the identification of undernutrition and the monitoring of nutritional status, it is necessary to implement systematic screening for undernutrition and follow-up of weight status. The method of a point prevalence approach can be a cost effective and rapid method for identifying different pitfalls in healthcare and should therefore be applied in a wider extent in hospital-based settings.

In addition, it would be important to further educate expatriate nurses about the Saudi culture, religion, and language. This can possibly have an impact on the nutritional care provided to malnourished patients. In addition, involving the relatives in the nutritional care of in-hospital patients might improve the nutritional health status of the whole family.

Because the results of this thesis show a high level of underweight students, this phenomenon should be targeted in future research regarding body weight, body image perceptions and associated factors. The results of such studies could be beneficial to healthcare officials and policy makers in trying to prevent many underweight -related health conditions such as tuberculosis, infectious diseases, and osteoporosis. These studies could also form the basis for prevention of social consequences related to ideal body shape perceptions in KSA society and may shed light on individuals with anorexia nervosa or other nutritional related disorders. Furthermore, based on this thesis' results, the most effective way to prevent unhealthy intakes of sweets and to encourage healthy fruit consumption appears be to increase healthy eating campaigns that target the family as a whole. As a consequence of such action, obesity-promoting dietary habits might also be targeted leading to a possible increase in the health of Saudi women.

The positive and significant correlation between the mother's level of education and the students' PA levels that was found in this study lends support to the argument that it is valuable to provide physical education classes for female students as well as some kind of intervention for their mothers. Also building on the knowledge argument, it could be beneficial to implement a PA intervention in a university sample targeting the knowledge level, attitudes toward and levels of PA. In this case and as first step, the longitudinal data does not need to be a time consuming or costly one.

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