

Emergency Department Attendance

During Ramadan

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of

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in

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DECLARATION

I, Patricia Kilian, declare that this research report is my own work. It is being submitted for the degree of Master of Science in Medicine in Emergency Medicine in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other university.

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The5th.... day of ...March....., 2017

DEDICATION

In loving memory of my father

Trevor Terrance Alfred Rein

1937 - 2012

ABSTRACT

Introduction: The month of Ramadan is characterised by changes in dietary and lifestyle habits by those fasting, which could result in medical issues that may have an impact on the utilisation of the Emergency Department (ED) over this time period.

Methods: ED attendance was compared during the Ramadan period to a specified Control period, and included a comparison of demographic and clinical features of patients, nationalities, diagnosis profile, time of admission and number of ED admissions. This was a retrospective, observational study set in a private hospital in Dubai, UAE, which included patients aged 16 years and older.

Results: A total of 1766 patients presented to the ED, of which 822 (46.5%) were admitted during Ramadan, and 944 patients (53.5%) during the Control period. Although significantly more female patients attended the ED during the Control period, there were no differences in the ages nor the nationalities of the patients. Only one significant difference was noted in diagnoses, which was in the skin-related category ($p = 0.0012$). Significantly more patients were seen per day during the Control period compared to Ramadan ($p = 0.0057$). A significant change in the time of ED attendance for MENA region patients was noted during Ramadan ($p=0.0036$) with more patients presenting during the night-time, which was not observed in non-MENA region patients.

Conclusions: The significant shift in presentation towards the night was most notable in patients from the MENA region, and therefore most likely to be due to fasting. In addition, changes in certain diagnoses and gender distribution over the study period may assist in future ED management planning during Ramadan.

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ABBREVIATIONS

CVS	Cardiovascular
ED	Emergency Department
ENDO	Endocrine-related
GIT	Gastrointestinal
hr	Hour
ICD-10	International Classification of Diseases, Tenth Revision
MENA	Middle East North Africa
MUSC	Musculoskeletal
NEURO	Neurological
OBGYN	Obstetric-Gynaecological
PBUH	Peace Be Upon Him
RESP	Respiratory
SURG	Surgical
TSH	Thyroid Stimulating Hormone
UAE	United Arab Emirates
URTI	Upper Respiratory Tract Infection
USA	United States of America
UTI	Urinary Tract Infection

Chapter 1: LITERATURE REVIEW

1.1 Introduction

Ramadan is the ninth month in the Islamic lunar calendar, during which millions of Muslims worldwide fast from dawn to sunset.(1) The month begins with the sighting of the new moon by Islamic scholars, and is either 29 or 30 days in length.(2,3) Fasting is compulsory for all healthy Muslims who have reached puberty, as it forms one of the five fundamental pillars of the Islamic faith. Ramadan marks the revelation of the Holy Qur'an to Prophet Mohammed (PBUH) and provides an opportunity for Muslims to focus on developing a deeper spiritual awareness; encouraging the believer to remember those that are poor and hungry; to refrain from materialism; and help lessen the burden of the person's past sin.(4,5) The end of Ramadan is followed by Eid Al Fitr, which denotes the beginning of a new month.

During Ramadan, from dawn to sunset, Muslims are required to refrain from eating, drinking, smoking and engaging in sexual intercourse; in an effort to achieve better self-control.(6) Fasting is not obligatory for pre-pubertal children, menstruating women, those travelling (more than 80km from the city of residence) or the sick. Pregnant and lactating women do not have to fast, and are allowed to postpone their fast to a later, more appropriate time when it will not affect their maternal duties.(7,8) If an individual has an incurable sickness and is unlikely to recover, then instead of fasting they are required to feed a needy person (or make an equivalent donation of money for one day's meal for the number of fasting days missed). Fasting is not recommended for psychiatric patients as it is deemed possible they may not be able to follow the rules.(5)

The common dietary practice during Ramadan is to consume two meals a day, one large meal immediately after sunset (Iftar) and one lighter meal before dawn (Suhoor). Some Muslims consume an additional meal before sleeping.(1)

The Islamic calendar (Hijra) is based on a lunar cycle, so the Islamic year contains 354 days. Hence Ramadan advances 11 days every year in relation to the Gregorian calendar, and thus falls in different parts of the seasonal year over a 33-year cycle. As a result, there is not only a seasonal variation but also a difference in the amount of hours spent fasting each day, depending on the location's latitudinal distance from the equator. Those countries in the more polar areas will experience longer fasting hours during the summertime compared to those near the equator, with the daily fasting time varying from 11 to 18 hours.(1)

The Emergency Department (ED) at the centre of the research report is located in the United Arab Emirates (UAE). This Islamic country is steeped in rich Arab and Islamic culture and heritage and the month of Ramadan is highly treasured. The fasting month has a significant impact on everyone (Emiratis and expatriates) residing in the country as it is illegal to eat, drink, or smoke in public from dawn to sunset.(9)

The literature review will focus on the various health-related aspects of Ramadan fasting in healthy individuals and its medical ramifications in patients with acute and chronic medical conditions. There are also social changes, which may increase the number of patients presenting to the ED. This will give a deeper insight into the nature of the disease presentations that are expected to present to

the ED during Ramadan. In addition, the current literature specifically related to ED attendances will be examined more in-depth.

Ramadan brings with it a number of lifestyle changes that can affect the individual's health status:

- A change in meal schedule and frequency: Meals are exclusively nocturnal and less frequent.(2,10) Reduced meal frequency often leads to reduced energy intake and loss of body mass and body fat.
- A change in the amount and type of food.
- A reduction in the amount of sleep.
- An increase in physical worship.

There are also a number of confounding variables that influence the health-related biomarkers of Ramadan on fasting individuals. These are: cultural habits; diet; smoking status; caffeine intake; medication and variability in daily fasting times. For instance, the heavy smokers who give up smoking in the day may experience changes in the biomarkers simply by virtue of smoking less. The dietary norms of individuals (food choice and eating habits) confound the health-related biomarkers, giving mixed results and a lack of consensus regarding the effects of Ramadan on health-related biomarkers.(1)

1.2. General principles

While there are many changes that occur during Ramadan, this literature review will focus mainly on the medical disorders most commonly affected by the month of fasting. There is also a limitation on the type of disorder that can be discussed,

as it depends on previous research by other authors or where the circumstances of Ramadan may have induced changes in medical disorders.

The following metabolic effects and systemic changes are noted in healthy individuals who fast during Ramadan (Table 1-1):

Table 1-1: The effect of Ramadan fasting on metabolism and different organs in healthy individuals (6)

Parameter	Changes during Fasting
Carbohydrates	Glycogenolysis, gluconeogenesis
Lipids	Depends upon change in diet and weight
Body weight	Decreased or no change
Liver	Slight increase in indirect bilirubin followed by a decrease
Haematological	Small decrease in both iron and total iron-binding capacity
Kidney	Rise in uric acid
Neuro-psychiatric	More frequent headaches, disruption of sleep patterns
Endocrine glands	Slight changes in protein binding of T4 and T3 and in serum calcium concentration. Small reversible shifts in cortisol, testosterone and prolactin secretions
Gut, heart, lungs, eyes	No significant changes seen

Regarding carbohydrate metabolism, it was found that after the pre-dawn meal (Suhoor) is taken and following a longer fasting day of more than 16 hours, stores of glycogen, along with some degree of gluconeogenesis, are able to maintain serum glucose within normal limits. After 16-24 hours of fasting gluconeogenesis becomes the only source of glucose, thus it is advised that fasting individuals should not skip Suhoor. Lipid metabolism changes seems variable but this is

thought to depend on the quality and quantity of food consumed and the degree of weight change.(6)

A body weight loss of 1 - 4 kg has been reported in people who start fasting at a normal weight. Obese people tend to lose more weight, whereas those who are undernourished tend not to lose weight.(11) Some studies have shown an increase in weight due to an increase intake of carbohydrates and fats.(6) Lipid changes tend to mirror changes in body weight, although most studies have shown a decrease in cholesterol and low-density lipoprotein.(5,10)

Circadian and hormone changes have been described during Ramadan, including a reversal of the morning and midnight cortisol levels which occurs at around 3-4 weeks in people who are fasting. These levels return to normal 6 weeks after the fasting has finished.(5) Minimal changes were observed in the levels of T3, T4, and TSH for the length of fasting in Ramadan in a normal person.(12) Most of these changes reverted to pre-Ramadan levels after the fasting.

An increase in serum uric acid, urea and serum osmolarity were the most important changes observed during Ramadan.(10) These changes are mostly attributed to dehydration, although the breakdown of ribonucleic acid tissue can also lead to an increase in uric acid. Electrolyte changes that were seen included a decrease in calcium, iron and magnesium, with an increase in phosphate blood levels.(10)

1.3 Ramadan fasting and medication intake

Patients fasting during Ramadan often do not receive enough information or advice about how to adjust their daily medication during this time period. Dosing schedules have to be altered as drug doses can only be taken between sunset and dawn, and the time span between taking the medication is shorter than when it is not Ramadan. Preferably, it is easier for the patient to use a single daily dose of prescribed medicine if possible, and to take it in the evening.

However, some medications need to be administered twice a day, and this creates a complex problem, as accurate distribution of a drug is difficult to achieve between the break from fasting (Iftar) and the beginning of fasting (Suhoor). This can affect the drug's plasma concentration profile and hence its efficacy and tolerance. In addition the drug-food interaction may also result in reduced, delayed or increased systemic availability of the drug. Ideally it is better to use slow release formulations, or use a drug with a longer half-life elimination. Ultimately, it is the healthcare professional's role to provide accurate and standardised advice on the appropriate use of medication during the month of Ramadan.(13)

1.4 The effect of Ramadan fasting on specific medical disorders

1.4.1 Neurological and other psychosomatic changes

Epilepsy is the main neurological disorder that is affected by fasting. In addition, increases in the following complaints have been noted during the fasting: irritability; lack of sleep; and headaches. To complicate matters, these symptoms are all inter-dependent.

- **The patient with epilepsy**

Research has shown that epileptic patients are more prone to increased seizure frequency in the month of Ramadan.(14) There are a number of predisposing factors to consider, including the change in sleep cycle; the timing of drug intake; a change in the bio-kinetics of the anti-epileptic drugs; as well as the physical and emotional stress associated with a long daytime fast.

During the Ramadan month of 2004, 114 known epileptic patients in Turkey were studied and of these, 38 patients had seizures including one with status epilepticus. Further investigation revealed 76.3% of the epileptic patients who had seizures had changed their drug regimens according to the times of Iftar and Suhoor. The actual treatment and dosage was unchanged. There was a statistically significant increase in seizure frequency in these patients when compared to that in the last year and the three-month period just prior to Ramadan. It seems that changing the drug regimen appeared to be the most important reason for the increase in seizure frequency during the fasting period.(15) In addition, the lack of sleep experienced by fasting patients with epilepsy during the month of Ramadan is a factor that influences the occurrence of seizures and inter-ictal discharges. Other seizure-precipitating factors reported are emotional stress and tiredness, all of which are more likely during Ramadan.(16)

- **Irritability**

Studies in fasting individuals have shown an increase in lethargy and irritability, accompanied by a decrease in subjective feelings of alertness during the daytime fast.(2,10) Some of the mood changes can be partially attributed to the alterations

in normal circadian rhythms and sleep deprivation.(17) A higher level of irritability has been documented among the younger generation (18-25 years) during religious fasting.(3,18)

A patient's general mood can be affected by the very nature of Ramadan and the restrictions required - no smoking, no caffeine, no energy or fluid intake allowed during the day. The feeling of "irritability" as a mood per se is confounded by these physiological variables.(2)

Cigarette smoking is known to produce dependence, and a nicotine withdrawal syndrome is characterised by insomnia, irritability, frustration, anger and anxiety.(19) The level of irritability was monitored over the Ramadan month for two successive years in a group of healthy Muslim individuals, of which 51% were smokers. Included in the observation was the consumption of psycho-stimulants (tea and coffee); duration of sleep; and anxiety levels. The results of the study showed that although irritability increased in both the non-smokers and smokers during Ramadan, it was found to be higher in the group of smokers. In addition, the consumption of psycho-stimulants and the anxiety level followed the same pattern, in that it was higher in the group of smokers. It was concluded that irritability during fasting seemed to be related to several lifestyle factors, especially the use of nicotine and the reduction in the amount of sleep.(20)

- **Reduction in sleep**

Several modifications in sleep patterns during Ramadan have been observed, including sudden and significant delays in bedtime and advanced wake-up time

leading to a decrease in total sleep time. Poor sleep in fasting individuals is thought to cause more daytime working difficulties and functioning than thirst and hunger.(10) Polysomnographic recordings showed an increase in light sleep (non-rapid eye movement stage 2) compared to a decrease in deep sleep (slow-wave) and rapid eye movement sleep while fasting. However assessing the total sleep time can be difficult as often those fasting may have taken naps during the daytime, which would affect the quality of the night-time sleep.(21)

- **Increase in headaches**

Fasting appears to be an important precipitating factor for headache attacks.(2,22) A retrospective study in Turkey showed that the number of Emergency Department admissions for 'primary' uncomplicated headaches were significantly higher around Ramadan than in non-Ramadan times of the year.(23) The frequency of headaches increased with the duration of the fast, with the majority being tension headaches.(24)

A "fasting headache" is currently coded in Group 10 of the International Classification of Headache Disorders (ICHD-II) as a "Headache attributed to disorder of homeostasis".(25) According to the diagnostic criteria, a fasting headache should have at least one of the following characteristics:

- Frontal location; diffuse pain; non-pulsating quality; and mild or moderate intensity.
- The patient must, in addition, have fasted for more than 16 hours; the headache must develop during fasting and resolve within 72 hours after resumption of food intake.

The ICHD-II noted that the likelihood of a headache developing as a result of a fast increases with the duration of the fast. In addition, other variables such as the duration of sleep, caffeine withdrawal and hypoglycaemia do not appear to be related to a fasting headache, confirmed by a study on the effect of the 25-hour fast of Yom Kipper.(25) Indeed a headache may occur if the patient is suffering from hypoglycaemia-induced brain dysfunction, but there is not enough evidence to establish a causal association.

Contrary to this statement by the ICHD-II, a study in Saudi Arabia attributed caffeine withdrawal as the main contributory factor for the fasting headache.(24) The study sample was a group of hospital staff of which 41% of those fasting reported having a headache, compared to the 8% of those staff who did not fast. The majority (78%) of the cases were tension headaches and affected mainly those who were normally prone to having headaches. The main exogenous factor implicated in these headaches seemed to be caffeine withdrawal, however other factors also appeared to play a role, including lack of sleep, hypoglycaemia and dehydration.

In this regard, one study advised a progressive reduction in the intake of caffeine in the weeks preceding the fast and/or taking a strong cup of coffee before the start of the fast. Alternatively non-steroidal drugs (COX2 inhibitors) were advocated to prevent or attenuate the headache.(14)

1.4.2 Ramadan fasting and metabolic disorders: Diabetes mellitus

The EPIDIAR study is a population-based survey in 13 Muslim countries investigating the features of diabetes, including the characteristics and care of diabetic patients during the month of Ramadan. The survey estimated that 43% of patients with Type 1 diabetes and 86% of patients with Type 2 diabetes fast during Ramadan in the Muslim world.(26)

Due to the relationship between fasting and hypoglycaemia, diabetic patients who undertake Ramadan fasting are considered a highly vulnerable group. As diet and exercise are considered central to controlling diabetes, the daytime fasting of Ramadan will predictably interfere with these factors, as patients tend to alter their eating habits, sleep less, and decrease their physical activity.(14)

Fasting during Ramadan is generally contraindicated in poorly-controlled or brittle Type 1 (insulin dependent) or Type II (non-insulin dependent) diabetics; and those patients who are not compliant with taking their medications, watching their diet or following exercise advice.(27)

Diabetic patients who are at risk for serious complications should be closely monitored. These include patients with concurrent uncontrolled hypertension; ketoacidosis; unstable angina; inter-current infections; those who are pregnant; and those patients who have previously experienced two or more episodes of hypoglycaemia and/or hyperglycaemia during Ramadan. Fasting should be allowed for controlled diabetic patients who do not have the above complications

and patients who are willing to accept medical advice regarding management.(28,29)

Risks for the fasting diabetic patient include:

- 1. Daytime hypoglycaemia:** This is due to either the lack of carbohydrate intake, or lack of downward adjustment of doses of oral hypoglycaemic drugs or insulin. Diabetics who are fasting are advised to eat Suhoor.(28) In the EPIDIAR study, the incidence of severe hypoglycaemia (defined as hospitalisation due to hypoglycaemia) was more frequent, from 4.7 fold in patients with Type 1 diabetes to 7.5 fold in patients with Type 2 diabetes. This was associated with changes in the treatment regimen (dose adjustment, timing of medication dose) and reduced physical activity during Ramadan.(26)
- 2. Evening hyperglycaemia:** This is due to excessive intake of food. The EPIDIAR study also showed that the risk of severe hyperglycaemia (requiring hospitalisation) was increased 3 fold in Type 1 diabetics and 5 fold in Type 2 diabetics.(26) The traditional rich calorie-filled foods and sweet sugary pastries and foods (especially dates which have a high glycaemic index, dried fruit and juices) associated with Ramadan may also present a risk of hyperglycaemia and weight gain for Muslim diabetic patients.(7,30–32)
- 3. Possible daytime hyperglycaemia:** This is most likely due to omission of insulin doses (at Suhoor) or drastically reduced doses.(14)

4. Diabetic ketoacidosis: Although the risk is thought to be higher, this remains just a speculation as there are no studies which show that the incidence of diabetic ketoacidosis is increased.(33)

5. Dehydration and thrombosis: Diabetic patients have a hypercoagulable state due to increased clotting factors and impaired fibrinolysis, hence dehydration from the limitation of fluid intake during the fast may lead to increased blood viscosity that may enhance the risk of thrombosis. This dehydration is worse in hot and humid climates and among individuals performing heavy labour who perspire a lot. Hyperglycaemia in itself can result in an osmotic diuresis, enhancing the volume and electrolyte depletion.(33)

A study by Herrag *et al.*, specific to the utilisation of the Emergency Department during Ramadan, noted that a higher number of diabetic patients in Ramadan were complicated by diabetic ketoacidosis or by hypoglycaemia in those receiving insulin shots.(34) Another study based on ED attendance by Topacoglu *et al.* found that the mean age of patients presenting due to diabetic-related conditions in Ramadan was significantly lower when compared to the non-Ramadan time period. This was noted to be the case especially if the patient was female.(23)

1.4.3 Ramadan fasting and cardiovascular disease

The cardiovascular disorders that have been investigated in relation to Ramadan include hypertension, acute coronary events/ ischaemia and arrhythmias.

Hypertensive patients, who are compliant with their medications, can safely undertake the Ramadan fast. The Saudi Hypertension Management Group made formal recommendations regarding the management of hypertension during Ramadan:(35) Many of these recommendations can be applied to other disorders as well.

- Physician's advice and management should be individualised.
- Patient education should emphasise the need to maintain compliance with non-pharmacological and pharmacological measures.
- Diuretics are better avoided, especially in hot climates or are to be administered in the early evening.
- Patients are encouraged to seek medical advice before fasting in order to adjust their medication if needed.
- A once daily dosage schedule with long acting preparations is recommended.
- Patients with hypertension should be advised not to fast until their blood pressure is reasonably controlled.
- Patients with hypertensive emergencies should be treated appropriately regardless of fasting.

A study based in Saudi Arabia showed that the majority of stable cardiac patients who fasted during Ramadan showed no detrimental side effects.(36) In Qatar, where more than 95% of the Qatari adults regularly practice fasting during Ramadan, the effect of Ramadan fasting on ischaemic heart disease was monitored and no significant differences in the incidence of acute myocardial

infarction and unstable angina were reported. The conclusion drawn was that most patients with stable cardiac disease can fast safely.(37)

Two studies which were based on Emergency Department attendances in Ramadan, reported a higher incidence of hypertension.(23,34) However no increase in acute coronary disease and no significant increase in ischaemic and haemorrhagic cerebrovascular accidents were reported in patients admitted to the ED.(23,38) In the latter study by Temizhan *et al.* in Turkey, the researchers did not know whether or not the patient was fasting, but it was assumed that, as the country is 99.2% Muslim, at least 66% of the patients presenting would be regularly fasting during Ramadan. The findings were that of no change.(38) The rates of admission for congestive heart failure during Ramadan in Qatari patients did not change, and these patients would have all been fasting.(39)

Evidence from a detailed review of coronary artery disease management during Ramadan showed that the impact of Ramadan fasting on the patient with stable coronary artery disease was minimal and did not lead to an increase in acute events. Ramadan is in itself to a certain extent, a form of “mild physical hibernation” where the fasting individuals are naturally much less active than normal and this in itself may avoid acute events happening.(40)

A different study raised the question as to whether fasting affected the circadian presentation of acute cardiac events. Significant changes were found, with fasting patients less likely to have their symptoms start between 5 and 8 a.m. in the morning (11.1% vs. 19.4%) and more likely to experience symptoms between 5

and 6 p.m. (11.1% vs. 6.0%) and 3 and 4 a.m. (11.1% vs. 6.9%). The study concluded that the circadian rhythm was affected by exogenous factors associated with fasting (such as the changes in food intake and/or sleep timings) which influenced the timing of the acute coronary events.(41)

One group of researchers suggested that fasting may affect cardiac patients specifically because it is difficult for them to take their medications in the time between Iftar and Suhoor; there is limited time allowed for food intake; and there is intensive physical worship that is performed after a heavy meal.(14) During Ramadan, there are special prayers known as Taraweeh during which long portions of the Qur'an are recited. The prayer can be very long (well over an hour) and involves many cycles of movement – standing (when reading from the Qur'an), bowing, prostrating and sitting.(42)

There have been reports of bradycardia and hypotension, including ECG changes (decreased altitude of the QRS complex and T wave, and right axis deviation) in prolonged fasting.(6) A study conducted in Malaysia reported a reduction in heart rate during Ramadan thought to be related to the effects of an altered mental state (due to the increased religious dedication), and/or the decreased metabolic rate mediated by reduced sympathetic activity.(17)

1.4.4 Ramadan fasting and the respiratory system

The effect of Ramadan fasting on patients with asthma specifically has been well documented. Certain healthcare personnel allow stable asthmatic patients to use inhalers, slow-release drugs and suppositories during the month of Ramadan,

without breaking their fast.(7,13) However dehydration (from fluid deprivation during the day) and dryness of the respiratory tract experienced during the fast may worsen bronchoconstriction in asthmatic patients, hence the preferred recommendation for the majority of clinically symptomatic patients with either asthma or chronic lung disease would be to advise against fasting in Ramadan.(6)

Two studies considered the effect of Ramadan fasting on the respiratory system in patients presenting to the Emergency Department. The first by Bener *et al.*(43) found no difference in the number of patients hospitalised for asthma and allergic diseases, nor a change in the spirometric values obtained in the Ramadan compared to the control periods. The second study reported no difference in the frequencies of asthmatic and COPD patients visiting the ED.(23)

1.4.5 Ramadan fasting and the gastrointestinal tract

During the night hours of Ramadan, eating and drinking tend to be increased, which is out of phase with the circadian rhythm of gut activity. Common gastrointestinal complaints reported are therefore indigestion, bloating and heartburn and these are mostly due to overeating at Iftar and Suhoor. The type of food eaten also affects the symptoms, as fatty foods tend to stay in the stomach for a longer period and cause excess production of acids. In addition, smoking, consuming carbonated drinks, and coffee aggravates the symptoms.(44)

During Ramadan, it is common for those fasting to have altered bowel habits, presenting clinically either as diarrhoea or constipation. In order to keep the bowel movements regular, it is advisable to maintain good hydration during the break

from fasting, and increase the fibre content of the food, add more vegetables and fruit and participate in light exercise.(44)

Ramadan fasting is associated with an increase in gastric acidity, especially in the daytime, and the acidity reaches its maximum at the end of the fasting day. This increase in gastric acid secretion continues throughout the fasting period and usually returns to pre-Ramadan levels one month later.(13) The lower oesophageal sphincter pressure is decreased, usually after eating Iftar, and this encourages reflux and hence worsening symptoms.(13) Thus it is advisable to eat a smaller meal at Iftar and if symptoms persist, then a proton pump inhibitor should be given at Iftar and Suhoor.(14)

In patients presenting to the Emergency Department, an increase in peptic ulcer complications and acute mesenteric ischaemia during Ramadan were reported by Göçmen *et al.*(45) and Herrag *et al.*(34) In addition, twice the increase in the ratio of acute mesenteric ischaemia cases were observed.(45) The increased acidity, combined with the change in diet and possible decrease in medication intake compliance during the month of Ramadan, was thought to worsen or cause a relapse in a patient with underlying peptic ulcer disease.(46)

An Iranian-based study showed a more frequent incidence of duodenal ulcer in the fasting group (38%) compared to the non-fasting group of patients (19.5%). It was noted that Ramadan fasting could increase acute upper gastrointestinal bleeding by aggravating the duodenal ulcer, but that it does not make the prognosis poorer than in the non-fasting patients.(46)

Similarly, a study in Turkey reported that the number of patients presenting with acute upper gastrointestinal bleeding during Ramadan was significantly higher than for a non-Ramadan month, and that fasting seemed to reactivate and aggravate the severity and complications of pre-existing gastrointestinal diseases like peptic ulcer and gastritis. In this case, peptic ulcer was the most common event in both groups (Ramadan and non-Ramadan months).(47) The severity of these problems are confirmed by another study in Turkey, that found that peptic ulcer perforation and acute mesenteric ischaemia were significantly increased in 1408 patient records over a 5 year period during Ramadan when compared with the months before and after Ramadan.(45)

Not all studies have shown these results. A retrospective study of ten years of data on patients presenting to the Emergency Department of a hospital in the United Arab Emirates found no significant increase in the incidence of peptic ulcer disease during or after Ramadan, but noted that the frequency of peptic ulcer disease and peptic ulcer perforation was higher after Ramadan, than during Ramadan, although the difference was not statistically significant.(48)

Patients with active complicated peptic ulcer disease are advised not to fast. However, those who are asymptomatic may try fasting and take cimetidine or ranitidine, or a small dose of proton pump inhibitors at Iftar and Suhoor if hyperacidity continues to be a problem. In some patients such as those with spastic colitis and other intestinal motility disorders, fasting may be a benefit.(6) However, in patients with chronic conditions such as Crohns' disease, ulcerative

colitis and decompensated liver disease, and especially those patients with clinically apparent hepatitis and cirrhosis, the advice is to refrain from fasting.(14)

From a surgical perspective with regard to gastrointestinal disorders and fasting during Ramadan, a study based in Turkey over a four-year period found that long-term hunger and changes in the usual dietary routine during Ramadan did not constitute an increased risk for the outcome of surgery for acute appendicitis.(49)

1.4.6 Ramadan fasting and renal disorders

The kidney is particularly likely to be affected by the fasting period of Ramadan due to the clear dehydration occurring during the daytime hours.

In healthy individuals with normal renal function, fasting during Ramadan has no apparent adverse effect on the kidney. A Malaysian-based study documented the effect of Ramadan fasting on urinary excretion of normal healthy adult Muslims, and found that urinary volume, osmolality, pH, nitrogen, solute and electrolyte excretion remained normal. The changes in serum urea and creatinine were small and not statistically significant, with only a slight increase in uric acid, as the fast of Ramadan is intermittent. The authors noted that the kidney's ability to excrete a highly concentrated urine in the daytime showed that the body is well adapted to compensate for the water deprivation and lack of food, including reduced intake of sodium and potassium during the day throughout Ramadan.(50)

It has been proposed that the high urine concentration reached during the daytime fasting and increased level of uric acid could both contribute to the formation of urinary crystals leading to urinary tract calculi.(51) The increase in uric acid during

Ramadan fasting was confirmed in another study which noted that the hyperuricaemia could have resulted either from an acceleration of the metabolic cycle of urates or from a deficiency in kidney clearance. Fluid deprivation during fasting causes volume contraction and renal hypoperfusion, which may together with the increased intake of protein and fat observed during Ramadan explain the hyperuricaemia.(52)

In regions that experience much higher temperatures, especially in summer months, there is an increased incidence of renal stones compared to countries with colder temperatures. Perspiration and decreased urine volume with high concentration of lithogenic substances, the type of food consumed and the amount of water taken during Ramadan contribute to the production of urinary stones.(53)

The prevalence of renal colic in Ramadan compared with other months of the lunar year was studied in a group of patients living in an extremely hot region of Iran. The results showed that renal colic was more common in the summer months.(53) The frequency of admission for renal colic in Ramadan was not significantly different from the mean admission for any other month of the year. This led the authors to conclude that higher ambient temperature rather than fasting is the cause for the presentation of renal colic in these patients.

Two studies focused on the presentation of renal complaints to the Emergency Department during Ramadan. In the first study the number of ED admissions for renal colic were high in the first two weeks of Ramadan, and then after that decreased.(54) The other study showed a highly significant positive correlation

between colic frequency and mean monthly temperature, with colic reaching its maximum frequency during the summer months of July and August. This is attributed to dehydration during fasting and the associated increase in urinary concentration causing an increase in urolithiasis. Although the study concluded that there was an increase in the number of patients presenting to the ED with renal colic in Ramadan, it maintained that this increase could be explained by the change in temperature, and not necessarily due to the fasting during Ramadan.(55) The influence of ambient weather on renal colic is supported by the study by Basiri *et al.* based in Iran, discussed earlier.(53)

Whether fasting during Ramadan is safe for patients with chronic kidney disease (CKD), is unclear. One study supported the notion that fasting in Ramadan is safe in stable CKD patients, with the proviso that it needs to be under close medical supervision with strict attention to fluid intake, daily activity, and adjustment of drug regimes and with special attention needed for the management of diabetic CKD patients.(56)

In contrast, another study found that fasting in Ramadan in terms of fluid restriction might have an injurious effect on the renal tubules in CKD patients. In Egypt, 15 pre-dialysis CKD patients and 6 healthy volunteers as the control group were studied both when the subjects were drinking and eating freely before the start of Ramadan, and towards the end of Ramadan. Glomerular filtration rate (GFR) was estimated using DTPA dynamic renal scan and tubular cell damage was assessed by measuring the level of N-Acetyl-B-D-glucosaminidase (NAG). There was no significant difference in the GFR of the CKD group compared to the control group,

however the urinary NAG percentage change was significantly higher in the CKD patients when compared to the control group. This was thought to be due to the vulnerability of the tubules to haemodynamic changes (fluid restriction), especially in diseased kidneys. In addition, there was a significantly positive correlation between the NAG values and a change in blood glucose level, with the conclusion that diabetic CKD patients should be meticulously followed during Ramadan fasting.(57)

An increased risk of high blood sugar levels has been reported in other studies of CKD patients with diabetes. A study of 31 CKD patients in the UAE during Ramadan confirmed previous findings that changes in urinary protein secretion, protein to creatinine ratio and urine osmolality were not significant during the fasting month, however higher blood sugar levels occurred in the fasting patients.(56,57)

Regarding patients on chronic haemodialysis, it is recommended that fasting on non-dialysis days is probably safe and that dietary advice in fasting patients assumes increasing importance.(14)

The number of kidney transplants performed in Islamic countries is on the rise, which raises the question of whether it is safe for these patients to fast during Ramadan. Transplant patients are at increased risk of adverse effects related to fasting due to their chronic underlying illness and immunosuppressive medication. The current literature on the safety of fasting in this group of patients and general consensus among medical transplantation professionals is to allow fasting when

the transplanted kidney graft has functioned well for at least one year post-transplant, so that the patient's condition can be assumed to be stable.(58)

1.4.7 Ramadan fasting and haematological disorders

In general, patients with chronic blood disorders who fast do not suffer any adverse effect, however there are a few clinical conditions that warrant special attention. These include sickle cell anaemia, thalassaemia, oral anticoagulation therapy, chronic myeloproliferative disorders and chronic leukaemias. The first three diseases are the most commonly seen and will be discussed below.

Sickle cell anaemia is an inherited autosomal recessive disorder characterised primarily by chronic anaemia and periodic episodes of pain. The incidence of sickle cell anaemia in the UAE is 1.9%.(59) It has been reported that these patients experience a higher risk or increased incidence of a vaso-occlusive crisis occurring during Ramadan, which seems to be related to dehydration.(14)

Thalassaemia is also an inherited blood disorder of haemoglobin synthesis. The aim during Ramadan would be to keep the haemoglobin at an acceptable level, and most patients would likely only need one transfusion during Ramadan. Patients need to adhere to their usual iron chelator regimen.(14)

Patients on anticoagulation medication can safely fast during Ramadan. If on warfarin, then this needs to be taken at the same time every evening, and close monitoring of the INR is required. Specific care should be taken regarding dietary

habits, in particular patients should avoid sudden intake of foods rich in vitamin K, as this may reduce the efficacy of the warfarin.(14)

1.4.8 Ramadan fasting and pregnancy

A pregnant Muslim woman is exempt from fasting if there is reason to believe that her health or that of the foetus is at risk by doing so, and can compensate for it by fasting at a later stage. If she and the foetus are in good health, then she should be able to fast during Ramadan.(60,61) The most common adversities suffered during the fast by pregnant women are giddiness; nausea and/or vomiting; hunger and/or thirst; abdominal pain; weakness and fatigue. In order to avoid adverse outcomes, pregnant women who would like to fast should consider intermittent fasting, they should be ready to break the fast if there are any warning signs (this would need pre-counselling first), and if determined to fast then there should be available information about the correct food choices that will allow for complex carbohydrates to provide calories for longer.(62)

Lactating mothers, however, are advised not to fast as studies have shown that in fasting lactating women, the loss of body water and the changes seen in plasma osmolality, uric acid, lactose, sodium, and potassium content of breast milk, cause a marked disturbance in milk synthesis.(6)

1.5 Road accidents during Ramadan

Risk factors for traffic accidents during Ramadan include lower alertness and higher irritability.(10,20) A study of road traffic accidents in Al-Ain in the UAE showed a higher incidence during the month of Ramadan, with most accidents and

injuries occurring from 8 a.m. – 2 p.m. The most common cause was excessive speeding and poor driving habits.(63) In a retrospective study over 6 years in Karachi, results showed that the frequency of road traffic accidents did not change significantly during Ramadan, however most accidents were clustered around the breaking of the fast and the mandatory late-evening Taraweeh prayers.(64) Thus an increased accident rate may change the profile and timing of patients coming to the ED.

Regarding the incidence of trauma presenting to the ED during Ramadan, the studies by Göçmen *et al.*(45) and Herrag *et al.*(34) both showed a decrease in the number of emergencies due to aggression or violence, especially penetrating injuries (gunshot wounds/ stabs), as well as a reduction in accidents related to alcohol intake.

1.6 Utilisation of the ED during Ramadan

The ED is usually the first place patients present when feeling unwell, as the services are available 24/7. Significant changes in medical disorders due to fasting would thus tend to increase the number of patients who need to come to the ED during Ramadan.

There is limited research that investigates the effect of Ramadan specifically on attendance to hospital emergency departments. The studies that have concentrated on ED admissions during Ramadan are summarised in Table 1-2.

Table 1-2: Summary of studies involving ED admissions during Ramadan

Study	Sample size	Study Duration	ED admission during Ramadan
Langford <i>et al.</i> 1994 (UK)	391 Muslims 8507 Non-Muslims	2 months (1993) (Ramadan, 15 days prior and after)	Increase (in number of Muslims attending and non-accident complaints)
Parrilla Ruiz <i>et al.</i> 2003 (Spain)	213	2 weeks (2001) (1 week of Ramadan and 1 week prior)	Increase (in trauma, sprains and falls)
Göçmen <i>et al.</i> 2004 (Turkey)	1408	4 years (1999-2003) (Ramadan, month before and after)	Increase (in peptic ulcer complications, acute mesenteric ischaemia) Decrease (in violence-induced penetrating injuries)
Topacoglu <i>et al.</i> 2005 (Turkey)	130506	4 years (2000-2004) (Ramadan, month before and after)	Increase (in headaches and hypertension) No change (acute coronary heart disease)
Herrag <i>et al.</i> 2010 (Morocco)	250-500 per day	2 months (Ramadan and another month)	Increase (in gastro-duodenal ulcers, hypertension and diabetic complications) Decrease (aggression induced accidents)
Abdolreza <i>et al.</i> 2011 (Iran)	610 15-85yrs	8 weeks (2008) (Ramadan, 15 days prior and after)	Increase (renal colic only)
Al-Hadramy 1997 (KSA)	Approx. 405	3 years (1992-1994) (Ramadan, month before and after)	Increase (in renal colic but noted correlation between renal colic and seasonal temperature)

Temizhan <i>et al.</i> 1999 (Turkey)	1655	6 years (1991-1997) (Ramadan, month before and after)	No change (in acute coronary syndromes)
Al Suwaidi <i>et al.</i> 2003 (Qatar)	20856	10 years (1991-2001) (Ramadan, month before and after)	No change (in congestive heart failure) Change (in timing)
Bener <i>et al.</i> 2006 (UAE)	470	10 years (1992-2002) (Ramadan, month after)	No change (in peptic ulcer disease)
Bener <i>et al.</i> 2006 (Qatar)	1590	4 years (2000-2004) (Ramadan, month before and after)	No change (in hospitalisation rate for asthma, allergic diseases)
Halasa 2014 (Jordan)	17770	2 months (2010) (Ramadan, month prior)	No change (in diagnosis) Change (in timing)
Pekdemir <i>et al.</i> 2010 (Turkey)	2079	2 months (2004) (Ramadan, month after)	No change (in diagnoses) Increase (in ED admissions) Change (in timing)

The design and reporting of these studies is varied, with some involving large patient numbers, whereas others have smaller samples; some are retrospective over many years whereas some may only concentrate on one or two years for the study duration. Only one of the studies specifically compared the admission of Muslim to non-Muslim patients to the ED during Ramadan, while the majority of the other studies have compared specific medical conditions presenting in a mostly Muslim population.(28)

Studies that showed a significant change in ED admissions included the initial study in 1994 by Langford *et al.*(65) in the United Kingdom, which documented a significant increase from 3.63% before and after Ramadan, to 5.11% during Ramadan in the number of Muslims attending the ED. There was also a significant increase in non-accident related attendances among Muslims compared to Non-Muslims.

A significant shift in the time of ED attendances by patients during Ramadan compared to the non-Ramadan period has been reported. One study showed that Ramadan altered the timing of the presentation of clinical problems, with a higher frequency of patients presenting later in the night from 11 p.m. to 8 a.m. in Ramadan, compared to the non-Ramadan period when the highest ED footfall was witnessed earlier in the evening from 6 p.m. to 11 p.m.(66) In contrast, a study in Turkey showed that the most frequent time period for admission to the ED during Ramadan was 4 p.m. to 8 p.m. (25.8%) versus 22.8% in the non-Ramadan control group, while the less frequent time for admission was 4 a.m. to 8 a.m. (5.8%) in Ramadan compared to 4.9% in the non-Ramadan period.(67) Even though the overall number of ED admissions per day was higher during Ramadan, there no significant differences seen in the demographic and clinical features of the patients in the fasting period compared to the non-fasting period. Another study reported that fasting patients were more likely to present to the ED in the time period 5 a.m. to 6 a.m. and from 11 p.m. to midnight, and were less likely to present to the ED from 1 p.m. to 2 p.m. and from 5 p.m. to 6 p.m.(39)

One study noted that the most frequent diagnosis made during Ramadan was “injury, poisoning and certain other consequences of external causes” (25.76% compared to 24.13% in the control period). The diseases of the circulatory system constituted 12.24% in Ramadan versus 10.9% in the control period, followed by diseases of the respiratory system (10.77% in Ramadan versus 10.49% in the control period). Although there was a slight increase in neurological and cardiac diseases, with these being more prevalent in Ramadan, the difference was not statistically significant.(67) Another study reported the main clinical complaints seen in Ramadan were URTI (24%), followed by acute gastroenteritis (17%), abdominal pain (9%), skin problems (6%), renal problems that included renal colic and UTI (6%), and patients requesting sick leave (3%). In this study, unfortunately, the author did not compare these presenting complaints to those seen in the non-Ramadan period.(66) There was one study conducted in Spain which noted the most frequently seen complaints in the ED during Ramadan were due to trauma, sprains and falls, however as the study is in Spanish, requiring the use of Google® translate, it is uncertain whether this was increased compared to the period outside of Ramadan.(68)

Some of the limitations faced in the above studies included the failure to document the fasting status of the patients presenting to the ED. This precludes a causal relationship between fasting and certain changes in demographics and the number of visits. In addition, there was also a lack of “gold standards” to determine definitive diagnoses. Some of the study designs were not clear, with no statistics given, nor an exact time period when the study took place. Lastly, some did not specify the sample population.

1.7 Summary

At present, despite a number of studies done on ED admissions in Islamic and non-Islamic countries, there are no studies that have focused specifically on ED attendances in a private hospital in Dubai, UAE. There was one previous study that concentrated on the presentation of patients with renal colic to a hospital in Al-Ain, which is located in the Abu Dhabi emirate of the UAE but no current studies specifically regarding ED attendance patterns during Ramadan.(48)

The city of Dubai is representative of a multi-cultural society, which allows for a diverse patient sample to be accessed for the research. Cultural factors are of fundamental and increasing importance to healthcare delivery and health-related behavior, and the fast of Ramadan affects all who live here, whether Muslim or non-Muslim. Thus the ED should be run as a culturally competent clinical practice and faith and religion should ideally be topics of discussion in the ED in order to ensure optimal patient care. An updated working knowledge about fasting religious rules and its medical implications, in addition to the effect that Ramadan has on ED patient attendance, should enable ED physicians to provide an efficient, higher quality level of care for the patients.(10,69,70)

Chapter 2: INTRODUCTION

2.1 Motivation and rationale for this research

The researcher has lived and worked in the UAE for over seven years, and has witnessed the effect of the Ramadan on patients presenting to the ED over this time period. Being immersed in the culture of the society, combined with an avid interest in cross-cultural values and emergency medicine, established the driving force behind the research to investigate whether the fast of Ramadan affected the ED presentation of patients from demographic and clinical perspective, as well as from a timing perspective.

2.2 Statement of the problem

As seen in the literature review, the effect of Ramadan fasting from a medical perspective has been investigated extensively, but at the time of writing the research there were only thirteen papers which mentioned specifically the effect of the Ramadan fast on ED attendances, of which only one other exists in the UAE. Significant changes in presentation of patients may require an adjustment to staffing during Ramadan, not only from the ED perspective, but also from the medical and surgical specialities, in addition to radiology and other supporting services. Hence the motivation to concentrate on the effect the Ramadan fast has on the patients presenting to an emergency department in Dubai.

2.3 Aims and objectives of the study

2.3.1 Study aim

The aim of this study was to assess emergency department attendances during Ramadan.

2.3.2 Study objectives

1. To describe the characteristics of patients seen at a private ED in the UAE.
2. To compare the demographic and clinical features of the patients presenting during Ramadan to those presenting during a Control period.
3. To compare the different nationalities presenting to the ED during Ramadan to those presenting during a Control period. In addition, these patients will be placed in region-specific groups for the purpose of comparison (see Methods section on p36).
4. To compare the diagnosis profile between Ramadan and a Control period. Diagnoses will be predetermined categories and patients will be placed in region specific groups for comparison.
5. To compare the time of admission and number of ED Admissions between Ramadan and a Control period.

Chapter 3: MATERIALS AND METHODS

3.1 Study design

This is a retrospective, observational study.

3.2 Study setting

The data for the study was collected from patient attendance records at the emergency department of a private hospital, Mediclinic City Hospital, in Dubai, United Arab Emirates. The study period occurred in the summer months, where the average daily high temperatures ranged from 39 to 41 degrees Celsius, while the average daily low temperatures ranged from 28 to 31 degrees Celsius.(71) The population in Dubai at the time of the study was estimated to be 2 million, according to the population clock of the Dubai statistics centre.(72)

3.3 Study population

The study population included all patients 16 years and older presenting to the ED during two weeks of Ramadan in 2012 (Ramadan period), as well as one week in the month before Ramadan and one week in the month immediately after Ramadan (Control period). The start age of 16 years was chosen as it is not a requirement for pre-pubertal Muslim children to participate in the fast, and most would have entered puberty by this age, and thus be required to fast during Ramadan. In 2012, Ramadan was from the 20th July to the 18th August, a total of 30 fasting days.

Data was collected for the Control and the Ramadan periods as follows:

- **For the Control period:**
 - **Week 1:** Data was collected from the second week of the month before Ramadan (27 June – 3 July 2012).
 - **Week 4:** Data was collected from the second week of the month post-Ramadan (26 August – 1 September 2012).
- **For the Ramadan period:**
 - **Week 2:** Data was collected from the second week of Ramadan (27 July – 2 August 2012).
 - **Week 3:** Data was collected from the fourth week of Ramadan (10 – 16 August 2012).

3.3.1 Inclusion criteria:

- All patients 16 years or older presenting to the ED during the specified time periods.

3.3.2 Exclusion criteria:

- Records with incomplete or missing data were excluded from this study.
- Patients referred from another clinic or hospital that have already received some form of medical treatment.
- Patients who have returned to the ED for minor procedures, for example: for removal of sutures, dressing changes.
- Patients who are a repeat visit (follow-up) to the ED within 48 hours of being seen initially.

Clinical records were reviewed from the Electronic Medical Records (EMR) and from patient files. Permission to access the Mediclinic City Hospital's medical records was granted by the hospital Ethics Committee. The information was requested from the EMR department and the data obtained included name of patient, hospital number, age, gender, nationality, the case sheet on which the doctors had written their notes and in most case included a final diagnosis. In cases where there was not a final diagnosis the researcher used the presenting symptoms and examination notes to format a diagnosis. Extracting data from clinical records is subject to bias and inaccuracies, and there are well-defined methodological standards which should be applied.⁽⁷³⁾ The researcher was the sole abstractor of the information, but had not undergone any formal training as a chart abstractor. So if there was bias in interpreting the data, it would have been consistent throughout the extraction of the data. However, the inclusion and exclusion criteria that were clearly laid out and the variables were well defined. A formal data collection sheet was used to guide the researcher. In cases where there was ambiguity the researcher consulted the supervisor to concur. The remaining strategies, which included the monitoring of the chart abstractor, blinding and testing of interrater agreement, were not possible as the researcher was the sole abstractor.

3.3.3 Working with the study population:

Dubai is a cosmopolitan society, as is witnessed by the number of different nationalities presenting to the ED during Ramadan and the Control period. For comparison purposes, the country of origin was used to place the patients into meaningful groups in order to explore the main focus areas of the research report.

These groups are based on their geographical and cultural significance – the Middle East and North Africa (MENA) region, and the non-MENA region countries.

The MENA region consists of countries whose populations are more than 90 percent Muslim and would thus be presumed to be fasting if age appropriate.⁽⁷⁴⁾ For example, a census in 2005 reported that 97% of the citizens in the UAE are Muslim ⁽⁷⁵⁾, while a study based in Qatar used a similar assumption, where 95% of the Qataris regularly practice fasting during Ramadan.⁽³⁷⁾ These countries are geographically located in South-western Asia and North Africa, as shown in Figure 1-1.

There is slight variation regarding which countries are included, however for the purpose of this research, the MENA region as defined by www.menaregion.com ⁽⁷⁶⁾ was used as a term which refers collectively to the Asian countries of Bahrain, Cyprus, Iran, Iraq, Israel, Palestine, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, Turkey, the United Arab Emirates, Yemen, and the North African countries of Algeria, Egypt, Libya, Morocco, and Tunisia.

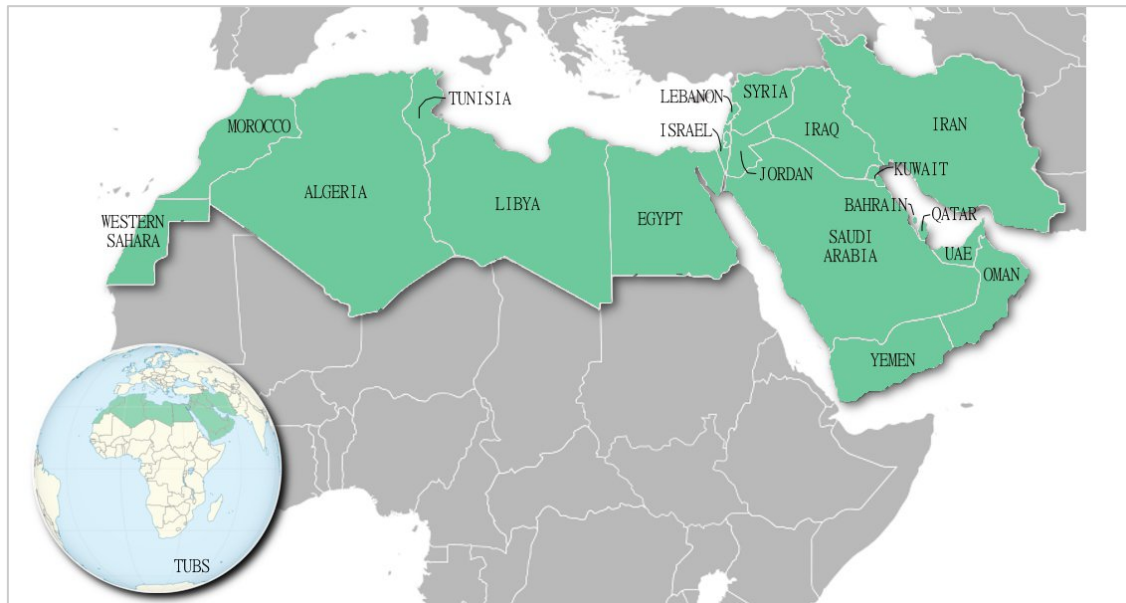


Figure 1-1: Middle East and North Africa region (77)

The non-MENA region patients were grouped per continent of origin in order to compare their ED attendance during Ramadan and the Control period. The following website, <http://www.worldatlas.com/cntycont.htm> was used as a reference for the six continents, namely Africa, Asia, Europe, North America, Oceania, and South America.(78)

3.4 Ethics

This research was approved by the Human Research Ethics Committee of the Faculty of Health Science of the University of the Witwatersrand (protocol approval number M130246 – see Appendix A).

3.5 Sample Size

The final sample size was 1766 patients, of which 822 attended the ED during Ramadan and 944 attended the ED in the Control period.

3.6 Variables (please see Appendix B for the full data collection sheet)

The following variables were collected:

1. Age
2. Gender
3. Nationality
4. Diagnosis (presenting symptoms which were allocated a diagnosis by the researcher)
5. Admission time to the ED

3.6.1 The variable of “diagnosis”

Twelve categories of diagnoses were formed based on the researcher’s analysis of presenting symptoms, and abbreviated as indicated in brackets:

1. Cardiovascular (CVS)
2. Endocrine-related (ENDO)
3. Gastrointestinal (GIT)
4. Musculo-skeletal (MUSC)
5. Neurological (NEURO)
6. Obstetric-Gynaecological (OBGYN)
7. Other
8. Renal
9. Respiratory (RESP)
10. Skin
11. Surgical (SURG)
12. Trauma

3.7 Data analysis

The following analyses were performed on the data collected:

- 1. Comparison of the two Control weeks and the two weeks chosen to represent Ramadan.** If no differences were found, the two control weeks would be combined and the two Ramadan weeks would be combined.
- 2. Demographic and clinical features, nationality and diagnosis profile of the patients were compared in Ramadan and the Control period.**
- 3. Comparison of the time of admission and number of ED Admissions between Ramadan and the Control period:**
 - The time of ED admission was compared during Ramadan and the Control period, in addition to looking at the specific groups of patients.
 - Initially the time of ED admission was divided into day versus night admissions. For the purpose of this research, the day was considered to be 8 a.m. to 8 p.m. and the night was considered to be the opposite.
 - Following this, the 24-hour day was divided in to 4-hourly time periods as follows:
 1. 12 a.m. to 4 a.m.
 2. 4 a.m. to 8 a.m.
 3. 8 a.m. to 12 p.m.
 4. 12 p.m. to 4 p.m.
 5. 4 p.m. to 8 p.m.
 6. 8 p.m. to 12 a.m.

The patients in the study were again divided into the following groups and compared: ALL patients, MENA region patients (which included the UAE patients) and non-MENA region patients. It was presumed that the majority of the MENA region patients would be fasting during Ramadan.

The data collected was entered into a Microsoft Excel[®] spreadsheet and the data analysis was performed using the statistical package GraphPad[®] InStat, in addition to StatPlus[®] as an add-on for Microsoft Excel[®]. Most of the data collected was non-parametric, so data was described using non-parametric methods including medians and ranges. The analytical test used to compare age (an ordinal value) was the Mann-Whitney *U*-test. The remaining data was categorical, requiring the use of percentages for description. The Fisher's exact test, the Chi-squared test and the unpaired t test were used when appropriate for comparing groups.

Chapter 4: RESULTS

The final sample size was 1766 patients, of which 822 (46.5%) attended the ED in the Ramadan period and 944 (53.5%) attended the ED in the Control period.

During Ramadan, 378 (21.4%) MENA region and 444 (25.1%) non-MENA region patients were admitted to the ED, whereas during the Control period, 431 (24.4%) MENA region and 513 (29.1%) non-MENA region patients presented to the ED.

4.1 Comparison of the Control weeks and the Ramadan weeks

- **Week 1: (Pre-Ramadan)**

The total number of patients initially was 478, which was reduced to 437 due to the exclusion of 14 patients with no notes, 9 follow-ups and 18 patients who came for minor procedures or issues. Minor procedures included scheduled IV injections; encounters for dressing changes and wound checks; removal of sutures and repeat prescriptions.

- **Week 2: (Ramadan)**

The total number of patients initially was 451, which was reduced to 421 due to the exclusion of 9 patients with no notes and 21 patients who came for minor procedures.

- **Week 3: (Ramadan)**

The total number of patients initially was 414, which was reduced to 401 due to the exclusion of 10 patients with no notes, 1 follow-up and 2 patients for minor procedures.

- **Week 4: (Post-Ramadan)**

The total number of patients initially was 526, which was reduced to 507 due to the exclusion of 14 patients with no notes and 5 patients attending for minor procedures.

The age and gender of patients presenting in the two weeks outside of Ramadan (Week 1 and Week 4) were compared and found not to be statistically different; hence all data collected during these two weeks were combined in order to represent the non-fasting time period called the Control period. The total number of patients for the Control period was 944. In addition, the age and gender of patients presenting in the two weeks during Ramadan (Week 2 and Week 3) were compared and found not to be statistically different; hence all data collected during these two weeks were combined in order to represent the fasting period (Ramadan). The total number of patients for Ramadan was 822 (Table 4-1).

Table 4-1: Comparison of the four weeks of data

Variable	Control period		p value	Test
	<u>Week 1 (27/6 to 3/7)</u>	<u>Week 4 (26/8 to 1/9)</u>		
	N = 437	N = 507		
Age	33 (16-76)	33 (16-92)	0.8303	Mann-Whitney
Gender males	206 (47,1%)	220 (43,4%)	0.2650	Fisher's exact
Ramadan				
	<u>Week 2 (27/7 to 2/8)</u>	<u>Week 3 (10-16/08)</u>		
	N = 401	N = 421		
Age	34 (16-103)	33 (16-89)	0.1045	Mann-Whitney
Gender males	213 (53,1%)	215 (51,1%)	0.5767	Fisher's exact

All ages are in years. All p values were created using the Mann-Whitney U test, except gender, which used the Fisher's exact test.

4.2 Comparison of the demographic and clinical features of the patients in Ramadan and the Control period

There were significantly more patients seen per day in the Emergency Department (ED) during the Control period (67.43 ± 7.81) compared to the number seen in the ED (58.71 ± 7.49) during the Ramadan period ($p = 0.0057$; unpaired t test; two-tailed). The demographic and clinical features of the patients presenting to the ED during Ramadan and the Control period are shown in Table 4-2.

Table 4-2: Demographic and clinical features of the patients

ALL patients			
	Ramadan (822)	Control (944)	p value
Age: median (range)	33 (16-103)	33 (16-92)	0.116
Gender (F/M) %	48/52	55/45	0.0056
Female age: median (range)	32 (16-69)	32 (16-80)	0.8934
Male age: median (range)	36 (16-103)	34 (16-92)	0.0899
MENA region patients			
	Ramadan (378)	Control (431)	p value
Age: median (range)	32 (16-103)	31 (16-92)	0.074
Gender (F/M) %	45/55	52/48	0.0487
Female age: median (range)	30 (16-67)	30 (16-80)	0.4839
Male age: median (range)	34 (16-103)	32 (16-92)	0.1471
Non-MENA region patients			
	Ramadan (444)	Control (513)	p value
Age: median (range)	34 (16-87)	33 (16-76)	0.647
Gender (F/M) %	50/50	57/43	0.0374
Female age: median (range)	32 (16-69)	33 (16-76)	0.3472
Male age: median (range)	38 (16-87)	37 (16-76)	0.2983

All ages are in years. All p values were created using the Mann-Whitney U test, except gender, which used the Fisher's exact test.

Significantly more females than males presented to the ED during the Control period for all groups of patients compared to the Ramadan period (Fisher's exact test were all statistically significant). However, no significant difference was found

in the ages of the patients presenting to the ED for the aforementioned groups during Ramadan compared to the Control period (Mann-Whitney U tests).

4.3 Comparison of the different nationalities presenting to the ED during Ramadan and the Control period

The distribution of patients between MENA and non-MENA countries during the Control and Ramadan periods is indicated in Figure 4-1. During Ramadan, there were 378 MENA region and 444 non-MENA region patients who attended the ED. During the Control period, there were 431 MENA region and 513 non-MENA region patients seen in the ED.

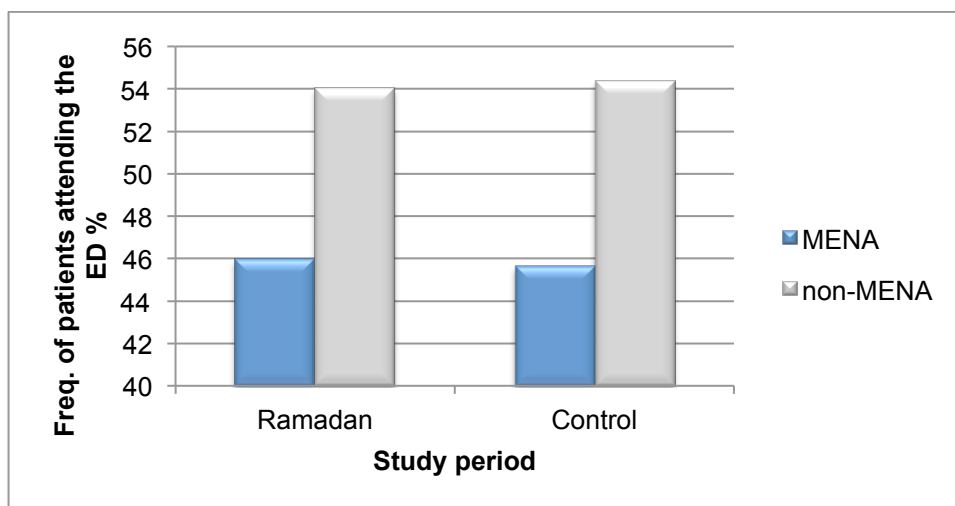


Figure 4-1: ED attendance of MENA and non-MENA region patients.

There was no statistical difference in the number of patients from the MENA region compared to those from the non-MENA region presenting to the ED during Ramadan when compared to the Control period ($p = 0.9237$; Fisher's exact test).

4.3.1 The MENA region patients (n = 809)

The MENA region patients presenting to the ED during Ramadan and the Control period were representative of twenty countries, and those comprising at least 5% of the total are shown in Figure 4-2. The country with the largest percentage of patients was the UAE, which constituted 43.4% of the MENA region patients.

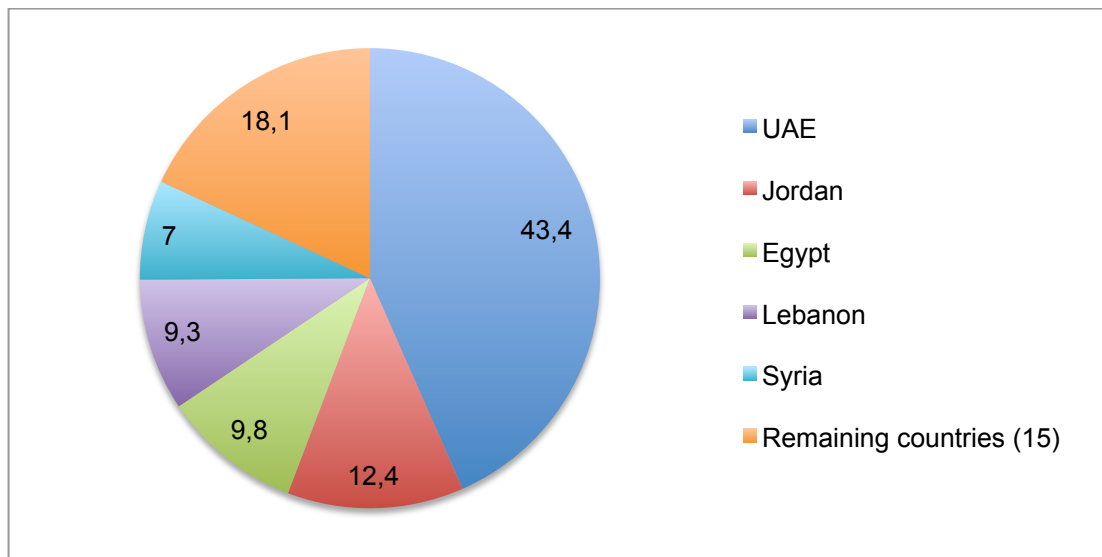


Figure 4-2: Percentage of MENA region patients by country of origin seen during the combined Ramadan and Control period

A comparison of the top five MENA countries with the highest patient numbers which were the UAE (n = 351), Jordan (n = 100), Egypt (n = 79), Lebanon (n = 75) and Syria (n = 57) showed that the number of patients who presented to the ED were not statistically different in Ramadan compared to the Control period ($p = 0.7367$; $\chi^2 = 1.995$; chi-squared test). The remaining countries which constituted less than 5% of the total MENA region were Palestine (4.8%), Iran (2.2%), Saudi Arabia (2.1%), Morocco (1.9%), Iraq (1.2%), Tunisia (1.1%), Bahrain (1%), Kuwait and Turkey (both 0.9%), Yemen (0.7%), Oman (0.5%), Algeria (0.4%), Qatar (0.2%), Cyprus and Libya (both 0.1%).

Patients from the United Arab Emirates (UAE) formed the largest group by nationality not only of the MENA region patients (43.4%), but also out of all the patients (both MENA and non-MENA) presenting to the ED (19.9%).

A comparison of the clinical and demographic features of the UAE patients presenting in Ramadan and the Control period showed no significant difference in the age of patients presenting, although there were a significantly higher proportion of female patients that attended the ED during the Control period, as shown in Table 4-3.

Table 4-3: Demographic and clinical features of the UAE patients

	UAE patients		
	Ramadan (174)	Control (177)	p value
Age: median (range)	31 (16-103)	31 (16-92)	0.374
Gender (F/M) %	47/53	58/42	0.0425
Female age: median (range)	30 (16-67)	30 (18-80)	
Male age: median (range)	32 (16-103)	31 (16-92)	

All ages are in years. The p value for age was created using the Mann-Whitney U test, and for gender using the Fisher's exact test

4.3.2 The non-MENA region patients (n = 957)

The distribution of the non-MENA patients by continent of origin is shown in Figure 4-3. The largest group of patients came from Asia followed by Europe.

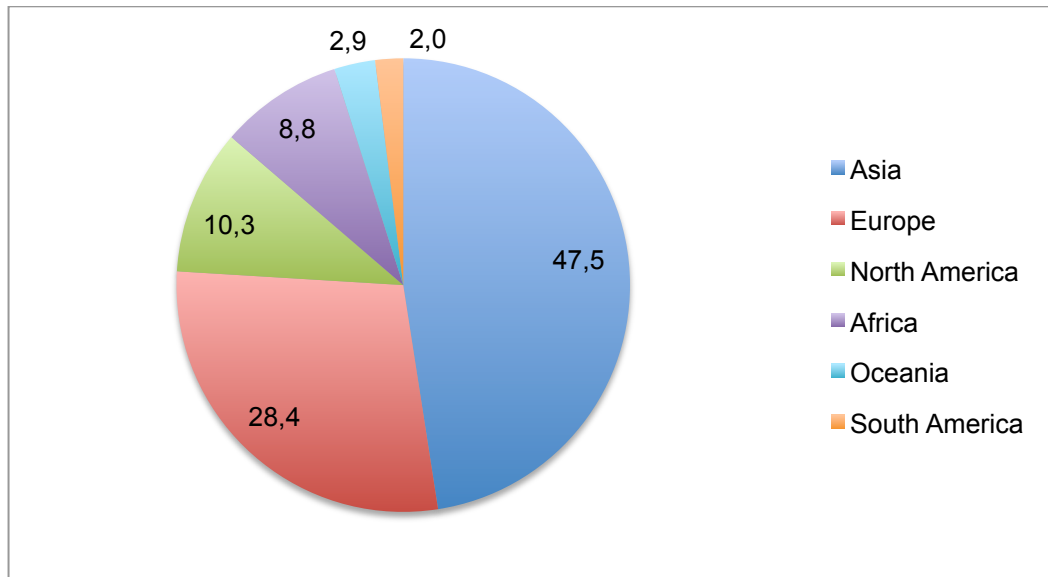


Figure 4-3: Percentage of non-MENA region patients by continent of origin seen during the combined Ramadan and Control period

4.3.2.1 Non-MENA region patients from Asia (n = 455)

The non-MENA region patients from the Asian continent that attended the ED during Ramadan and the Control period were from nineteen different countries – the top five are shown in Figure 4-4. For the combined Ramadan and Control period, patients of Indian nationality (n = 179) represented 39.3% of the total Asian countries represented, followed by the Philippines (n = 141) with 31% and Pakistan (n = 77) with 16.9%. When considering the entire group of patients who attended the ED during Ramadan and the Control period (n = 1766), patients of Indian nationality represented 10.1% while those from the Philippines formed 8%, followed by patients from Pakistan who represented 4.4%.

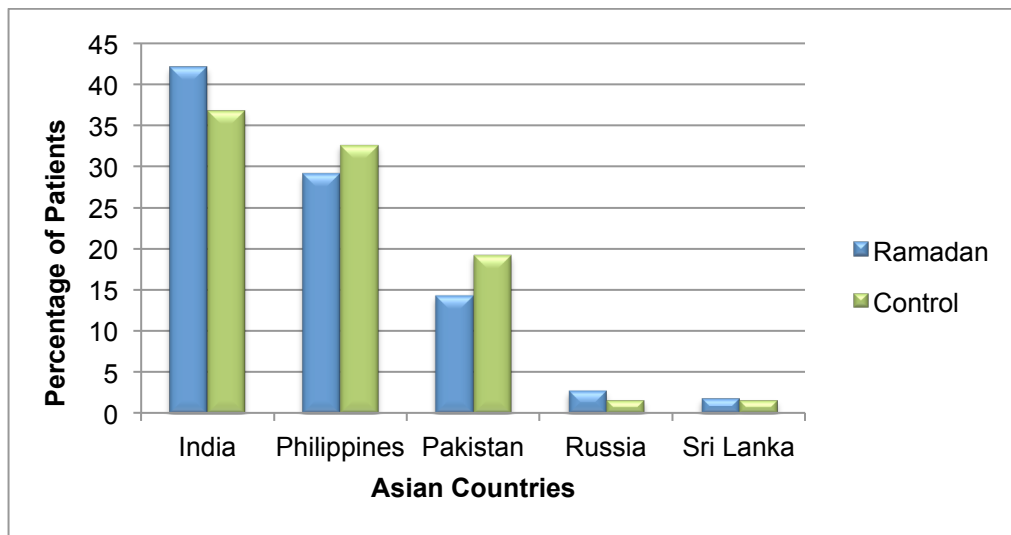


Figure 4-4: Top five non-MENA Asian patients attending the ED as a percentage of the total Asian countries (n = 455)

There was no significant difference in the number of these patients in the top five non-MENA Asian countries above seen during Ramadan compared to the Control period ($p = 0.4817$; $\chi^2 = 3.475$; chi-squared test).

4.3.2.2 Non-MENA region patients from Europe (n = 265)

Non-MENA region patients from 24 different European countries presented to the ED during Ramadan and the Control period. The top five European countries with the highest frequency of patient ED attendance were compared, as shown in Figure 4-5. Patients from the United Kingdom (n = 135) had the highest frequency out of the European countries for ED attendance - 50.9% for the combined Ramadan and Control period, and formed 7.6% of the entire group of patients seen over the combined period (n = 1766).

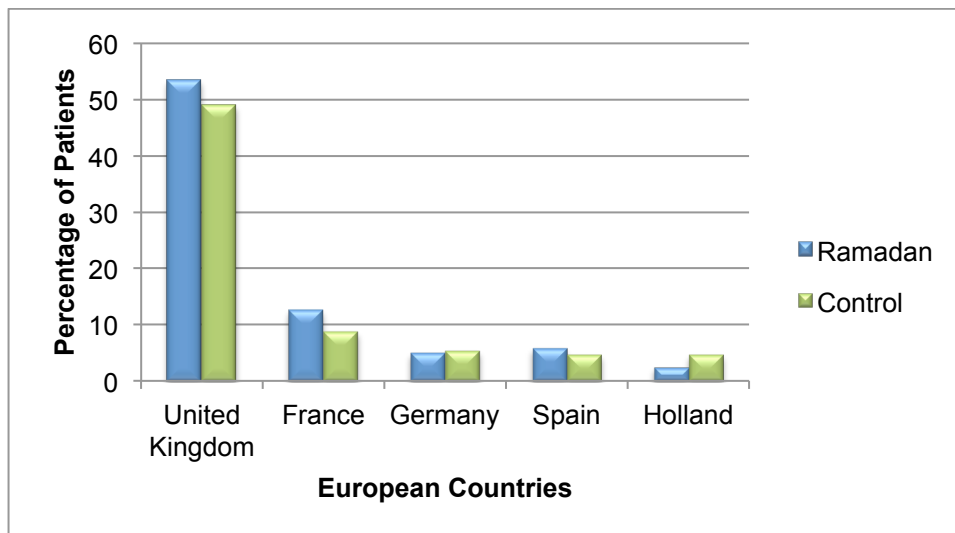


Figure 4-5: Top five non-MENA European countries with patients attending the ED as a percentage of the total European countries (n = 265)

There was no significant difference in the attendance of these top five European patients in Ramadan compared to the Control period ($p = 0.7733$; $\chi^2 = 1.795$; chi-squared test).

4.3.2.3 Non-MENA region patients from North America (n = 99)

The non-MENA region patients from the North American continent that presented to the ED during Ramadan and the Control period were from five different countries, seen in Figure 4-6.

Patients from the USA (n = 63) represented 63.6% of the North American non-MENA region patients in the combined study periods, but only 3.6% of the entire group (MENA and non-MENA).

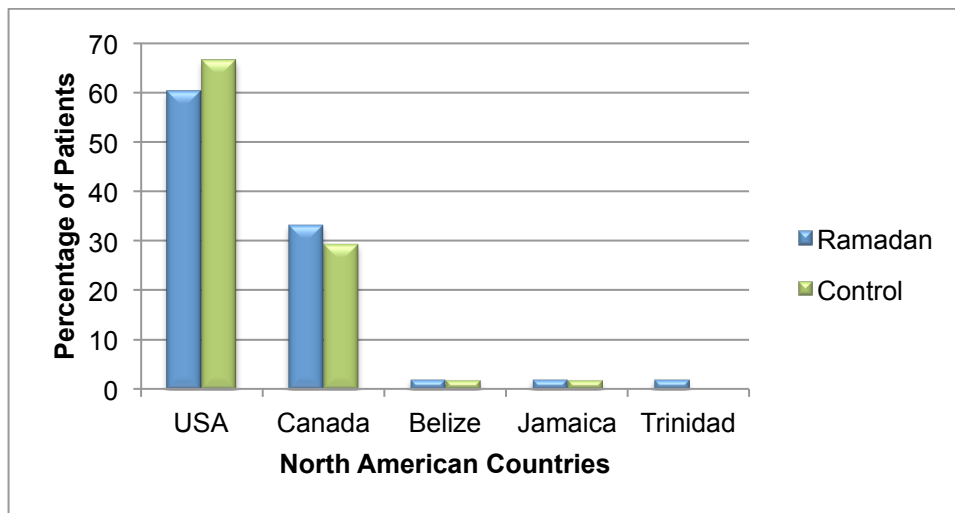


Figure 4-6: North American countries represented during Ramadan and the Control period (n = 99)

There was no significant difference in the ED attendance of patients from the North American countries in Ramadan compared to the Control period ($p = 0.8547$; $\chi^2 = 1.339$; chi-squared test).

4.3.2.4 Non-MENA region patients from Africa (n = 84)

The non-MENA region patients from the African continent that presented to the ED during Ramadan and the Control period represented ten countries in total and 8.8% of the total non-MENA (n = 957) countries. The three African countries with the highest ED attendance during Ramadan and the Control period are shown in Figure 4-7. The country with the highest frequency for the combined period was South Africa (n = 44), with 52.4%, followed by Sudan (n = 19) with 22.6% and Kenya (n = 7) with 8.3%.

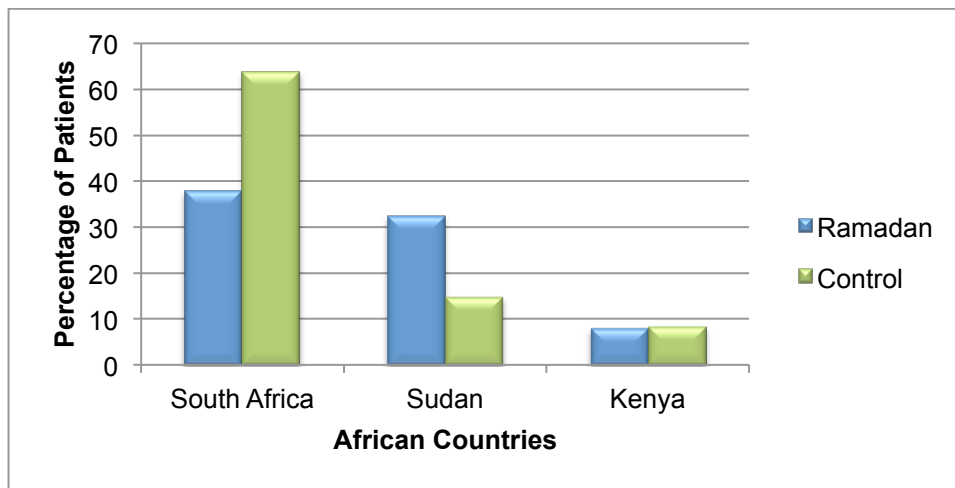


Figure 4-7: Top three non-MENA African countries with patients attending the ED as a percentage of the total African countries (n = 84)

There was no significant difference in the number of patients from South Africa, Sudan or Kenya presenting to the ED during Ramadan compared to the Control period ($p = 0.0680$; $\chi^2 = 5.378$; chi-squared test).

4.3.2.5 Non-MENA region patients from Oceania (n = 28)

The non-MENA patients from the continent of Oceania that presented to the ED during Ramadan and the Control period were from Australia and New Zealand, shown in Figure 4-8.

Patients from Australia (n = 19) represented 2% of the total non-MENA patients (n = 957) attending the ED, and 1.1% of the entire group (MENA and non-MENA).

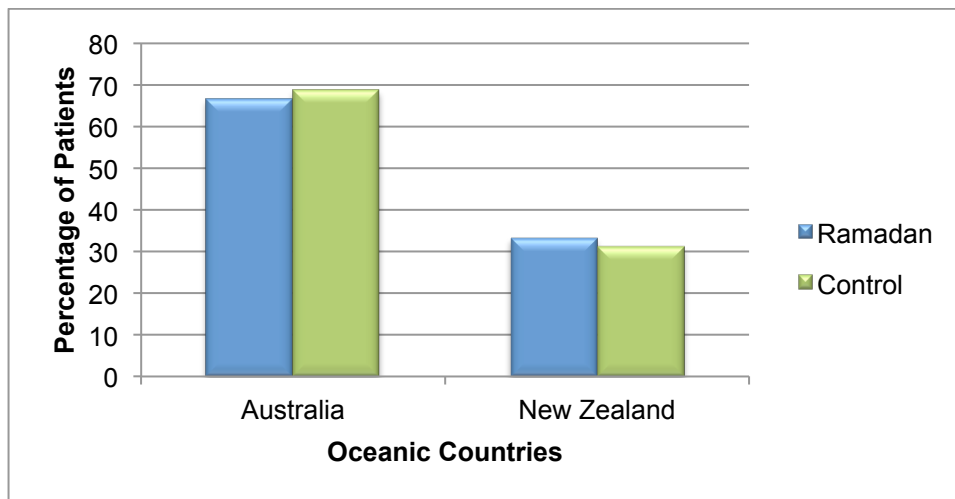


Figure 4-8: Oceanic non-MENA countries represented during Ramadan and the Control period (n = 28)

There was no significant difference in the ED attendance of patients from Australia and New Zealand in Ramadan compared to the Control period ($p= 1$; Fisher's exact test).

4.3.2.6 Non-MENA region patients from South America (n = 19)

The non-MENA region patients from the South American continent that presented to the ED during Ramadan and the Control period were from five different countries, indicated in Figure 4-9.

Patients from Brazil constituted the largest number of patients (n = 11) from the South American continent, a total of 57.9% for the combined Ramadan and Control period.

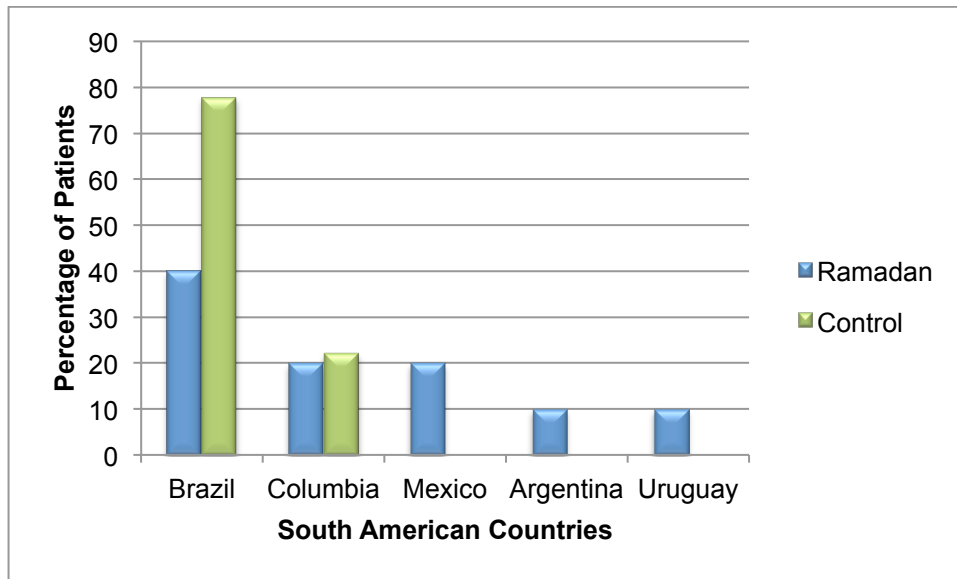


Figure 4-9: South American countries represented during Ramadan and the Control period

There was no significant difference seen comparing the attendance of patients in Ramadan to the Control period in these South American patients ($p = \text{value of } 0.3108; \chi^2 = 4.779; \text{chi-squared test}$).

4.4 Comparison of the diagnosis profile between Ramadan and the Control period

4.4.1 All patients (n = 1766)

The percentage of patients classified into the different diagnoses categories during Ramadan and the Control period is indicated in Figure 4-10.

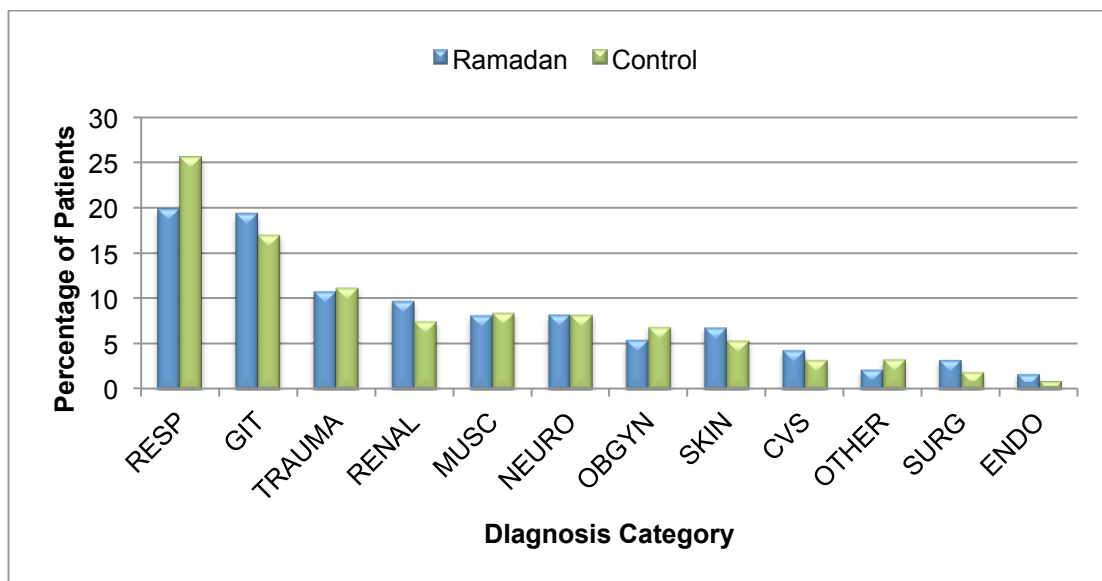


Figure 4-10: Diagnosis Category for all patients during Ramadan and the Control Period.

RESP – Respiratory; GIT – Gastrointestinal; MUSC - Musculo-skeletal; NEURO – Neurological; OBGYN - Obstetric-Gynaecological; CVS – Cardiovascular; SURG - Surgical; ENDO - Endocrine-related

There was a significant difference in the diagnoses made during Ramadan compared to the diagnoses made during the Control period ($p = 0.0244$, $\chi^2 = 22.00$, Chi-squared test). Each diagnosis category was then compared individually in Ramadan to the Control period, shown in Table 4-4, and only one category – “SKIN”, showed a significant difference.

Table 4-4: Chi-squared test results on the different diagnosis categories

Diagnosis Category	Chi-Squared test value χ^2	p value
CVS	2.022	0.7317
ENDO	Not enough patients to produce a valid chi-squared test	
GIT	6	0.1996
MUSC	6.755	0.3441
NEURO	6.362	0.2726
OBGYN	4.406	0.7321
OTHER	1.140	0.5656
RENAL	1.914	0.3841
RESP	0.6159	0.8928
SKIN	13.51	0.0012
SURG	0.5145	0.7732
TRAUMA	4.173	0.1242

RESP – Respiratory; GIT – Gastrointestinal; MUSC - Musculo-skeletal; NEURO – Neurological; OBGYN -

Obstetric-Gynaecological; CVS – Cardiovascular; SURG - Surgical; ENDO - Endocrine-related; URTI – upper respiratory tract infection

In the skin category, the most common diagnosis was “Allergic reaction”, accounting for 37.4% of the total presentations, followed by “Cellulitis” (15%) and “Other skin rash” (12.2%), as indicated in Figure 4-11.

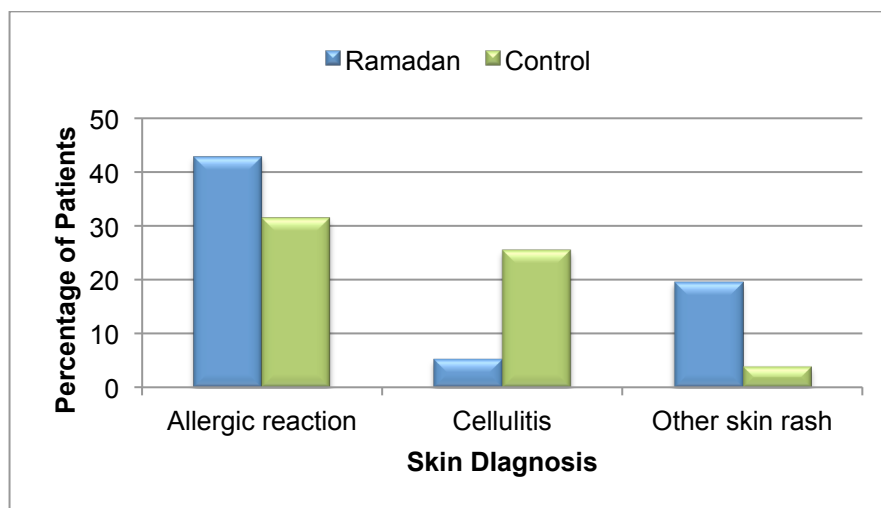


Figure 4-11: Most common skin diagnoses

Diagnoses that occurred in at least 15% of the patients for either the Ramadan and/or the Control period in that particular diagnosis category were considered to be of significance for the sake of comparison, as indicated in Table 4-5.

Table 4-5: Diagnoses that constituted at least 15% of the diagnosis category

Diagnosis Category	≥ 15% of patients with a diagnosis	Ramadan %	Control %	p value
CVS	Chest pain	55.6	48.4	1.0000
	Palpitations	30.6	29.0	
ENDO	Gout	28.6	33.3	0.4444
	Thyroid goitre	0.00	22.2	
GIT	Acute gastroenteritis	31.5	28.6	0.4880
	Acute gastritis	21.4	28.0	
	Abdominal pain	15.1	15.5	
MUSC	Muscle spasm	32.8	33.8	0.4192
	Low back pain	38.8	27.5	
NEURO	Headache	19.1	20.2	0.2011
	Migraine	20.6	10.3	
	Dizziness	10.3	15.4	
OBGYN	Threatened miscarriage	13.3	16.9	0.4601
	Dysmenorrhoea	15.6	9.2	
OTHER	Fatigue	22.2	18.8	0.5656
	Viral illness	22.2	15.6	
	Stress	22.2	6.3	
RENAL	Urinary tract infection	53.8	57.8	0.4331
	Renal colic	28.8	21.1	
RESP	URTI	65.6	62.0	---
SKIN	Allergic reaction	42.9	31.4	0.0012
	Cellulitis	5.4	25.5	
	Skin rash	19.6	3.9	
SURG	Abscess	22.2	27.8	0.7416
	Acute appendicitis	22.2	22.2	
	Pain post surgery	18.5	11.1	
	Complication post surgery	7.4	16.7	
TRAUMA	Soft tissue injuries	30.3	44.3	0.1242
	Sprains	33.7	23.6	
	Fractures	16.9	17.9	

RESP – Respiratory; GIT – Gastrointestinal; MUSC - Musculo-skeletal; NEURO – Neurological; OBGYN -

Obstetric-Gynaecological; CVS – Cardiovascular; SURG - Surgical; ENDO - Endocrine-related; URTI – upper respiratory tract infection

The p values were derived from the Fisher's exact test when there were only two variables and the Chi-squared test when there were more than two variables.

4.4.2 The MENA region patients (n = 809)

A summary of the clinical diagnoses of the MENA region patients seen during Ramadan and the Control Period in respective categories is shown in Figure 4-12.

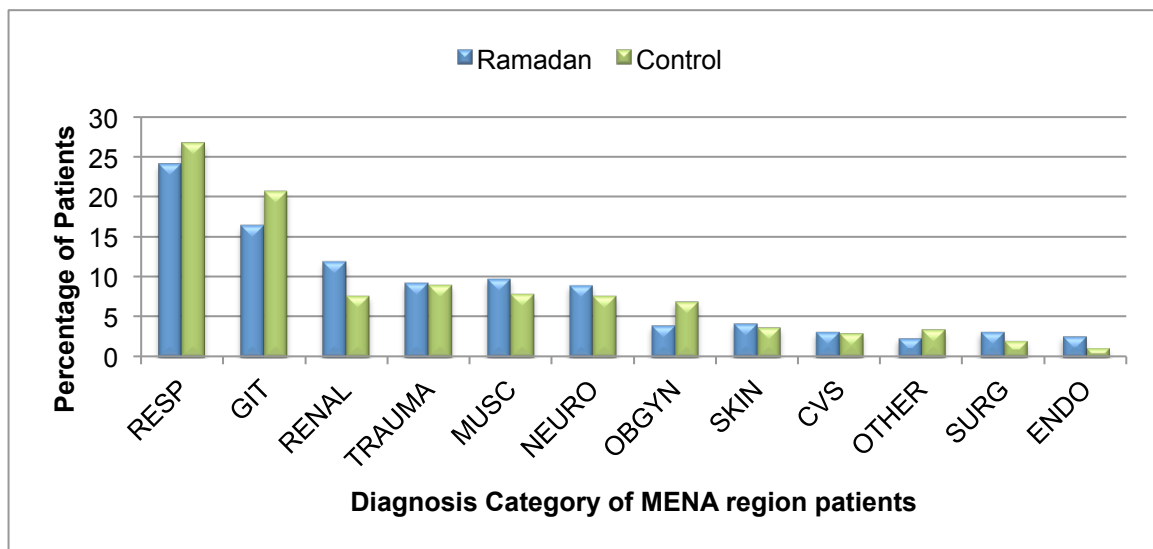


Figure 4-12: MENA region patient diagnosis

RESP – Respiratory; GIT – Gastrointestinal; MUSC - Musculo-skeletal; NEURO – Neurological; OBGYN - Obstetric-Gynaecological; CVS – Cardiovascular; SURG - Surgical; ENDO - Endocrine-related

There was no significant difference in the diagnoses made in the MENA region group of patients during Ramadan compared to the Control period ($p = 0.2384$; $\chi^2 = 15.06$; Chi-squared test). Respiratory diagnoses were the most commonly made diagnoses in patients presenting during both the Ramadan and the Control period.

A comparison of the UAE patients (the largest nationality group of the MENA region patients) seen during Ramadan and the Control period showed no

significant difference in the diagnoses made ($p = 0.2928$; $\chi^2 = 13.01$; Chi-squared test).

4.4.3 The non-MENA region patients (n = 957)

A summary of the clinical diagnoses of the non-MENA patients seen during Ramadan and the Control Period in respective categories is shown in Figure 4-13.

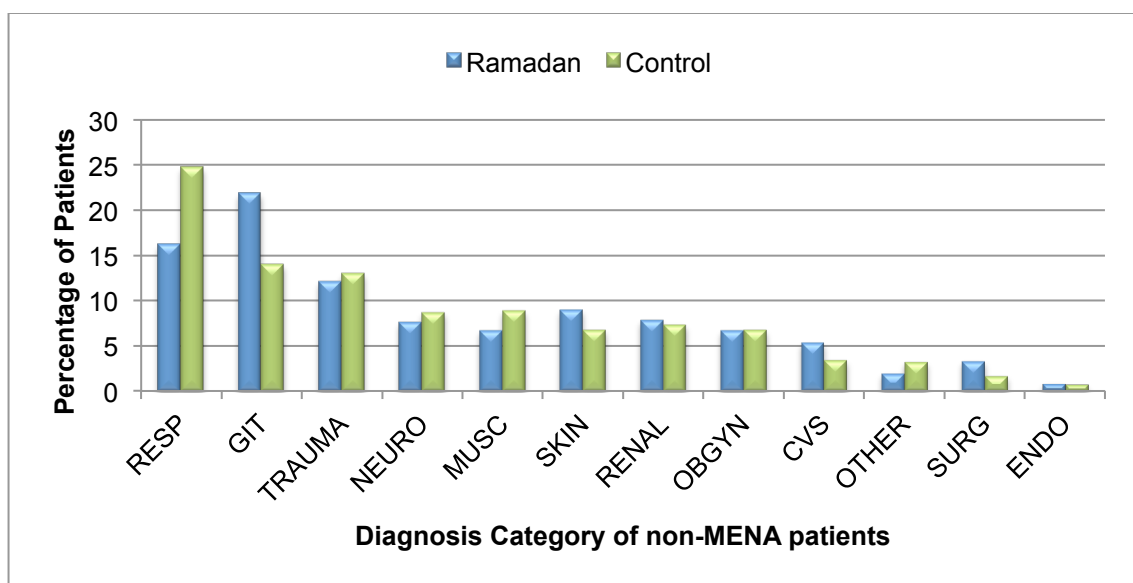


Figure 4-13: Non-MENA region patient diagnosis

RESP – Respiratory; GIT – Gastrointestinal; MUSC - Musculo-skeletal; NEURO – Neurological; OBGYN - Obstetric-Gynaecological; CVS – Cardiovascular; SURG - Surgical; ENDO - Endocrine-related

There was a statistically significant difference in the diagnoses made in the non-MENA group of patients during Ramadan compared to the Control period ($p = 0.0065$; $\chi^2 = 26.02$; Chi-squared test). It was likely due to an increase in the amount of GIT diagnoses and drop in respiratory complaints made in Ramadan compared to the Control period.

4.5 Comparison of the time of admission and number of ED Admissions between Ramadan and the Control period

4.5.1 Day versus night ED attendance

4.5.1.1 All patients (n = 1766)

During Ramadan, 59.1% of the patients attended the ED during the day, compared to the Control period, where 66.5% of the patients attended the ED during the day, as indicated in Figure 4-14.

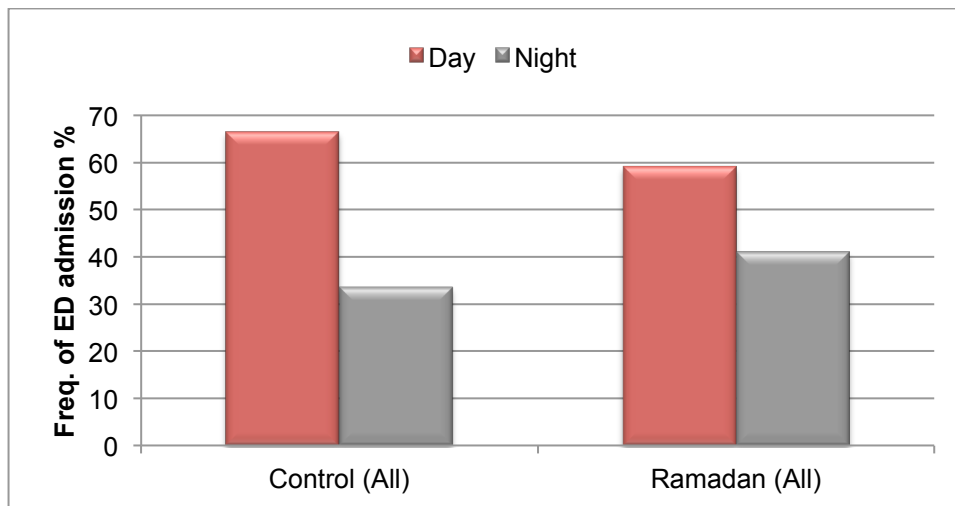


Figure 4-14: Frequency of ED attendances of all patients in the day versus the night

Significantly more patients were seen in the ED during the daytime in the Control period compared to the daytime during Ramadan ($p = 0.0016$, Fisher's exact test).

4.5.1.2 The MENA region patients (n = 809)

During Ramadan, 50.5% of the patients from the MENA region attended the ED during the daytime compared to 60.8% during the Control period. Similarly there was a higher percentage of MENA patients attending the ED during the night-time

(49.5%) in Ramadan compared to the night-time (39.2%) in the Control period, as indicated in Figure 4-15.

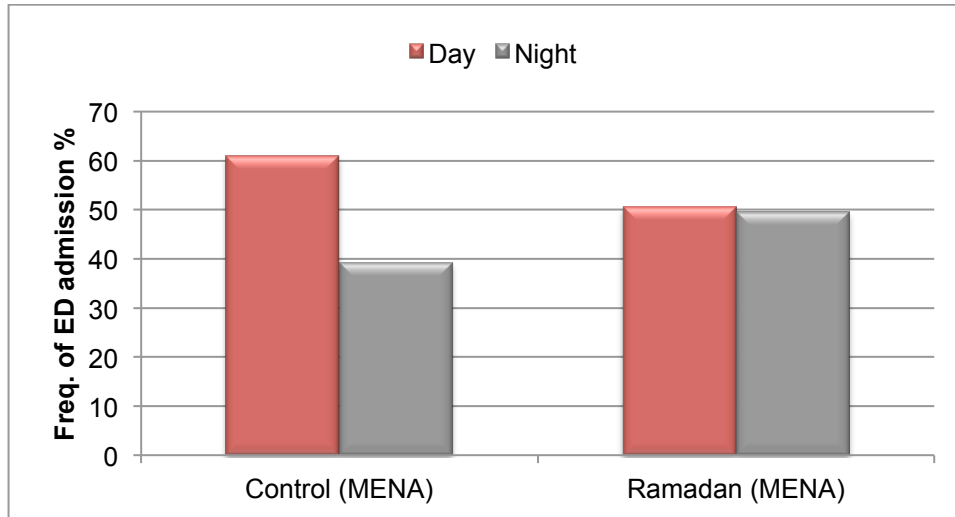


Figure 4-15: Frequency of the MENA region patient attendance in the ED during the day and night

These observed differences were statistically significant ($p = 0.0036$; Fisher's exact test). This is most likely due to more patients attending the ED during the night-time in Ramadan compared to the Control period.

The UAE patients constituted the majority of the MENA patients, and were the nationality that formed the largest percentage of patients seen overall in the ED. For the UAE patients it was noted that daytime ED attendance was 59.3% during the Control period compared to 44.2% during Ramadan, whereas the night-time attendance during Ramadan was much higher at 55.8% compared to 40.7% seen during the Control period, indicated in Figure 4-16. These differences were statistically significant ($p = 0.0054$; Fisher's exact test).

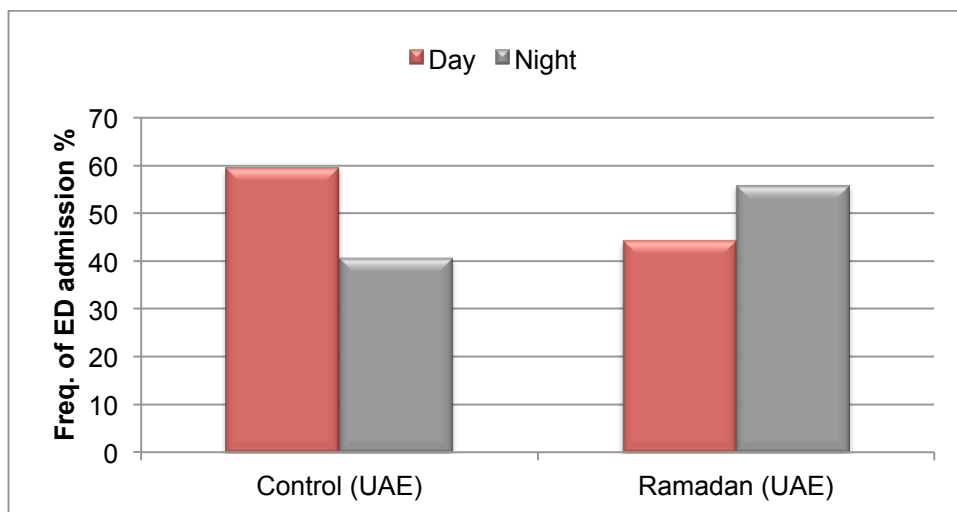


Figure 4-16: Frequency of UAE patient attendance in the ED during the day and night

4.5.1.3 The non-MENA region patients (n = 957)

During Ramadan, 66.4% of the non-MENA patients attended the ED during the daytime, compared to 71.4% during the Control period. During the night-time in Ramadan 33.6% non-MENA attended the ED compared to 28.7% in the Control period, indicated in Figure 4-17.

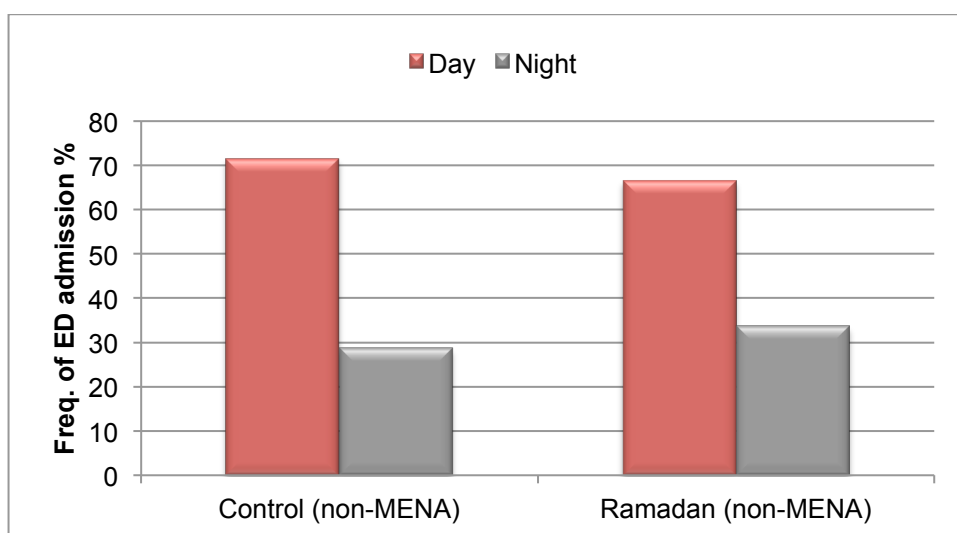


Figure 4-17: Frequency of non-MENA region patient attendance in the ED during the day and night

There was no significant difference seen in the comparison of ED attendances during the day versus the night for the non-MENA patient group ($p = 0.1071$; Fisher's exact test).

4.5.2 Comparison of ED attendance during the day in four-hourly time periods

4.5.2.1 All patients (n = 1766)

The frequency of ED attendances of all patients (MENA and non-MENA patients combined) presenting to the ED during Ramadan and the Control period were compared, as shown in Figure 4-18.

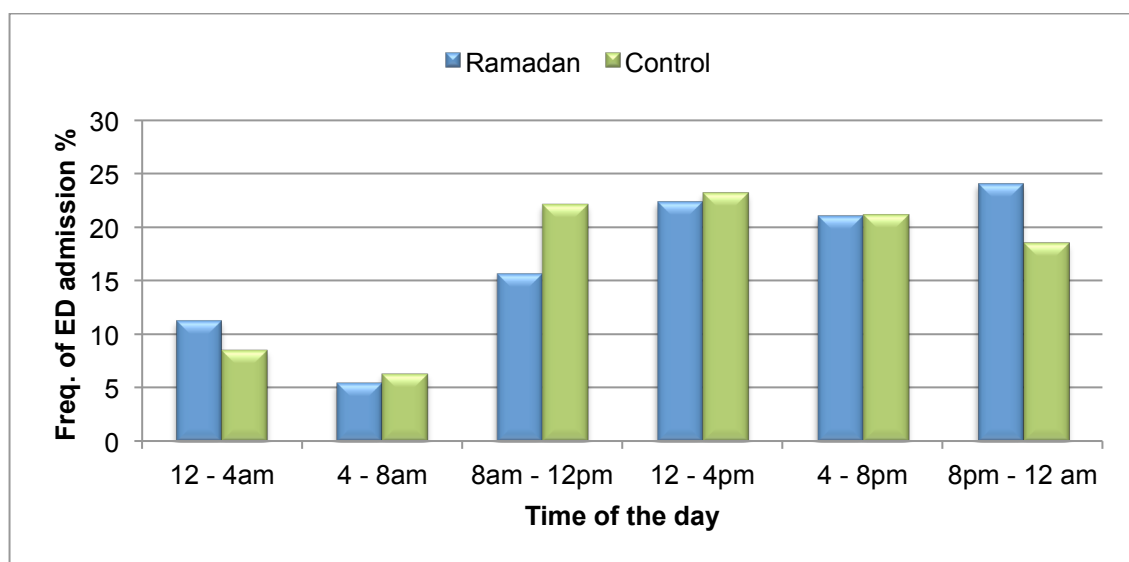


Figure 4-18: Frequency of ED attendances for all patients

The most frequent time for ED admission during Ramadan was from 8 p.m. to 12 a.m. (24.1%), whereas during the Control period the most frequent time for ED admission was from 12 p.m. to 4 p.m. (23.2%). For both Ramadan and the Control period, the least frequent ED admission was seen from 4 a.m. to 8 a.m. during Ramadan (5.5%) and the Control period (6.4%). There was a significant difference in the time of ED admission of all patients during Ramadan compared to the

Control period ($p = 0.0013$; $\chi^2 = 19.99$; Chi-squared test). The largest differences that may have accounted for this are the decreased number coming during Ramadan between 8 a.m. and 12 p.m. and the increased number coming during Ramadan between 8 p.m. and 12 a.m.

4.5.2.2 The MENA region patients (n = 809)

The frequency of ED attendances of MENA region patients during Ramadan and the Control period is shown in Figure 4-19.

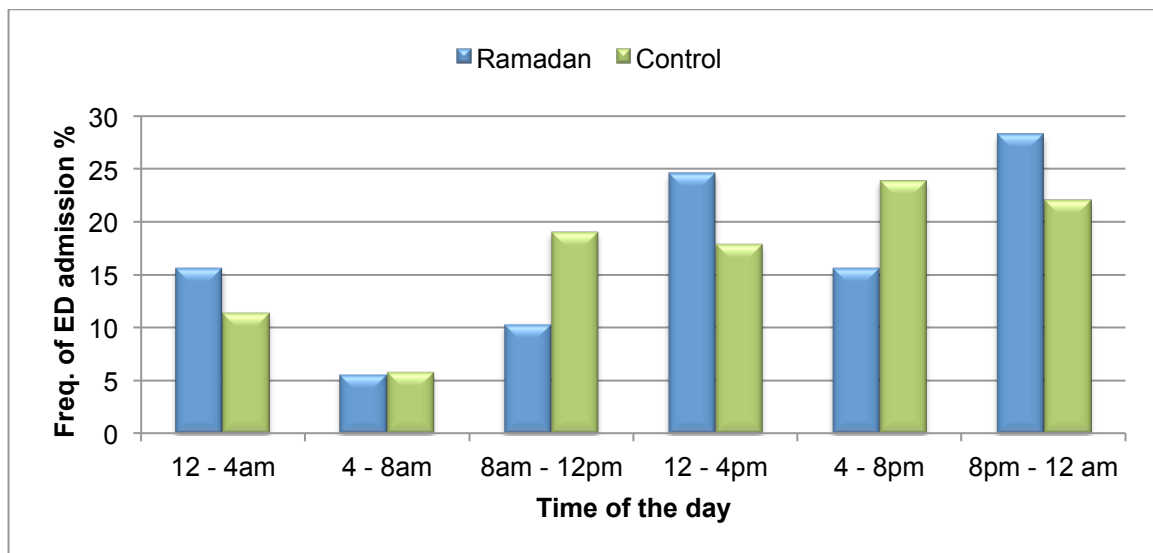


Figure 4-19: Frequency of ED admission for MENA region patients

The most frequent time of ED admission during Ramadan was from 8 p.m. to 12 a.m. (28.3%), followed by the period 12 p.m. to 4 p.m. (24.6%). During both of these time periods there were more admissions during Ramadan compared to the Control period. In contrast, there are marked drops in ED attendance in Ramadan compared to the Control period over the time period 4 p.m. to 8 p.m. (15.6%) and 8 a.m. to 12 p.m. (10.3%). The busiest time during the Control period was 4 p.m. to 8 p.m. (23.9%). In the night hours from 8 p.m. to 4 a.m., 43.9% of the MENA

region patients attended the ED during Ramadan, compared to 33.4% during the Control period. There was a significant difference in the time of ED admission of the MENA patients during Ramadan compared to the Control period ($p < 0.0001$; $\chi^2 = 27.37$; Chi-squared test). The UAE patients, who formed the majority of the MENA region patients showed an identical shift in the time of ED admission during Ramadan and the Control period, that was calculated to be significant ($p = 0.0007$; $\chi^2 = 21.32$; Chi-squared test).

4.5.2.3 The non-MENA region patients (n = 957)

The ED attendance of non-MENA region patients during Ramadan versus the Control period is the shown in Figure 4-20.

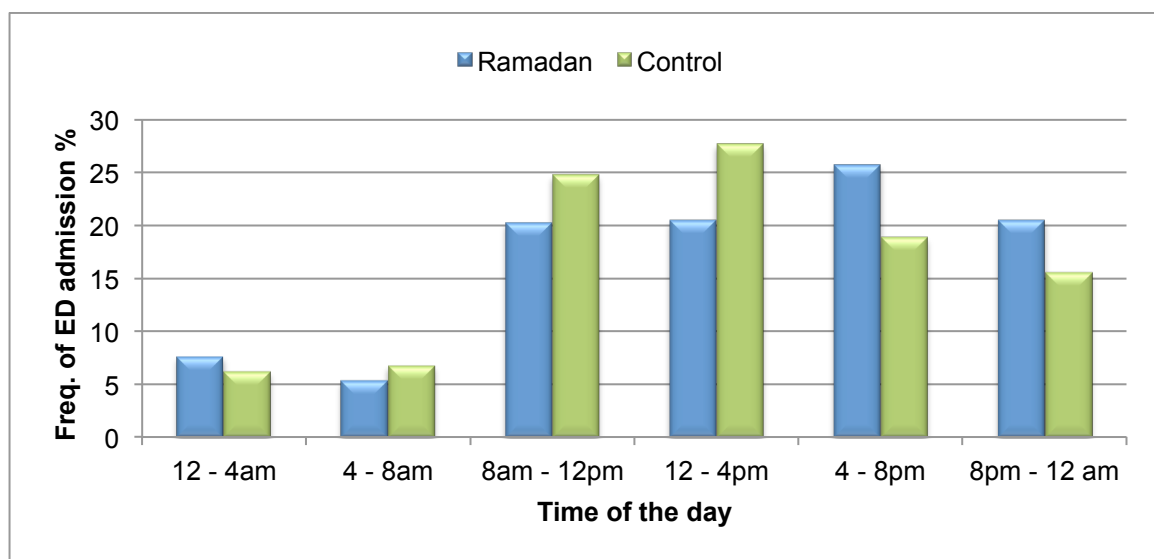


Figure 4-20: Frequency of ED attendances for non-MENA region patients

The most frequent time of admission for the non-MENA region patients was 4 p.m. to 8 p.m. during Ramadan (25.7%) and during the Control period, 12 p.m. to 4 p.m. (27.7%). The least frequent use of the ED during Ramadan for the non-MENA group of patients was 4 a.m. to 8 a.m. (5.4%), whereas in the Control period it was

12 a.m. to 4 a.m. (6.2%). These shifts resulted in a significant difference in the time of ED admission (when the day was divided into four-hourly intervals) of the non-MENA patients during Ramadan compared to the Control period ($p = 0.0050$; $\chi^2 = 16.77$; Chi-squared test). However as noted before when comparing day to night-time attendance the difference noted was deemed not significant.

4.5.2.4 ED Attendance of MENA region compared to non-MENA region patients during Ramadan and the Control period

The ED admissions during the six time periods in the day were compared in these two groups of patients and for MENA and non-MENA region patients the following time periods showed no difference.

- 12 a.m. to 4 a.m. ($p = 0.1446$; Fisher's exact test)
- 4 a.m. to 8 a.m. ($p = 0.6922$; Fisher's exact test)
- 8 a.m. to 12 p.m. ($p = 0.1028$; Fisher's exact test)
- 8 p.m. to 12 a.m. ($p = 1.0000$; Fisher's exact test)

However, there was a significant difference in ED attendances seen between MENA and non-MENA patients for the following time periods:

- **12 p.m. to 4 p.m.** ($p = 0.0023$; Fisher's exact test) During Ramadan, notably more MENA region patients attended the ED during this time period compared to non-MENA region patients.
- **4 p.m. to 8 p.m.** ($p = 0.0008$; Fisher's exact test) During Ramadan, a marked drop in ED attendance was seen in MENA region patients compared to non-MENA region patients during this time period.

Chapter 5: DISCUSSION

The results generated by the research have allowed a deeper insight into the effect that the fast of Ramadan had on patient utilisation of the emergency department. The focus points were based on a comparison of the demographic and clinical features of the patients; the different nationalities, the diagnoses made; and finally the impact that Ramadan had on the time of day that patients presented to the ED.

Initially, four weeks were chosen for the study – one week before and one week after Ramadan, and two weeks within the Ramadan period. As no statistical difference was found between the two weeks outside of Ramadan these were combined to form the Control period. There was also no difference between the two weeks within Ramadan, hence these were combined into one data set for the Ramadan period.

When comparing the Control period to the Ramadan period, there were no significant differences in the ages or the nationalities of the patients who presented to the ED, although there were significantly more females than males who presented to the ED during the Control period compared to Ramadan. Patients from the UAE formed the majority of the patients who attended the ED during the study period.

There were very few changes in the medical conditions presenting during the two time periods, and the only significant finding occurred with skin conditions presenting to the ED.

There were significant shifts in the time when patients attended the ED, which were most pronounced in the MENA region patients during Ramadan, but not present in the non-MENA region patients.

5.1 Comparison of the Control period weeks and the Ramadan weeks

There were significantly more patients seen during the day in the ED in the Control period compared to Ramadan. This could partly be because data collected for Week 4, which formed part of the Control group, contained more patients. This could be attributed to the time of year during which the study occurred. These differences were not seen in similar studies by Pekdimir *et al.*(67) and Topacoglu *et al.*(23) However, in Dubai where the study was based, there is a mass exodus of expatriates and local residents alike out of the city in the very hot summer months, which coincide with school holidays.(79) Week 4 of the study occurred when school had started again and families had returned to Dubai and thus an influx of patients was seen in the ED, which in this community is the first port-of-call for most acutely ill patients.

5.2 Comparison of the demographic and clinical features of the patients in Ramadan and the Control period

There were no significant differences in the ages of the patients presenting to the ED for each group during Ramadan compared to the Control period. There was however a gender difference, with significantly more females than males presenting to the ED during the Control period compared to Ramadan. The reason for this is unknown. In contrast, Pekdimir *et al.* found no significant difference in the demographic and clinical features of the patients in the fasting period

compared to the non-fasting period.(67) The study by Topacoglu *et al.*, like the previous study, also did not find any difference in the demographics of patients presenting with medical entities to the ED during Ramadan compared to other times of the year.(23)

5.3 Comparison of the different nationalities presenting to the ED during Ramadan and the Control period

There were no significant differences found in the distribution of the MENA region and the non-MENA region patients during Ramadan and the Control period. It is of interest to note that the majority of European patients were from the United Kingdom. This is because of the strong bond that has existed between the UAE and the United Kingdom since the formation of the UAE in 1971. It is a relationship cemented bilaterally with economic, strategic and cultural interests.(80) There are no previous studies conducted to date, which have compared nationalities of patients presenting to the ED during Ramadan. It was decided to group patients into MENA and non-MENA countries, as mentioned earlier in the materials and methods section, as almost 90% of the MENA region are estimated to be Muslim and thus it was expected that this percentage of the patients chosen for the study would be fasting. There have no been studies to date, which have compared the ED attendance of MENA to non-MENA region patients.

Patients from the UAE formed the largest majority of patients presenting to the ED. Although forming part of the MENA region, at times the UAE patient data was investigated as a stand-alone group, purely out of interest to the research. This is because a patient who is a UAE citizen is most likely to be Muslim and if over the

age of 16 years, will most likely be fasting during Ramadan.(75) This knowledge could help establish a causal relationship between fasting and ED attendance patterns.

5.4 Comparison of the diagnosis profile between Ramadan and the Control period

The comparison of diagnoses in patients presenting to the ED during Ramadan and the Control period yielded only one significant difference and this was found in the skin category, with more patients presenting with skin complaints during Ramadan compared to the Control period. Combining the diagnosis of “allergic reaction” with “other skin rashes”, it was found that 4.3% of the cases were seen during Ramadan compared to 1.9% during the Control period. The study by Halasa also mentioned that skin complaints formed at least 6% of patients’ diagnoses during Ramadan.(66) The reason for the significant finding, however, is unknown, and could possibly be related to different food being consumed, lack of sleep or even stress.

With regard to the remaining diagnosis categories, no significant differences were seen in the diagnoses made in patients presenting to the ED during Ramadan compared to the Control period. Respiratory diagnoses were the most commonly made diagnoses in all patients groups over the study period, followed by gastrointestinal, trauma and then renal diagnoses. Similar results were reported by Halasa, who also noted that following on from respiratory complaints, were gastrointestinal complaints then skin complaints.(66) Unfortunately there was no control group in the study by Halasa to compare the diagnoses that were made

outside of the Ramadan period. Pekdimir *et al.* documented that respiratory problems were the third most common complaint during Ramadan.(67)

In the combined MENA and non-MENA group of patients during Ramadan, gastrointestinal complaints were the second commonest reason for attendance to the ED. This is in keeping with previous literature which noted an increased incidence of gastrointestinal complaints seen in Ramadan.(44) Specifically, there was a slight increase in the number of cases of acute gastroenteritis seen in Ramadan when compared to those seen in the Control period, which was supported by a similar study by Halasa, in which a high frequency of acute gastroenteritis cases was reported.(66) There was no significant change in gastrointestinal complaints seen in the data of the combined MENA and non-MENA population from the United Arab Emirates reported in the present study. There was however a significant difference was seen in diagnoses made in the non-MENA region patients in Ramadan compared to the Control period. It is possible that this could be due to an increase in gastrointestinal complaints, but there is no real evidence or previous studies in this particular patient group to support this.

The renal diagnoses made most commonly in this study were those of urinary tract infection and renal colic, but there were no significant differences found between Ramadan and the Control period. Previous studies have also reported an increase in renal colic during Ramadan.(51,53) In addition, results from Abdolreza *et al.* showed that the number of ED admissions for renal colic cases were high in the first two weeks of Ramadan.(54) Al-Hadramy suggested that it is the higher

ambient temperature rather than fasting that is the cause for the presentation of renal colic in patients during Ramadan.(55) Similarly, Ramadan in the current study occurred in the height of summer in the UAE and it is possible that this could be the reason for the increase in renal colic cases.

In the cardiovascular category, chest pain was the most common complaint, however no significant differences were found between Ramadan and the Control period. Similar results were reported in the study by Topacoglu *et al.*(23) which found no increase in acute coronary disease and no significant increase in ischaemic and haemorrhagic cerebrovascular accidents being admitted to the ED. Pekdimir *et al.* also noted no significant differences in the presentation of diseases of the circulatory system during Ramadan compared to the Control period.(67)

There was no significant difference seen in patients with diabetes complaints in Ramadan compared to the Control period. These results are similar to Topacoglu *et al.* who also reported no differences in the frequencies of diabetes-related visits.(23)

In the neurological category during Ramadan, there was a slight increase (although not significant) in the number of patients who presented to the ED with headaches and migraines compared to the Control period. This is in agreement with the results of Topacoglu *et al.* who reported that the visit frequencies for uncomplicated headaches were significantly higher in Ramadan than in non-Ramadan times.(23) Indeed, fasting has been shown to be an important

precipitating factor for the development of headaches, and previous studies support the findings of the present study.(2,22,24)

Fatigue was seen in Ramadan and in the Control period but there were no significant differences. The reduction in sleep experienced by those fasting has been shown previously to cause fatigue and difficulties in daytime functioning.(10)

From a surgical perspective, no significant difference was seen in the diagnoses made during Ramadan compared to the Control period. The diagnosis of acute appendicitis was one of the common presenting complaints, and likewise, a previous study showed that fasting did not constitute any risk factors for acute appendicitis.(49)

There was no significant difference found in trauma diagnoses (which encompassed sprains, soft tissue injuries and fractures) made during Ramadan compared to the Control period, although it was the second most common complaint seen in both periods. In contrast, the study by Parrilla *et al.* (68) found complaints due to trauma, sprains and falls were the most frequently seen during Ramadan.

5.5 Comparison of the time of admission and number of ED admissions between Ramadan and the Control period

5.5.1 Day versus night ED attendances

The MENA region patients showed a significant shift in day versus night-time attendance to the ED, with more patients presenting to the ED during the night.

With a proposed 90% of these patients fasting, it is likely that this shift was due to the very nature of Ramadan, which essentially causes a “swapping” of the day and the night routine for those fasting. There was however, no significant difference in the pattern of ED attendance in the non-MENA region patients in Ramadan compared to the Control period. It is postulated that the majority of these patients were probably not fasting, hence the observed non-effect of the Ramadan period on individuals who do not change their lifestyle during this period. Naturally, there are still existing climate and external factors, which would have affected this patient group.(81,82) There is, in addition, no comparative literature to date that has grouped patients into MENA and non-MENA regions and compared their attendance to an ED during Ramadan and a specified Control period.

5.5.2 ED attendance in four-hourly time periods

When the MENA and non-MENA region patients were combined it was found that during Ramadan, the most frequent time period for admission to the ED was from 8 p.m. to 12 a.m. However when the patients were considered as two separate groups, the MENA region patients maintained the same time period as the most frequent time of admission, whereas the non-MENA region patients attended most frequently earlier in the day during Ramadan from 4 p.m. to 8 p.m. Pekdimir *et al.*(67) also reported their busiest time during Ramadan from 4 p.m. to 8 p.m., whereas Suwaidi *et al.* noted that fasting patients suffering from cardiac symptoms were more likely to present to the ED from 5 a.m. to 6 a.m. and again from 11 p.m. to midnight.(41) By comparison, the study by Halasa showed that in Ramadan, more patients came in the later shift from 11 p.m. to 8 a.m. while in the Control period the most frequent visits were from 6 p.m. to 11 p.m.(66) The results from

this study are in keeping with the current literature, which shows a significant shift in the time that patients attended the ED during Ramadan compared to the Control period.

In both the MENA and non-MENA region patients, the least frequent attendance to the ED occurred from 4 a.m. to 8 a.m. Similar results were seen in the study by Pekdimir *et al.*(67), while Suwaidi *et al.* documented that fasting patients with cardiac symptoms were less likely to present to the ED between 1 p.m. and 2 p.m. and between 5 p.m. and 6 p.m.(41) The ED attendance of the MENA region patients was also decreased during the time period 8 a.m. to 12 p.m. in Ramadan compared to the Control period. This is most likely because those people were fasting would have been resting or sleeping after the long evening prayers. The results of the current study also showed a marked drop in ED attendance by the MENA region patients from 4 p.m. to 8 p.m. This lower frequency of ED attendance during this time period may be because those fasting would be at home preparing for or having Iftar with their families. In addition, another possible explanation is that people would have finished work earlier than normal and already headed home. During Ramadan in the UAE, the working day is officially 2 hours less for all individuals.

The most frequent visits during the Control period for the MENA region patients took place from 4 p.m. to 8 p.m., whereas for the non-MENA region patients the time was from 12 p.m. to 4 p.m. When the groups were combined the most frequent time was from 12 p.m. to 4 p.m. It is feasible that that both periods would be busy in the Control period, due to the time of day when individuals finish work,

and if unwell, proceeded to the ED for medical attention. It is possible that outpatient clinics would mostly have been closed for appointments due to the shorter working hours, hence the attendance to the ED.(83)

5.6 Limitations

One of the major limitations in the research was the failure of documentation regarding the fasting status of patients admitted to the ED. The hospital from where the data was collected is not required to keep a record of the religion nor the fasting status (in Ramadan) of patients admitted. This precludes a causal relationship between fasting and certain changes in demographics, diagnoses and the number of visits. An attempt was made to circumvent this by grouping patients into geographic regions where evidence exists as to the religion of the individuals living in those particular regions and hence partly enabling a deduction to be made about an individual's fasting status. However there could be Muslims who are fasting who fall into the non-MENA region classification, for instance the patients from Pakistan, which is a mostly Muslim country. However these patients are not included in the group of patients who are fasting, purely on the basis of country of origin. If there were a large majority of patients who held citizenship in countries falling into the non-MENA category, who were also Muslim and fasting, then there would be a chance that the results might be skewed. An additional limitation was that no comparative literature existed at the time of the research report that had specifically divided the study population into MENA and non-MENA regions for comparison of ED attendance during Ramadan.

Another problem faced with regard to the collection of data was the lack of a predetermined “gold standard” that could be used to define the final diagnosis for each patient. At the time of data collection, formal diagnosis coding such as the ICD-10 (84) was not routinely applied to patients’ case notes, and this would have made the process much simpler and more accurate in assigning the final diagnosis. In the research, assessment of the diagnoses was done based on the patient’s presenting complaints, and in some cases there were documented definitive diagnoses. Although this created bias in itself, as the researcher was the sole person who made the final diagnosis decision, the bias was consistent. The data for the research was collected from electronic medical records. Ideally all chart reviews should have methodological standards applied which will reduce the inaccuracies, bias and errors in extracting the necessary medical information needed.(73)

Chapter 6: CONCLUSIONS

Fasting from dawn to sunset by millions of Muslims worldwide marks the month of Ramadan. Although the medical implications of this fast have been well documented, there are only a few studies which have concentrated specifically on the effect that the fast of Ramadan has had on Emergency Department attendance.

The results of this research have shown that although there were no significant differences in the ages of the patients, there were more female patients seen in the Control period compared to Ramadan. Besides the significant difference found in presentation of skin diseases in Ramadan, there were no other significant changes in diagnoses made during the period. There were in some cases an increased frequency of common presentations but these were not significant.

The most significant finding from this study was the shift in the time of patient admission to the ED during Ramadan. From an ED management perspective this has important implications regarding staffing over Ramadan. It would be wise to ensure a fuller staff complement in the later hours of the evening in order to maintain effective patient flow through the ED, minimising the wait times and increasing patient satisfaction. The evidence from this study is indeed significant enough to warrant this decision.

Future research should be focused on establishing a more causal relationship between fasting and the diagnoses made and for this, one would need to have the ability and permission to document the fasting status of the patient at presentation

to the ED. Ideally in this case, a prospective study with defined endpoints would be beneficial.

However, in the interim, equipping the ED staff with a working knowledge of the effects of Ramadan fasting and the cultural belief systems will make for a well-functioning and competent Emergency Department with satisfied patients.

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Appendix A

Human Research Ethics Committee Clearance



R14/49 Dr Patricia Kilian

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M130246

NAME: Dr Patricia Kilian
(Principal Investigator)

DEPARTMENT: Division of Emergency Medicine
Medical School

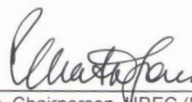
PROJECT TITLE: Emergency Department Attendance during
Ramadan

DATE CONSIDERED: 22/02/2013

DECISION: Approved unconditionally

CONDITIONS:

SUPERVISOR: Dr Alison Bentley

APPROVED BY: 
Professor PE Cleaton-Jones, Chairperson, HREC (Medical)

DATE OF APPROVAL: 22/02/2013

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Secretary in Room 10004, 10th floor, Senate House, University.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**

Principal Investigator Signature _____

Date _____

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

Appendix B

Data Collection Sheet

Allocated Patient Number: _____

Age: _____ years

Gender: Male ☐ Female ☐

Nationality: _____

Date: _____

Time period: Pre-Ramadan ☐ Ramadan ☐ Post-Ramadan ☐

Day of the week: _____

Time of admission to the ED:

Day: first half ☐ (1) second half ☐ (2)

Night: first half ☐ (3) second half ☐ (4)

Diagnosis:

Medical ☐ **Surgical and Trauma** ☐ **OBGYN** ☐

☐ Respiratory URTI/ asthma/ COPD/ pneumonia/ other _____

☐ Cardiovascular hypertension/ myocardial infarct/ cardiac failure/ other _____

☐ Gastrointestinal gastritis/ gastroenteritis/ peptic ulcer/ other _____

☐ Neurological migraine/ stroke/ multiple sclerosis/ other _____

☐ Renal UTI/ renal and ureteric calculi/ pyelonephritis/ other _____

☐ Endocrinological diabetes/ thyroid problems/ other _____

☐ Trauma fall/ lacerations/ motor vehicle accidents/ other _____

☐ Other diagnoses not categorised above _____

Past Medical History: Yes ☐ No ☐

If yes, then document: _____

Medications: Yes ☐ No ☐

If yes, then document: _____